SUDAS

Standard Specifications

2026 Edition



Statewide Urban Design and Specifications

Notice to Users of the
SUDAS Standard Specifications

Before using the SUDAS Standard Specifications, the Project Engineer must check with the Engineer of the Jurisdiction in which the project will be constructed for any supplemental specifications that modify the Specifications contained herein. The Jurisdiction will review all submittals for compliance with the specific local design criteria, procedures, and regulations. Approval by the Jurisdiction does not relieve the Project Engineer from the responsibility of ensuring that the specifications are properly applied and are in compliance with the SUDAS Standard Specifications as may be modified by the Jurisdiction's supplemental specifications and for the needs of a particular project based on sound engineering principles.

Foreword

In the late 1980s, sixteen central Iowa public agencies, including the City of Des Moines, surrounding cities, and two counties, began meeting to discuss developing common urban design standards and construction specifications.

Developing common standards among several jurisdictions was breaking new ground in Iowa, and the group made slow but deliberate progress.

Their efforts came into focus when, in 1995, Governor Terry Branstad assembled the "Blue Ribbon Task Force on Transportation" to investigate ways to use Iowa's Road Use Tax Fund more efficiently. One of the task force's recommendations was that agencies "adopt common standards for construction specifications . . . ." By 1998, the central Iowa group (then known as the Central Iowa Committee) had expanded to 34 Iowa jurisdictions, including several communities outside the Des Moines area, and had published their design guidelines and standard specifications.

In 2000, the effort was underway to further expand the number of cities using the Central Iowa Committee's manuals and to convert them to statewide manuals, eventually known as the Statewide Urban Design and Specifications (SUDAS) program.

A statewide steering committee, comprised of various stakeholder groups, including Iowa's cities and counties, the Iowa DOT, engineering consultants, and industry representatives, was organized in 2002 to oversee the new SUDAS program. Iowa State University's Center for Transportation Research and Education (CTRE) was chosen to manage the program.

In 2004, a new nonprofit entity was created to establish a mechanism for statewide ownership: the Iowa SUDAS Corporation. The Board of Directors for the corporation consisted of members who formerly served on the statewide steering committee, with the addition of a few others.

On February 17, 2005, the Central Iowa Committee acted to officially transfer ownership of the manuals to the Iowa SUDAS Corporation. Statewide ownership of the manuals makes them truly the statewide standards for urban public works improvements. The program is funded through the Iowa DOT and the state transportation planning agencies.

The SUDAS Standard Specifications were revised and reissued with the 2009 Edition. This version represented the most extensive revisions since the original manual was published in 1998. Since it had been six years since the last full printing of the SUDAS Standard Specifications, another full printing with the 2015 Edition was issued so users could be assured they had a fully updated manual. With the 2015 Edition, demolition was moved to Division 10 and a new Division 11 (Miscellaneous) was developed.

The SUDAS Design Manual was reissued with the 2013 Edition, which included rewriting and revising 13 of the 14 chapters. This extensive work was accomplished through the SUDAS technical and district committees, the SUDAS Board of Directors, and engineering consultants. This task was completed within a 2 year period, and represented the most extensive revisions since the 2001 Edition.

Iowa State University's Institute for Transportation (InTrans, formerly CTRE) continues to manage the SUDAS program.

Contributors and Acknowledgments

In 2025, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2026 versions of the SUDAS manuals. These revisions would not have been possible without the efforts of the SUDAS technical committee members. The SUDAS program's success is also due to the dedication of the district committees and Board of Directors. Keeping the SUDAS manuals current is an ongoing, cooperative effort, involving hundreds of people who volunteer their time and expertise. It is not possible to acknowledge each of these volunteers individually, but we appreciate them all.

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DEFINITIONS

1.01 DESCRIPTION

Wherever the following definitions, terms, and abbreviations, or pronouns in place of them, are used in the plans, specifications, or other contract documents, the intent and meaning shall be interpreted as specified in this Section.

1.02 ABBREVIATIONS

Wherever in these specifications and contract documents the following abbreviations are used, they shall be understood to mean as follows: The serial designation of each reference shall be the latest year of adoption or revision, unless otherwise specified.

AAN - American Association of Nurserymen
AAR - Association of American Railroads
AASHTO (or AASHO) - American Association of State Highway and Transportation Officials
ACI - American Concrete Institute
AIA - American Institute of Architects
AMG - Automated Machine Guidance
ANSI - American National Standards Institute
API - American Petroleum Institute
APWA - American Public Works Association
ARA - American Railway Association
AREA - American Railway Engineering Association
ASA - America Standards Association
ASCE - American Society of Civil Engineers
ASLA - American Society of Landscape Architects
ASTM - American Society for Testing and Materials
AWPA - American Wood Preservers Association
AWS - American Welding Society
AWWA - American Water Works Association
BSC - Bituminous Seal Coat
CFR - Code of Federal Regulations
CLSM - Controlled Low Strength Material
CMP - Corrugated Metal Pipe
CPM - Critical Path Method
CRSI - Concrete Reinforcing Steel Institute
DIP - Ductile Iron Pipe
DNR - Department of Natural Resources
DOT - Department of Transportation
EEI - Edison Electric Institute
EPA - Environmental Protection Agency
FHWA - Federal Highway Administration
FSS - Federal Specification and Standards
ESAL - Equivalent Single Axle Load
GGBFS - Ground Granulated Blast Furnace Slag
GPS - Global Positioning System
GRI - Geosynthetic Research Institute
HDPE - High Density Polyethylene Pipe
HMA - Hot Mix Asphalt
IAC - Iowa Administrative Code
IEEE - Institute of Electrical and Electronics Engineers
IES - Illuminating Engineering Society
ICEA (or IPCEA) - Insulated Cable Engineers Association
IMSA - International Municipal Signal Association, Inc.
ISO - Insurance Services Office
ITE - Institute of Transportation Engineers
JMF - Job Mix Formula

1.02 ABBREVIATIONS (Continued)

MAPLE - Materials Approved Product List Enterprise
MGAL - 1,000 Gallons
MUTCD - Manual on Uniform Traffic Control Devices
NEC - National Electrical Code
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NPDES - National Pollutant Discharge Elimination
NSF - National Sanitation Foundation
OSHA - Occupational Safety of Health Administration
PCC - Portland Cement Concrete
PLS - Pure Live Seed
PROWAG - Public Right-of-Way Accessibility Guidelines
PVC - Polyvinyl Chloride
RAP - Recycled Asphalt Pavement
RCAP - Reinforced Concrete Arch Pipe
RCP - Reinforced Concrete Pipe
SAE - Society of Automotive Engineers
SDR - Standard Dimension Ratio
SSPC - Steel Structures Painting Council
SUDAS - Statewide Urban Design and Specifications
SWPPP - Stormwater Pollution Prevention Plan
UL - Underwriters' Laboratories, Inc.
US - United States
USC - United States Code
VCP - Vitrified Clay Pipe

1.03 DEFINITIONS AND TERMS

ADDENDUM. A revision to the contract documents written and issued after the notice to bidders, and prior to the time for receipt of proposals. Changes reflected in the Addendum shall govern over all other contract documents.

ALLEY. See Street.

APPROVED EQUAL (EQUIVALENT). A product, process, equipment, or material that, upon approval of the Engineer, is determined to meet or exceed the requirements called for by the specifications. Upon approval, the item will be allowed in lieu of the specified material, process, equipment, or product.

AWARD. The acceptance of the proposal of the lowest responsive, responsible bidder for the work, which shall not be binding upon the Contracting Authority until the contract for the said work has been executed by the bidder and by the Contracting Authority and bond(s) has been provided by the bidder as required by law.

BID. A properly signed and guaranteed written offer of the bidder containing the bid amount to perform the work. Bid is the same as Proposal.

BID AMOUNT. The aggregate sum obtained by totaling the amounts arrived at by multiplying the quantity of each bid item, as shown in the bid or proposal, by the unit price specified in the proposal for that bid item, including lump sum bid items.

BID ITEM. A specifically described unit of work for which a price is provided in the proposal. A bid item may also be referred to as a contract item.

BID SECURITY. The security furnished by the bidder with its bid as guaranty that the bidder will execute the contract and furnish bond for the work if the proposal is accepted. For bids submitted to governmental entities, the bidder shall furnish bid security as defined in Iowa Code Chapter 26.

1.03 DEFINITIONS AND TERMS (Continued)

BIDDER. Any individual, firm, partnership, joint venture, corporation, or association licensed or otherwise authorized by law to do business where the work is located, which has submitted a proposal for the work, acting directly or through a duly authorized representative.

CALENDAR DAY. Every day shown on the calendar.

CHANGE ORDER. A written order to the Contractor signed and approved by the Contracting Authority, ordering a change in the work from that originally shown by the plans and specifications. Change orders duly signed and executed by the Contracting Authority and the Contractor shall constitute authorized modifications of the contract.

COMMENCEMENT OF WORK. Work will be considered commenced when the Contractor's operations are started on items of work covered by the contract documents, or when the Contractor notifies the Engineer, and the Engineer agrees, that the Contractor's equipment and personnel are available to the site but the operations are prevented by conditions outside the Contractor′s control.

COMPETITIVE QUOTATION. A properly signed written offer of the Contractor according to Iowa Code Chapter 26.

CONTRACT. The written agreement, between the Contractor and the Contracting Authority, setting forth the terms and conditions under which the work is to be performed. The contract includes all contract documents.

CONTRACT AMOUNT. The bid amount plus approved change orders.

CONTRACT DOCUMENTS. The contract documents consist of the following: The notice to bidders and notice of public hearing; the instructions to bidders; special provisions; standard specifications; general supplemental specifications; supplemental specifications; plans; addenda; proposal; contract; performance, payment, and maintenance bond; insurance certificate(s); Notice to Proceed; and change orders. These documents form the agreement whereby the Contractor will furnish all labor, equipment, tools, and materials, and perform all work necessary to satisfactorily accomplish the proposed improvement. The contract documents are complementary and what is called for by one shall be as binding as if called for by all.

CONTRACTING AUTHORITY. The body, entity, board, commission, officer, or governmental entity having authority to award a contract.

CONTRACTOR. The individual, firm, partnership or corporation, and the heirs, executors, administrators, successors and assigns thereof, or the lawful agent of any such individual, firm, partnership, or corporation, or the surety thereof under the contract bond, constituting one of the principals to the contract and undertaking to perform the work herein specified. Where the pronoun "it" is used as referring to the word "Contractor" it shall mean the Contractor as defined above.

CONTROLLING ITEM OF WORK. The unique activity of a contract that will determine the duration of the construction period or if a working day is charged. The character of this work may change during the project. It is the work that could be in progress at any time that would have the greatest influence on the duration of the project.

CULVERT. A structure not classified as a bridge or storm sewer which provides an opening under a roadway or embankment, except that such term shall not include tiles crossing the road, or intakes thereto, where such tiles are part of a tile line or system designed to aid subsurface drainage.

1.03 DEFINITIONS AND TERMS (Continued)

DEPARTMENT OF TRANSPORTATION, (THE DEPARTMENT). The Department of Transportation, as defined in Iowa Code Chapter 307.

EMPLOYEE. Any person working on the project mentioned in the contract of which these specifications are a part, and who is under the direction or control, or receives compensation from, the Contractor or subcontractor.

ENGINEER. For publicly owned projects, the Engineer is a Professional Engineer licensed in the State of Iowa and is the authorized representative of the Contracting Authority. For privately contracted projects, with improvements that are to become publicly owned, the Engineer is the Professional Engineer licensed in the State of Iowa and is the authorized representative of the Jurisdiction ultimately accepting ownership of the improvement. For all other projects, the Engineer is the Professional Engineer licensed in the State of Iowa and is the owner's authorized representative. The Engineer may act directly or through duly authorized representatives.

EQUIPMENT. All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of the work.

EXTRA WORK. Work not provided for in the contract, as awarded, but deemed essential to the satisfactory completion of the contract and authorized by the Engineer. Extra work shall not include additional materials, equipment, and labor used due to natural variations in surface and subsurface conditions, except as specifically provided for elsewhere in the contract documents.

GENERAL SUPPLEMENTAL SPECIFICATIONS. Specifications approved by the Board of Directors for the Iowa SUDAS Corporation subsequent to publication of the latest edition of the SUDAS Standard Specifications. They involve changes in the SUDAS Standard Specifications and apply only when specified in the contract documents.

GOVERNMENTAL ENTITY. As defined in Iowa Code Chapter 26.

IMPROVEMENT. Shall mean any public improvements as defined in Iowa Code Chapter 26 and shall also include highway, bridge, or culvert projects.

INCIDENTAL ITEMS. Materials, equipment, or labor essential for the proper completion of the work that are not specified as bid items in the contract documents and the cost of which shall be included in other bid items.

INSPECTOR. The authorized representative of the Engineer assigned to make a detailed inspection of any or all portions of the work, or materials.

IOWA DEPARTMENT OF TRANSPORTATION (DOT) STANDARD SPECIFICATIONS. The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.

JOINT VENTURE. The joining of two or more contractors for the purpose of combining equipment, personnel, and finances in order to submit a bid on a single project.

JURISDICTION. A governmental entity or the Iowa Department of Transportation, acting through its governing body, or through the authorized representatives of such governing body when so authorized.

JURISDICTIONAL ENGINEER. See Engineer.

1.03 DEFINITIONS AND TERMS (Continued)

LABORATORY. The testing laboratory of the Jurisdiction, or any other testing laboratory which may be designated by the Engineer.

LIQUIDATED DAMAGES. The dollar amount established by the Contracting Authority and set forth in the contract documents as compensation for the damage to the Contracting Authority, or public, for delay in completion of the work, to be paid to the Contracting Authority, or to be deducted from any payments due or to become due the Contractor.

LUMP SUM. Unit of measurement for a bid item where no direct measurement will be made. The bid item amount is complete payment for all work described in the contract documents and necessary to complete the work for that item. The estimated quantities of lump sum work shown in the contract documents are approximate.

MAPLE. Iowa DOT's materials approved product list enterprise. MAPLE contains a searchable database of most of the approved products, sources, producers, and suppliers of materials for Iowa highway projects. MAPLE may be searched by the brand/product name, producer, Iowa DOT Materials Instructional Memorandum (IM) number, or material name. New approvals are continually added as Iowa DOT approves them for use.

MATERIALS. Any substances specified for the use in the construction of the project and its appurtenances.

MATERIALS INSTRUCTIONAL MEMORANDUM (MATERIALS I.M.). This is an instruction prepared by the Iowa DOT's Construction and Materials Bureau. These may identify approved sources of various qualities or types of materials, sampling, testing, and approval procedures, and conditions for acceptance and use.

MEDIAN. The portion of a divided roadway separating the traveled ways for traffic.

MOBILIZATION. Mobilization shall consist of preparatory work and operations for all items under the contract, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site, and for the establishment of all offices, buildings, and other facilities, which must be performed or costs incurred prior to beginning work on the various items on the project site.

NOTICE OF PUBLIC HEARING. The public announcement or publication by the governmental entity, as required under Iowa Code Chapter 26, notifying the public of the time and place where any interested person may appear and file objections to the proposed plans, specifications, contract, or estimated cost of the improvement.

NOTICE TO BIDDERS. The public announcement, publication, or solicitation by the Contracting Authority, inviting bids for work to be performed or materials to be furnished as required by Iowa Code Chapter 26.

NOTICE TO PROCEED. A written notice to the Contractor issued by the Engineer stating the date, on or before which, the Contractor is to begin the work. The date set forth in this notice shall be considered as the official starting date.

PERFORMANCE, PAYMENT, AND MAINTENANCE BOND. The bond submitted by the designated low bidder, in the amount specified in the contract documents, for the faithful performance of the contract and the terms and conditions therein contained, for payment for all labor and materials provided, and for maintenance of improvements in good repair for the specified number of years from the time of acceptance of the improvements by the Jurisdiction.

1.03 DEFINITIONS AND TERMS (Continued)

PLANS. Plans are the official drawings, standard plans, profiles, typical cross-sections, and supplemental drawings or reproductions thereof, approved and furnished by the Jurisdiction, which show the location, character, dimensions, and details of the work. All such documents are to be considered as a part of the plans whether attached to the plans or separate.

PROFILE GRADE. The trace of a vertical plan intersecting the top surface of the proposed wearing surface, usually along the longitudinal center line of the roadbed. Profile grade means either elevation or gradient or such trace, according to the context.

PROJECT AREA. The area of the specified project limits shown on the plans, and any additional area which is necessary for the Contractor to place traffic control devices required by the contract documents or necessary to protect the work.

PROPOSAL. The proposal is a properly signed and guaranteed written offer of the bidder containing the bid amount to perform the work. Proposal is the same as Bid.

PROPOSAL FORM. A form provided by the Jurisdiction, to the bidder, containing a listing of the bid items and quantities, and locations to enter unit prices and the bid amount.

PROWAG. The July 26, 2011 “Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way” was written by the US Access Board and is also known as the Public Right-of-Way Accessibility Guidelines or PROWAG.

RESIDENT BIDDER. A person or entity authorized to transact business in this state and having a place of business for transacting business within the state at which it is conducting and has conducted business for at least three years prior to the date of the first advertisement for the public improvement. If another state or foreign country has a more stringent definition of a resident bidder, the more stringent definition is applicable as to bidders from that state or foreign country.

RESPONSIVE, RESPONSIBLE BID. A bid submitted in accordance with the Notice to Bidders by a bidder that acknowledged all addenda, that responded to all proposal requirements, and that agreed to do everything required by the plans and specifications and other bid documents without any conditions, qualifications, or exclusions.

A bid submitted by a bidder that is capable of performing the work, possess the necessary financial and technical capability to perform the work, as well as the ability to complete the work in a timely and acceptable manner as demonstrated by past performance or other appropriate considerations, including but not limited to the ability to obtain and maintain insurance and bonding requirements.

RESPONSIVE, RESPONSIBLE BIDDER. A bidder that has submitted a bid that has been determined by the governmental entity to be both responsive and responsible.

RIGHT-OF-WAY. The land area of which the right to possession is secured or reserved by the Jurisdiction for the project, including permanent roadway easements.

ROAD. See Street.

ROADBED. The area of the roadway between the tops of foreslopes.

ROADWAY. The portion of the right-of-way designated or ordinarily used for vehicular travel.

SHOP DRAWINGS. Information and details for materials, products, or equipment to be supplied for the project, which are typically delivered to the project in an assembled or ready-to-use condition.

1.03 DEFINITIONS AND TERMS (Continued)

SHOULDER. That portion of the roadbed contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

SIDEWALK. That portion of the street primarily constructed for the use of pedestrians.

SLOPE. The inclination of a line or surface expressed as a ratio of horizontal distance to vertical distance.

SPECIAL PROVISIONS. Additions and revisions to the SUDAS Standard, General, and Supplemental Specifications covering conditions peculiar to an individual project. They only apply to a project when specified in the contract documents.

SPECIALTY ITEMS. Portions of work designated in the contract documents requiring equipment, skills, or crafts not ordinarily associated with the expertise of the Contractor or the major types of work covered by the contract; typically including, but not limited to, earthwork for building construction, electrical, mechanical, masonry, roofing, drywalling, floor covering, glass and glazing, painting, conveying systems, etc.

SPECIFICATIONS. The general term comprising all the written directions, provisions, and requirements including the SUDAS Standard Specifications and those added or adopted as Supplemental Specifications or Special Provisions all of which are necessary for the proper performance of the contract.

SPEED LIMIT. Refers to the legally established speed limit before construction and not the advisory speed during construction.

STANDARD ROAD PLAN. The Iowa Department of Transportation's manual of detailed drawings showing standardized design features, construction methods, and approved materials.

STATE. The State of Iowa acting through its authorized representatives.

STATION. One hundred linear feet.

STREET. A general term denoting public way for vehicular travel, including the entire area within the right-of-way.

SUBBASE. The layer or layers of specified or selected material of designed thickness upon which a base course or pavement is constructed.

SUBCONTRACTOR. The subcontractor is any individual, firm, partnership, joint venture, corporation, or association to whom the Contractor, with the written consent of the Jurisdiction, sublets a part of the work.

SUBGRADE. The top surfaced of a roadbed upon which the pavement structure and shoulders are constructed.

SUDAS STANDARD SPECIFICATIONS. The requirements contained herein applying to the contract, and pertaining to the method and manner of performing the work, or to the quantity and quality of the materials to be furnished under the contract. Previously referred to as the Iowa Statewide Urban Standard Specifications for Public Improvements.

SUPERINTENDENT. The Contractor's authorized representative in responsible charge of the work.

SUPPLEMENTAL CONTRACT (AGREEMENT). Written agreement between the Contractor and Contracting Authority modifying the original contract pursuant to the Iowa Code.

1.03 DEFINITIONS AND TERMS (Continued)

SUPPLEMENTAL SPECIFICATIONS. Specifications adopted by a Jurisdiction that involve changes to the SUDAS Standard Specifications. They only apply to a project when specified in the contract documents.

SURETY. The corporation, partnership, or individual, other than the Contractor, executing a bond furnished by the Contractor.

TARGET VALUE. When a target or target value is specified, a continuous and determined effort is expected to reach and maintain that value, as a goal.

UNAUTHORIZED WORK. Unauthorized work is work done contrary to, in addition to, or regardless of, the contract documents, or the instruction of the Engineer; work done without lines, grade, and/or cross-section stakes and grades shown on the plans or as given by the Engineer; or work done in deviation from the contract documents without written authority.

UTILITY. Includes all privately, publicly, municipally, or co-operatively owned structures and systems for supplying water, sewer, electric lights, street lights and traffic lights, gas, power, telegraph, telephone, communications, transit, pipelines, and the like.

UTILITY AGENCY. Means and includes (1) all franchised utilities having utility system facilities within the Jurisdiction, including but not limited to gas, electric, telephone, cable television, and communications; (2) communications systems licensed by the Jurisdiction; and (3) all governmental agencies owning or operating governmental utility systems, including but not limited to water, sewer, traffic control, and communications.

WORK. The work shall mean the furnishing of all labor, materials, equipment, and other incidentals necessary for construction of the improvement, successful completion of the contract, and the carrying out of all duties and obligations imposed by the Contract, including the submission of all necessary paperwork relating to payrolls, sales tax, warranties, owner's manuals, maintenance manuals, and the like.

WORKING DAY. Any calendar day, exclusive of Saturdays, Sundays, or a recognized legal holiday, on which weather or other conditions (not under control of the Contractor) will permit construction operations to proceed for not less than 3/4 of a normal work day in the performance of a controlling item of work.

END OF SECTION

PROPOSAL REQUIREMENTS AND CONDITIONS

1.01 QUALIFICATION OF THE BIDDERS

A. The Jurisdiction reserves the right to reject any bid that is not responsive to the proposal form or contract documents, or not submitted by a responsive, responsible bidder.

B. Upon request of the Engineer, the apparent lowest responsive bidder, whose bid is under consideration for award of a contract, shall submit evidence of its financial resources, construction experience, and organization available for performance of the proposed work. A bidder's ability to promptly secure the required bonds and insurance coverages for the proposed work, as well as the bidder's demonstrated ability to continuously maintain insurance coverages on past projects, may be considered an indication of financial responsibility and the bidder's qualification as a responsive, responsible bidder.

1.02 CONTENTS OF THE PROPOSAL FORMS

A. Each prospective bidder will be furnished with a proposal form showing the location and description of the proposed work, the approximate quantities of work to be performed for which bid prices are requested, and the completion provisions. The contract documents will contain any special provisions that shall apply to the work to be performed.

B. The purpose of the contract documents is to require the furnishing of highest quality equipment, material, and workmanship, and best accepted construction practice. The Bidder is expected to base its bid on materials and equipment complying fully with the contract documents. Each bidder, in submitting its bid, acknowledges its willingness to comply with the terms of these contract documents.

1.03 QUANTITIES AND UNIT PRICES

A. Bidders shall submit a lump sum bid or unit bid price, as required by the proposal for the work covered by the contract documents. Prices shall cover complete work and include all costs incidental thereto.

B. When unit prices are requested in the proposal form, the quantities indicated on the proposal form are approximate only, and do not constitute a warranty or guarantee by the Jurisdiction as to the actual quantities involved in the work. Such quantities are to be used for the purpose of comparison of bids and determining the amount of bid security, contract, and performance, payment, and maintenance bond. In the event of discrepancies between unit prices and unit price extensions listed in a bidder’s proposal, unit prices shall govern and unit price extensions shall be corrected, as necessary, for agreement with unit prices. The Jurisdiction expressly reserves the right to increase or decrease the quantities during construction as outlined in Section 1040, 1.06 - Increase or Decrease of Work, and to make reasonable changes in design, provided such changes do not materially change the intent of the contract. The amount of work to be paid for shall be based upon the actual quantities performed.

C. The proposal may have a lump sum item for mobilization. The bidder will indicate its bid price in dollars, and this will be the contract price for mobilization.

D. Materials, equipment, or labor essential for the proper completion of the work that are not specified as bid items in the contract documents and are incidental, and the cost of which shall be included in other bid items.

1.04 EXAMINATION OF THE CONTRACT DOCUMENTS AND SITE OF WORK

A. By submission of a proposal on the work, the bidder represents that it has carefully examined the site of the proposed work; the plans, specifications, and all other contract documents; and that the bidder is fully informed concerning the requirements of the contract, the physical conditions to be encountered in the work, and the character, quality, and the quantity of work to be performed, as well as materials to be furnished. The Contractor will not be entitled to additional compensation if it subsequently finds that conditions require methods or equipment other than that anticipated by the Contractor in making its proposal, except as provided in Section 1040, 1.09 - Changed Site Conditions.

B. The attention of the bidder is directed to the fact that contracts for work, other than the proposed work, may have been awarded or may be awarded in the future. Completion of the proposed work may be contingent upon certain work by others or covered by other contracts being performed on the project in advance of this work; likewise, completion of work by others or covered by other contracts may be dependent upon completion of the proposed work. The bidder is expected to become familiar with work already in progress or previously let on this project, the contract periods, the progress being made, and any other conditions regarding work that may affect the bid or the bidder's performance under this contract.

C. The bidder on this work acknowledges the facts set out in the proceeding paragraph and agrees it is in the public interest to have the work of other contracts and agencies performed concurrently rather than consecutively. The bidder further agrees to cooperate and coordinate the work with other contractors or agencies to the mutual interest of all parties doing work on the project.

D. By the submission of a bid on this work, the bidder acknowledges and agrees investigation and inquiry has been made regarding the contracts for work with which this work must be coordinated. In the event disputes arise between contractors or other agencies doing work on the project as to their mutual rights or obligations, the Engineer will define the rights of all interested parties regarding the work.

E. The Jurisdiction does not warrant, impliedly or explicitly, the nature of the work, the conditions that will be encountered by the bidder, the adequacy of the contract documents for the Contractor to perform the work, or the conditions or structures to be encountered under any surface. Any such data supplied on the plans or other contract documents, or interpretation thereof by the Engineer, are merely for the convenience of the prospective bidders, who are to rely upon their own explorations of latent or subsurface site conditions, before completing and filing their proposal, except as provided in Section 1040, 1.09 - Changed Site Conditions.

1.05 INTERPRETATION OF THE CONTRACT DOCUMENTS

If any prospective bidder is in doubt as to the true meaning of any parts of the contract documents, the bidder may request an interpretation from the Engineer. Any interpretation of the contract documents will be made only by an addendum duly mailed or delivered to each prospective bidder who received, or in the future requests, contract documents from the Jurisdiction.

1.06 ADDENDUM

Each bidder will receive a notice of addendum for any changes in the contract documents made prior to the time established for the receipt of bids. The notice will be delivered in the manner chosen by the Jurisdiction to the bidder's business address with an acknowledgement of receipt required. Acknowledgement of the receipt of the addendum will be as provided in the proposal form.

1.07 PREFERENCE FOR LABOR AND MATERIALS

A. By virtue of statutory authority, preference will be given to products and provisions grown and coal produced within the State of Iowa, and to Iowa domestic labor, to the extent lawfully required under Iowa Code Chapter 73.

B. Such preferences will not be given where funding requirements, federal or otherwise, prohibit the giving of such preferences.

1.08 TAXES

A. Sales Tax Exemption Certificate: The Jurisdiction, as a designated exempt entity awarding construction contracts, will issue Sales Tax Exemption Certificates to contractors and subcontractors allowing them to purchase, or withdraw from inventory, materials for the contract free from sales tax pursuant to Iowa Code Sections 423.2 and 423.45 and Iowa Administrative Code rule 701-219(423). This Sales Tax Exemption Certificate may also allow a manufacturer of building materials to consume materials in the performance of a construction contract without owing tax on the fabricated cost of those materials.

1. Upon award of contract, the Jurisdiction will register the contract, Contractor, and each subcontractor with the Iowa Department of Revenue and Finance; and distribute Sales Tax Exemption Certificates and authorization letters to the Contractor and each subcontractor duly approved by the Jurisdiction according to Section 1080, 1.01 - Subletting or Assignment of Contract. These documents allow the Contractor and subcontractors to purchase materials for the contract free from sales tax. The Contractor and subcontractors may make copies of the Sales Tax Exemption Certificate and provide a copy to each supplier providing construction material. These Sales Tax Exemption Certificates and authorization letters are applicable only for the work under the contract.

2. At the time the Contractor requests permission to sublet according to Section 1080, 1.01 - Subletting or Assignment of Contract, the Contractor shall provide a listing to the Jurisdiction identifying all subcontractors. For each subcontractor, include the Federal Employee Identification Number (FEIN), contact information, the name of a representative for the organization, a description of the work to be sublet, and the associated cost.

3. The Contractor and each subcontractor shall comply with said Iowa Code sales tax requirements, shall keep records identifying the materials and supplies purchased and verify they were used on the contract, and shall pay tax on any materials purchased tax-free and not used on the contract.

B. Alternate Sales and Use Tax: If the Jurisdiction, at its option, decides to utilize the sales and use tax option, it will so state by special provision and publication in the Notice of Hearing and Letting.

1. The bidders shall include in their proposals all amounts payable by the Contractor for taxes imposed by any taxing authority on the sale, purchase, or use of materials and equipment covered by the contract documents. All taxes of the foregoing description shall be paid by the Contractor.

1.08 TAXES (Continued)

2. After delivery of materials and equipment, the Contractor shall submit to the Jurisdiction a statement (on a current Iowa Department of Revenue form) of all taxes of the foregoing description paid on materials and equipment incorporated in the complete construction. If a Sales Tax Exemption Certificate is issued by the Jurisdiction according to Section 1020, 1.08, A, no statement is required.

C. Income Tax: The bidder who is awarded the contract will be subject to payment of Iowa income tax on income from this work in amounts prescribed by law. If such bidder is a non-Iowa partnership, individual, or association, it shall furnish evidence, prior to execution of contract, that bond or securities have been posted with the State of Iowa Department of Revenue in the amount required by law and shall file a certificate issued by the Department, as provided in Iowa Code Section 422.17, releasing the Jurisdiction from withholding any and all sums required by the provision of Iowa Code Section 422.17.

1.09 PREPARATION OF THE PROPOSAL

A. Proposal: Proposals shall be legibly written in ink or typed on the forms provided by the Jurisdiction and shall be completely executed by the bidder with the requisite full signatures. The bidder must indicate in the proposal whether the proposal is submitted by an individual, partnership, joint venture, limited liability company, or a corporation. If the proposal is submitted by an artificial entity, it must be executed by an officer of such entity with authority to bind such bidder to perform the contract upon award. The business address of the bidder shall be typed or printed on the proposal. The Bidder Status Form is required by the Iowa Labor Commissioner, pursuant to Iowa Administrative Code rule 875-156.2(1). The bidder must complete the form and submit it with the proposal. Failure to provide the Bidder Status Form with the bid may result in the bid being deemed non-responsive and may result in the bid being rejected. If the bidder does not qualify as a resident bidder, the non-resident bidder shall specify on the Bidder Status Form whether any preference to resident bidders, including but not limited to any preference to bidders, the imposition of any type of labor force preference, or any other form of preferential treatment to bidders or laborers from that state or foreign country is in effect in the non-resident bidder's state or country of domicile at the time of a bid submittal.

B. Unit Price Attachment: The Engineer, at its option, may allow the bidder to submit a computer-generated attachment, hereinafter referred to as unit price attachment, in lieu of completing that portion of the proposal identifying the bid items, description, unit, quantity, and unit prices. If the Jurisdiction decides to allow this unit price attachment option, it will so state by special provision.

1. If a unit price attachment is submitted, it shall be attached to the proposal and shall include the following minimum information at the top of each page: project title, letting date, bidder's company name.

2. The unit price attachment shall have the same columns as the proposal; e.g. item number, description, unit, quantity, unit price, bid amount, etc. for each item. The bid item numbers and order on the unit price attachment shall follow that of the proposal.

3. The total amount bid shall be entered below the last bid item on the unit price attachment.

4. The unit price attachment page and print size shall be approximately the same as the proposal. Solid lines for separating the columns and lines need not be printed. Pages should be numbered by page number of the total pages (e.g. Page 1 of 4).

5. The bidder's company name, as well as the authorized person signature, name, and title, shall be in ink and shall follow the total amount bid; and shall be the same person that signs the proposal.

1.09 PREPARATION OF THE PROPOSAL (Continued)

6. In case of discrepancy in the item number, description, unit, or quantity between the unit price attachment and the proposal, the proposal shall govern. The unit price shown on the unit price attachment shall govern.

7. The bidder is solely responsible for the content, completeness, and accuracy of all the information contained in the unit price attachment. If the information in the unit price attachment is incomplete, the bid must be considered incomplete and be rejected.

8. When evaluating and tabulating the bids, the Jurisdiction shall utilize only the unit price as shown on the unit price attachment, and the item number, description, unit, and quantity as shown on the proposal.

C. The bidder, as a business organization, shall comply with the requirements of Section 1070, 1.11 - Business Organization Requirements.

D. When unit prices are requested, they shall be submitted on each and every item of work included for which bids are requested. The format for unit prices will be in dollars and whole cents only. In case of discrepancy, the unit price figures shall govern.

1.10 BIDDERS CERTIFICATION

By the submission of its proposal, the bidder certifies its bid is genuine and is not made in the interest of, or on behalf of, any undisclosed person, firm, or corporation; the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid; the bidder has not solicited or induced any person, firm, or corporation to refrain from bidding; and the bidder has not sought, by collusion or otherwise, to obtain for itself any advantage over any other bidder or over the Jurisdiction.

1.11 IRREGULAR AND NONRESPONSIVE PROPOSALS

A. Proposals will be considered irregular and may be rejected for any unauthorized changes in the proposal form or for any of the following reasons:

1. If submitted on a form other than that furnished by the Jurisdiction, or if the form is altered or any part thereof is detached or missing;

2. If the bidder submits an obviously unbalanced bid. An unbalanced bid shall be defined as a bid containing lump sum prices or unit bid prices that do not reflect reasonable actual costs plus a reasonable proportionate share of the bidder's anticipated profit, overhead costs, and other indirect costs to complete that item;

3. If the proposal does not contain a unit price for each pay item listed, except in the case of authorized alternate pay items; or

4. If the bidder submits more than one proposal for the same work under the same or different names.

B. Proposals will be considered nonresponsive and shall be rejected for any of the following reasons:

1. If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind that may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning;

2. If the bidder adds any provisions reserving the right to accept or reject an award or to enter into contract pursuant to an award;

1.11 IRREGULAR AND NONRESPONSIVE PROPOSALS (Continued)

3. If a bid on one project is tied to a bid on any other project, except as specifically authorized on the proposal form by the Jurisdiction;

4. If the bidder makes corrections or alterations to the unit prices it submits and such corrections or alterations are not initialed by the bidder. The Jurisdiction may require the bidder to identify any corrections or alteration so initialed;

5. If the bidder makes any omission of prices on items shown on the proposal forms, or any addition in writing to the form of the bid, or any condition or limitation on its proposal.

C. If the bidder notes a requirement in the contract documents it believes will require a conditioned or unsolicited alternate bid, it shall immediately notify the Engineer in writing identifying such requirement. If the Engineer finds that such a requirement does exist in the contract documents, the Jurisdiction will make corrections thereto by an addendum.

D. Proposals will be evaluated by the Jurisdiction pursuant to the provisions of Section 1030, 1.01 - Acceptance or Rejection of Proposals.

1.12 SUBMISSION OF THE PROPOSAL, IDENTITY OF BIDDER, AND BID SECURITY

A. The proposal shall be sealed in an envelope, properly identified as the proposal with the project title and the name and address of the bidder, and deposited with the Jurisdiction at or before the time and at the place provided in the Notice to Bidders. It is the sole responsibility of the bidder to see its proposal is delivered to the Jurisdiction prior to the time for opening bids, along with the appropriate bid security sealed in the separate envelope identified as bid security and attached to the outside of the bid proposal envelope. Any proposal received after the scheduled time for the receiving of proposals will be returned to the bidder unopened and will not be considered. If the Jurisdiction provides envelopes for proposals and bid security, bidders shall be required to utilize such envelopes in the submission of their bids.

B. A corporation, limited liability company, or limited partnership shall bid in the name under which it is registered with the Iowa Secretary of State. A partnership shall bid in the name under which it is registered with the County recorder. An individual operating under a trade name shall bid using the trade name registered with the County recorder if such registration is required. The bidder's exact name as registered, if required, shall appear as the "principal" on any bid bond and shall appear on any cashier's check or share draft submitted to fulfill the bid security requirement. A bidder's failure to satisfy these requirements may be grounds for rejection of the bidder's proposal.

1.13 WITHDRAWAL OR REVISION OF THE PROPOSAL PRIOR TO OPENING OF PROPOSALS

A. A bidder may request, without prejudice, to withdraw its proposal after it has been deposited with the Jurisdiction, provided such request is made in writing to the Jurisdiction prior to the time set for receiving proposals.

B. Modifications or corrections to proposals may be made on the withdrawn proposal, provided such modifications or corrections are initialed by the Bidder and are received by the Jurisdiction prior to the time set for receiving proposals. Modifications or corrections to a proposal will not be accepted if the modifications or corrections render the bid security inadequate or if not accompanied by sufficient additional bid security.

C. If a bidder has requested in writing to withdraw its proposal, said bidder may submit a different proposal and bid security at that time or any time prior to the time set for receiving proposals.

1.14 OPENING OF PROPOSALS

At the time and place set forth in the notice to bidders, proposals will be opened and read aloud. Proposals will be rejected if not accompanied by a bid security submitted in a separate, marked envelope. Submittals that do not include acknowledgement of each addendum to the contract documents will be rejected, except in those instances, in the opinion of the Engineer, where the addendum not acknowledged by a bidder will have no effect on the bid amount. Bid openings will be open to the public.

1.15 LIMITATION ON WITHDRAWAL OF PROPOSALS AFTER OPENING OF PROPOSALS

A. A bidder shall not withdraw its proposal for period of up to 60 calendar days after the date designated for opening of proposals, or such other period of time specified in the Notice. However, in those projects involving special assessments, and confirmation by the District Court, no bidder shall withdraw its proposal for a period of 30 calendar days after the confirmation of the assessments by the Court.

B. In the event a bidder desires to withdraw its proposal, it shall make request therefore in writing to the Engineer stating the reasons for such withdrawal.

C. If requested, the bid security of unsuccessful bidders shall be promptly returned as soon as the successful bidder is determined or within 30 days, whichever is sooner.

END OF SECTION

APPROVAL FOR AWARD AND AWARD OF CONTRACT

1.01 ACCEPTANCE OR REJECTION OF PROPOSALS

A. The Jurisdiction reserves the right to accept the proposal that, in its judgment, is the lowest responsive, responsible bid; to award the contract by sections, if so specified in special provisions; to reject any or all proposals; to reject irregular or nonresponsive proposals as defined in Section 1020, 1.11 - Irregular and Nonresponsive Proposals; and to waive irregularities and/or technical deficiencies in the proposals to the extent allowed by law.

B. An individual, firm, partnership, corporation, or any association under the same or different names shall not submit more than one proposal. When reasonable evidence exists that a bidder has submitted more than one proposal at any letting for the same work under the same or different names, said proposals may be rejected.

C. Any or all proposals may be rejected if there is reason to believe collusion exists among bidders. Proposals received from participants in such collusion may not be considered for the same work if re-advertised.

D. Proposals may be rejected if the apparent lowest responsive bidder has failed to promptly meet financial obligations undertaken in connection with other work under contract, or is in default on a previous contract, or has an unsatisfactory record of performance and cooperation on any such previous contract, or has failed to maintain satisfactory progress on work already under contract.

E. In the event the bid specifies the use of materials, workmanship, methods, or equipment not in conformance with the contract documents, the bid will be rejected. In the event the bid was based on, but did not specify, the use of materials, workmanship, methods, or equipment not in conformance with the contract documents, the bidder will be held responsible for furnishing or using materials, workmanship, methods, and equipment in conformance with the contract documents at no change in the bid price.

F. When a contract for a public improvement is to be awarded to the lowest responsible bidder, a resident bidder shall be allowed a preference as against a non-resident bidder from a state or foreign country if that state or foreign country gives or requires any preference to bidders from that state or foreign country , including but not limited to any preference to bidders, the imposition of any type of labor force preference, or any other form of preferential treatment to bidders or laborers from that state or foreign country . The preference allowed shall be equal to the preference given or required by the state or foreign country in which the non-resident bidder is a resident. In the instance of a resident labor force preference, a non-resident bidder shall apply the same resident labor force preference to a public improvement in this state as would be required in the construction of a public improvement by the state or foreign country in which the non-resident bidder is a resident. Application of the preference against a non-resident bidder shall be in accordance with the information filed with the proposal on the Bidder Status Form.

G. Promptly after the proposals are opened and evaluated, the Jurisdiction shall give careful consideration to its needs, available funding, and other project considerations; and shall either designate the lowest responsive, responsible bidder and proceed with award of contract, or reject all bids and reconsider the project.

1.02 RELEASE OF BID SECURITY

A. After the proposals are opened, verified, and duly considered, the Jurisdiction will promptly release the bid security of all except the lowest two bidders after the Jurisdiction's designation of the lowest responsive, responsible bidder. The bid security of the lowest two bidders will be promptly released after the Jurisdiction's approval of the contract executed by the lowest bidder. If all bids are rejected, all bid security will be promptly released.

B. Bid security shall be released to bidders, either by making such bid security available for retrieval by bidders, or, if requested by a bidder, by mailing the bid security to the bidder.

1.03 AWARD OF CONTRACT

A. Contract Document Submittal: Within 10 calendar days after notification by the Engineer, unless otherwise provided in the contract documents, the Contractor shall present the signed and executed contract documents, including contract, performance, payment, and maintenance bond; certificate of insurance; and all other items required by the contract documents. The performance, payment, and maintenance bond and insurance certificate shall meet the requirements of Section 1070, Part 3 - Bonds and Insurance as required by the Jurisdiction. The Jurisdiction will thereupon receive and file such documents and award the contract.

B. Deferred Award: The Jurisdiction reserves the right to defer award of any contract for a period not to exceed 60 calendar days from the date of opening of proposals. No claims for compensable delay shall arise as the result of delay in the approval of award.

C. Failure to Execute the Contract: It is agreed by the bidder that upon its failure to enter into the contract and furnish the necessary insurance certificate and performance, payment and maintenance bond within 10 calendar days after notification by the Jurisdiction, the amount of the bidder's bid security may at the Jurisdiction's option be forfeited and shall become the property of the Jurisdiction, to be retained not as a penalty, but as liquidated damages. The award of the contract may then, at the discretion of the Jurisdiction, be made to the next lowest responsive, responsible bidder, or the work may be re-advertised or may be constructed by the Jurisdiction in any legal manner.

D. Disclosure of Subcontractors:

1. The lowest responsive, responsible bidder shall be required to file a list of the names and subcontract amounts of all subcontractors who are expected to work on the project according to Section 1080, 1.01 - Subletting or Assignment of Contract.

2. If after award of the contract a subcontractor is replaced, or the subcontract price or the work under the subcontract is changed, the bidder shall disclose the name of the new subcontractor, the revised subcontract price, or the change in the scope of subcontract work.

   If a new subcontractor is added after award of the contract, the Contractor shall disclose the name of the new subcontractor.

END OF SECTION

SCOPE OF WORK

1.01 INTENT OF THE CONTRACT DOCUMENTS

A. These SUDAS Standard Specifications have been prepared to provide construction utilizing the best general practices and construction methods, utilizing first quality materials and work. The Contractor shall be responsible for providing or undertaking all work, labor, materials, equipment, tools, transportation, supplies, and activities included in these specifications, unless the responsibility for undertaking or providing same is specifically assigned to an identified party other than the Contractor.

B. The intent of the contract documents is to provide for the construction and completion in every detail of the work described or as may be amended. The Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work according to the plans, specifications, and terms of the contract documents. The apparent silence or omission of the contract documents as to any detail shall be regarded as meaning only the best general practice is to prevail and only first quality materials and work are to be used.

C. To prepare the plans, specifications, and contract documents, the Engineer may have performed exploratory work to gain information relative to surface and subsurface conditions. This information, when shown in the contract documents, represents a summary of conditions as of the date the survey was made; it is only an approximate estimation of the site conditions made for the Jurisdiction to identify construction conditions and quantities and classes of work. The appearance of this information in the contract documents will not constitute a guarantee conditions other than those indicated will not be encountered at the time of construction. The Contractor's bid shall be prepared based upon its examination of the site and its exploratory work.

D. Before making whatever additional investigations it feels are advisable, a bidder should contact the Engineer to determine available project area. If the Jurisdiction has not obtained right-of-entry for such investigation, the bidder shall be responsible to secure right-of-entry to any parcels where the Jurisdiction has not previously obtained right-of-entry before doing any investigation work. The bidder shall also be responsible for any traffic control necessary for any investigation work. The bidder shall further be responsible to obtain prior utility locates necessary to conduct such investigations.

1.02 CORRELATION OF THE CONTRACT DOCUMENTS

The plans and specifications are intended to supplement each other so any work shown on the plans and not mentioned in the specifications, or vice versa, shall be as binding and shall be completed the same as if that work was mentioned or shown on both and to the true intent and meaning of said plans and specifications.

1.03 COORDINATION OF SPECIFICATIONS, PLANS, AND SPECIAL PROVISIONS

A. In case of any discrepancy between the various items included in the contract documents, the items shall prevail, or govern, in the following descending order:

1. Change Orders
2. Addenda
3. Proposal and Contract
4. Special Provisions
5. Plans, including plan notes

1.03 COORDINATION OF SPECIFICATIONS, PLANS, AND SPECIAL PROVISIONS (Continued)

6. Supplemental Specifications (Jurisdictional document)

7. General Supplemental Specifications (SUDAS)

8. SUDAS Standard Specifications

In case of a discrepancy within any contract document, the following shall prevail, or govern, in descending order: written text, numerals, drawings.

B. The Contractor shall not take advantage of any apparent error or omission in the plans or specifications or of any discrepancy between the plans or specifications.

1.04 CONFORMITY WITH THE CONTRACT DOCUMENTS

A. Reasonably Close Conformity: All work performed and all materials furnished shall comply with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown in the contract documents. Where tolerances are not specified, work shall comply with reasonable and customary manufacturing and industry standards. The Engineer may, in the Engineer's sole discretion, accept variations beyond such requirements or tolerances where they will not materially affect the value or utility of the work and interests of the Jurisdiction.

B. Defective Work: Work not in reasonably close conformity with the contract documents, or requirements thereof that, in the sole discretion of the Engineer, has resulted in inferior or unsatisfactory work. Defective work shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

C. Deficient Work: Work not in reasonably close conformity with the contract requirements but that, in the sole discretion of the Engineer, may be accepted and allowed to remain in place with a price adjustment and/or extended warranty period. In the event the Engineer agrees to accept deficient work with a price adjustment/extended warranty, the Engineer will document the basis of acceptance by contract modification making appropriate adjustments in the contract price for such work or materials.

1.05 PLANS

The final plans on file in the Jurisdiction show the location, typical construction details, and dimensions of the work contemplated. The work shall be performed in conformity therewith, except in case of error or unforeseen contingency.

Electronic support files, if available, will be provided prior to letting and are for information only. Should there be a discrepancy between an electronic support file and a contract document, the contract documents shall govern. No guarantee is made that the data systems used by the Engineer will be directly compatible with the systems the Contractor uses.

Electronic information shall not be considered a representation of actual conditions to be encountered during construction. Providing the Contractor this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered, including, but not limited to, site visits and basing the bid on information obtained from these investigations and professional interpretations and judgment. The Contractor assumes the risk of error if the information is used for any purposes for which the information was not intended. Assumptions the Contractor makes from this electronic information or manipulation of the electronic information is at their risk.

If changes are made during construction, regardless if the change is initiated by the Contracting Authority or Contractor, it shall be the Contractor's sole responsibility to update electronic files that they will use.

1.06 INCREASE OR DECREASE OF WORK

A. The Jurisdiction reserves the right to make such alterations in the plans or in the quantities of work as may be considered necessary. Such alterations shall be in writing by the Engineer and shall not be considered as a waiver of any conditions of the contract documents or to invalidate any of the provisions thereof.

B. Unless such alterations, increases, or decreases materially change the character of the work to be performed or the cost thereof, the altered work shall be paid for at the same unit prices as other parts of the work. Quantity changes amounting to 20% or less of the total bid for an item shall not affect the unit price of that item. If, however, the character of the work or the unit costs thereof are materially changed, due to unforeseen events, an allowance shall be made on such basis as may have been agreed to in advance of the performance of the work.

C. Whenever materials have been delivered to the Contractor or to the work site and the bid item related to those materials is deleted, the Jurisdiction will determine one of the following:

1. Pay invoiced cost for the materials, not to exceed 80% of the authorized amount for the bid item, plus 10% of the invoiced material cost as an overhead charge in addition to documented transportation costs to have the Contractor deliver the materials to the site designated by the Engineer

   OR

2. Pay the invoiced restocking fee (not to exceed 15% of the actual material cost), plus 10% of the restocking fee as an overhead charge, in addition to documented transportation costs incurred by the Contractor to return the materials.

1.07 CHANGE ORDERS

A. Oral Orders: The Engineer shall have authority to give oral orders for minor or incidental changes in the work not involving extra cost and not inconsistent with the proposed purpose of the work.

B. Written Orders: The Engineer may in his/her discretion, and subject to formal approval by the Jurisdiction, if required, issue written change orders changing the scope of the work and/or adjusting the amount to be paid to the Contractor for performing such work; however, the Engineer may, in case of emergency of endangering life or property, orally authorize such a change order without formal approval by the Jurisdiction. Each written change order for extra work shall be explicit in its instruction and shall be duly executed by the Jurisdiction. One copy of said change order shall be filed with the Contractor. Each change order shall stipulate the amount and method of payment.

1.08 SITE CONDITIONS

A. The Contractor is required by Section 1020, 1.04 - Examination of the Contract Documents and Site of Work to make reasonable investigation and examination to determine latent and subsurface conditions at the site of the work prior to preparing its proposal. The Jurisdiction makes no guarantee of any conditions, latent or subsurface, at the site of the work. The Jurisdiction shall not be obligated to make any payments to the Contractor by reason of any latent or subsurface conditions.

B. Failure of the Contractor in determining adverse site conditions prior to filing its proposal, or in any phase of its performance of the work, shall be grounds for refusal by the Jurisdiction to agree to pay for additional work by the contractor necessitated by such site conditions.

1.09 CHANGED SITE CONDITIONS

A. Latent or Subsurface Conditions:

1. If the Contractor encounters latent or subsurface conditions differing materially from those indicated in the contract documents or from those ordinarily encountered in performing work of the character involved, and which the Contractor could not have discovered by a reasonable site investigation and examination of the type customarily undertaken by prudent and competent contractors, and if these unusual or changed conditions are considered by the Contractor as a basis for compensation in addition to the contract price, the Contractor shall promptly after discovery thereof notify the Engineer of its claim in writing. Before disturbing the site at which the latent or subsurface condition is alleged to exist, the Contractor shall give the Engineer the opportunity to inspect the same.

2. After inspection by the Engineer, the Jurisdiction may, in its discretion, authorize the Contractor to proceed with or abandon the work. The Contractor shall resume construction operations pending a decision regarding its claim by the Jurisdiction. Failure of the Contractor to give prompt written notice and to give the Engineer full opportunity to inspect the condition before disturbing the site shall be deemed a waiver by the Contractor of all claims for extra compensation arising out of the alleged condition.

B. Compensation:

1. If the Engineer determines the condition could not reasonably have been discovered, the Contractor is entitled to additional compensation by reason of increased expense caused by the condition, and said condition requires work not contemplated by the contract, a change order will be executed by the parties providing for additional compensation for such amount as the parties may agree upon.

2. If the Engineer determines the condition to be such as to justify an extension in contract time, such additional time will be granted according to Section 1040, 1.11 - Delays Caused by the Jurisdiction and Section 1080, 1.09 - Extension of Time.

1.10 DISPUTED CLAIMS FOR EXTRA COMPENSATION

A. Basis of Claim for Extra Compensation:

1. In any case where the Contractor believes extra compensation is due for work or material beyond the scope of the work under the contract and not ordered by the Engineer as extra work as defined herein, the Contractor shall notify the Engineer in writing of its intention to make claim for such extra compensation before beginning the work on which the claim is based. The Contractor shall not proceed with that work until the Contractor and the Jurisdiction have executed a change order with respect to extra compensation.

2. The Jurisdiction shall be responsible for damages attributable to the performance, nonperformance, or delay, of any other contractor, governmental agency, utility agency, firm, corporation, or individual authorized to do work on the project, only when such damages result from negligence on the part of the Jurisdiction, its Engineer, or any of its officers or employees.

3. In any case where the Contractor deems that extra compensation is due from the contracting authority as damages resulting from such performances, nonperformances, or delays, the Contractor shall notify the Engineer in writing at the time the delay occurs.

1.10 DISPUTED CLAIMS FOR EXTRA COMPENSATION (Continued)

4. In either case, if such notification is not given, or if after such notification is given, the Engineer is not allowed facilities for keeping strict account of actual costs as defined for force-account construction, the Contractor thereby agrees to waive the claim for extra compensation for such work. Such notice by the Contractor, and the fact the Engineer has kept account of the cost as aforesaid, shall not be construed as establishing the validity of the claim.

5. The claim, when filed, shall be in writing and in sufficient detail to permit auditing and an evaluation by the Jurisdiction. The claim shall be supported by such documentary evidence as the claimant has available and shall be verified by affidavit of the claimant or other person having knowledge of the facts.

B. Presentation and Consideration of Claim: If the claimant wishes an opportunity to present its claim in person, the claim shall be accompanied by a written request to do so. Where the claimant asks an opportunity to present its claim in person, the Jurisdiction, within 30 calendar days of the filing of the claim, shall fix a time and place for a meeting between the claimant and the Jurisdiction or its designated representatives or representative. The Jurisdiction shall, within a reasonable time after the filing of the claim or the meeting above referred to, whichever is later, rule upon the validity of the claim and notify the claimant, in writing, of its ruling together with the reasons therefore. In case the claim is found to be just, in whole or in part, it shall be allowed and paid to the extent so found.

C. Request for Arbitration: In the event a Contractor's claim as outlined in the above procedure has been disallowed, in whole or in part, the Contractor may, within 30 calendar days from the date the ruling of the Jurisdiction is mailed, make a written request to the Jurisdiction that its claim or claims be submitted to a board of arbitration. The Jurisdiction shall decide if the matter is subject to arbitration and shall, within 30 calendar days of the receipt of the request for arbitration, grant or deny the request for arbitration. The Jurisdiction's decision shall be final.

D. Board of Arbitration:

1. The board of arbitration shall consist of three persons - one to be appointed by the Jurisdiction, one to be appointed by the Contractor, and the third to be appointed by the two arbitrators thus chosen.

2. The arbitrators selected shall be persons experienced and familiar with construction or engineering practices in the general type of work involved in the contract, but shall not have been a regular employee or an individual retained by either party at the time the claim arose, or at the time of arbitration.

E. Arbitration Proceedings: The board of arbitration shall make its own rules of procedure and shall have authority to examine records kept by the Jurisdiction and the Contractor. If the desired records are not produced within 10 calendar days after they are requested, the board of arbitration shall proceed without them as best it may. Notification of arbitration proceedings shall be made by the arbitration board to both the Jurisdiction and the Contractor, and each shall have the opportunity to attend all sessions of the arbitration board. In determining the findings or award or both, a majority vote of the board shall govern. Copies of the findings or award or both, signed by the arbitrators, shall be filed with the Jurisdiction and the Contractor. A unanimous report or majority report may be used. The board of arbitration shall fix the cost of the proceedings, including a reasonable compensation to the arbitrators, and shall determine how the total cost shall be borne by the parties.

1.10 DISPUTED CLAIMS FOR EXTRA COMPENSATION (Continued)

F. Jurisdiction of Board of Arbitration: The board of arbitration shall have jurisdiction to pass upon questions involving compensation to the Contractor for work actually performed or materials furnished and upon claims for extra compensation that have not been allowed by the Jurisdiction. The board's jurisdiction shall not extend to a determination of quality of workmanship or materials furnished, or to an interpretation of the intent of the plans and specifications except as to matters of compensation. Jurisdiction of the board shall not extend to setting aside or modifying the terms or requirements of the contract.

G. Determination of Board of Arbitration Final: The findings or award, or both, of the arbitration board, if acceptable to both parties to the contract, may become a basis for final payment. If the findings of the arbitration board are unacceptable to either party to the contract, said findings may become the basis for further negotiation between the parties. In the event a solution agreeable to both parties has not been reached through the filing of a claim, through arbitration, or if arbitration has been denied, either party may resort to whatever other methods for resolving the claim are available to it. The Contractor shall not initiate any suit against the Jurisdiction for the adjudication of any claim until said claim has been first presented to the Jurisdiction, pursuant to this article, and either submitted to arbitration or a request for arbitration is denied.

1.11 DELAYS CAUSED BY THE JURISDICTION

If the Jurisdiction or its agents should cause a delay in any part of the work or in the final completion of the job, this fact shall not make void the provisions of the contract as to liquidated damages; but the Contractor will promptly be given such extension of time for the final completion of the job as the Jurisdiction may deem proper to compensate the Contractor for such delay.

1.12 ORAL AGREEMENTS, CONVERSATIONS, AND INFORMAL COMMUNICATIONS

No oral agreement or conversation made or had with any officer, agent, or employee of the Jurisdiction, and no informal written communication from any officer, agent, or employee of the Jurisdiction, occurring either before or after execution of the contract, shall affect or modify any of the terms or obligations contained in any of the contract documents. Such oral contact and such informal writings shall be considered as unofficial information and in no way binding upon the Jurisdiction.

1.13 ERRORS OR OMISSIONS

The Contractor shall examine the plans before beginning construction work. If errors or omissions are discovered in the plans, the Contractor shall call them to the attention of the Engineer before proceeding with the work. In no case shall the Contractor make the corrections therefore without written permission from the Jurisdiction. In case revised plans of a supplementary or explanatory nature are necessary or desirable for clarification, or to correct any errors or omissions, they will be furnished by the Jurisdiction from time to time as the work progresses.

END OF SECTION

CONTROL OF WORK

1.01 AUTHORITY OF THE ENGINEER

A. The work included in the contract is to be done to the complete satisfaction of the Engineer, and the decision of the Engineer as to the true construction and meaning of the contract documents, plans, specifications, estimates, and as to all questions arising as to proper performance of the work, shall be final, except as provided in Section 1040, 1.10 - Disputed Claims for Extra Compensation.

B. The Engineer shall determine the unit quantities and the classification of all work done and materials furnished under the provisions of the contract documents, and the Engineer's determination thereof shall be final except as provided in Section 1040, 1.10 - Disputed Claims for Extra Compensation.

C. The Engineer shall decide any and all questions that may arise regarding the quality or acceptability of materials furnished and work performed, the rate of progress of the work, including cleanup and restoration, acceptable fulfillment and performance of the contract on the part of the Contractor, and compensation. The decision of the Engineer in such matters shall be final except as provided in Section 1040, 1.10 - Disputed Claims for Extra Compensation.

D. Nothing contained in this section or in the contract documents shall be construed as requiring or permitting the Engineer to direct the means, methods, sequences, or procedures, including safety measures, of performing any work under the contract or contract documents, except to ensure the quality of work conforms to these specifications and other provisions of the contract documents and the contract will be completed as scheduled.

1.02 AUTHORITY AND DUTIES OF THE ENGINEER'S AUTHORIZED REPRESENTATIVE

A. The Engineer may appoint a representative to monitor any or all materials used and work done. Such observation may extend to any or all parts of the work and to the preparation or manufacture of the materials to be used. The Engineer's authorized representative will not be authorized to revoke, alter, enlarge, or relax the provisions of these specifications. When placed on the work, the Engineer's authorized representative will keep the Engineer informed as to the progress and quality of the work and the manner in which it is being done.

B. Results of tests and examinations may be available to the Contractor on an informational basis. Absence or presence of representative test data does not alter the Contractor's responsibility for compliance with the contract documents. The Engineer's authorized representative will call to the attention of the Contractor any lack of compliance with the contract documents. However, failure of the Engineer's authorized representative or the Engineer to call the attention of the Contractor to faulty work or to lack of compliance with the contract documents shall not constitute acceptance of such work.

C. The Engineer's authorized representative will not be authorized to approve or accept any portion of the work or to issue instructions contrary to the contract documents. The Engineer's authorized representative will act under the authority of the Engineer to reject defective work or material, and to suspend any work that is not being properly performed, subject to the final decision of the Engineer.

D. The Engineer's authorized representative will not act as supervisor or perform other duties for the Contractor, nor improperly interfere with management of the work. The Engineer's authorized representative will exercise such additional authority as may, from time to time, be delegated by the Engineer.

1.03 COOPERATION BY THE CONTRACTOR

A. A set of approved plans, specifications, contract documents, and any special provisions and authorized alterations will be supplied to the Contractor, and the Contractor shall have them available on the job site at all times.

B. A competent, authorized representative of the Contractor shall be present on the site of the work continually during its progress. This representative must be capable of reading and thoroughly understanding the contract documents and experienced in the type of work being performed. This representative shall supervise, direct, and control the Contractor's operations, personnel, and work, and oversee the Subcontractor's operations.

C. The Contractor shall give the Engineer written notification of the name of the Superintendent. The Contractor or its Superintendent shall receive from the Engineer all explanations and directions necessary for the satisfactory prosecution and completion of the work.

D. The Contractor shall not cause any unnecessary delay or hindrance to other contractors on the work and shall be required to cooperate with other contractors to the fullest extent.

1.04 COOPERATION WITH OTHER CONTRACTORS

A. The Jurisdiction reserves the right to award other contracts in connection with this work and the total improvement. The Contractor is required to become fully informed of the conditions relating to construction and labor under which the work will be or is now being performed, and the Contractor shall employ, as far as possible, such methods and means in the carrying out of its work as will not cause any interruption or interference with any other contractor or agency. The Contractor shall give other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly integrate, incorporate, and/or coordinate its work with theirs.

B. If any part of the Contractor's work depends for proper execution or results on the work of any other contractor, the Contractor shall inspect and promptly report to the Engineer any defect in such work by another contractor that renders it unsuitable for such proper execution and results. The Contractor's failure to inspect and report such defects shall constitute an acceptance of the other contractor's work as fit and proper for the integration or incorporation of its work, except as to defects that may develop in the other contractor's work after the execution of the Contractor's work.

C. Wherever work being done by the Jurisdiction's forces or by other contractors is contiguous to work covered by the contract, the respective rights of the various interests involved shall be established by the Engineer, in order to secure the completion of the various portions of the work in general harmony.

D. Unless otherwise specified in the contract documents, the Contractor shall give notice, as hereafter provided, to all utilities, public and private agencies, abutting property owners, and all others affected by its operations as to time for starting and for completion of its work, names of streets or locations of alleys closed, schedule of operations, and routes of detours where possible. Notification shall be made sufficiently ahead of time to provide proper re-routing of traffic and erecting of signs before the work is to begin.

E. The Contractor shall properly coordinate and expedite its work in such a manner as to cause the least amount of conflict and interference between its operation and those of all others affected by its operations. Any or all damages or claims resulting from the improper or insufficient notification of all others affected by its operations shall be the responsibility of the Contractor.

1.05 SHOP DRAWINGS, CERTIFICATES, AND EQUIPMENT LISTS

A. Submission of Drawings:

1. The Contractor shall submit to the Engineer all shop drawings and equipment drawings or lists as called for in the contract documents or as requested by the Engineer. Drawings and listings shall be complete and shall contain all required detail information conveyed according to the latest recommended standards for detailing.

2. The Contractor shall make any corrections required by the Engineer and submit the revised shop or equipment drawings or listings for review. After review by the Engineer, the shop or equipment drawings or listings will be so marked, dated, signed by the Engineer, and forwarded to the Contractor for reproduction and distribution.

B. Submission of Equipment Lists:

1. If requested in the contract documents, as soon as practicable after award of contract and before any items of material or equipment are purchased, the Contractor shall submit to the Engineer for review a complete list of the principal fixtures and equipment to be incorporated into the work.

2. The Contractor shall also submit applicable brochures, technical data, catalogs, cuts, diagrams, manufacturer's drawings and installation instructions, samples if required, and other descriptive data including the complete description, trade name, model number, type, size, and rating.

C. Engineer's Review:

1. Review by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detail is satisfactory. The Engineer assumes no responsibility for errors in dimensions in the shop drawings and assumes the Contractor will use material complying with requirements of the contract documents or, where not specified, those of sound and reasonable quality, and will erect the subjects of such shop drawings according to recognized standards of first quality work or, when specified, according to standards of the contract documents.

2. Any work done or material ordered by the Contractor prior to review by the Engineer shall be at the Contractor's risk.

1.06 CONFLICT AVOIDANCE

A. Expose possible conflicts, such as utility lines and drainage structures. Verify elevations of each and verify clearances for proposed construction.

B. Complete elements of the work that can affect line and grade in advance of other open cut construction unless noted on the plans.

C. See Section 1040, 1.09 - Changed Site Conditions if unknown or changed conditions are encountered.

1.07 EXAMINATION OF MATERIALS AND WORK

A. The Contractor shall furnish the Engineer and its agents every reasonable opportunity to ascertain whether the work and materials are in reasonably close conformity with the contract documents. At any time before final acceptance of the work, at the request of the Engineer, the Contractor shall remove or uncover portions of the work for examination. After examination, the Contractor shall restore such portions of the work to the standards required by the contract documents.

1.07 EXAMINATION OF MATERIALS AND WORK (Continued)

B. Should the work thus exposed and examined prove acceptable, the uncovering, removing, and replacing of such work shall be paid for as specified in Section 1090, 1.04 - Payment for Change Orders. Should the work thus exposed and examined prove unacceptable, the uncovering, removing, and replacing of such work shall be at the Contractor's expense.

1.08 REMOVAL OF DEFECTIVE WORK AND MATERIALS

A. Defective work or materials may be condemned by the Engineer any time before the final acceptance of the work. Notice of such condemnation shall be given in writing by the Engineer. Such condemned work shall be immediately corrected to the satisfaction of the Engineer. Failure or neglect on the part of the Engineer to condemn unsatisfactory material or reject inferior workmanship shall not release the Contractor, nor shall it be construed as an acceptance of such work, nor shall the final acceptance of such work bar the Jurisdiction from recovering damages on account thereof.

B. Any defective work shall be removed and replaced at the Contractor's expense. Should the Contractor fail or refuse to remove defective work when so ordered by the Engineer, the Engineer shall have authority to order the Contractor to suspend further operations, and may withhold payment on estimates until such defective work has been removed and replaced according to the contract documents.

C. Continued failure or refusal on the part of the Contractor to correct defective work promptly shall be sufficient cause for the Jurisdiction to declare the contract in default. No compensation will be paid to Contractor for defective work or materials, or for the satisfactory removal, correction, or disposal thereof.

1.09 UNAUTHORIZED WORK

A. Unauthorized work is work done contrary to the work shown in the contract documents. The Jurisdiction will not pay for unauthorized work.

B. Unauthorized work may be ordered to be removed and replaced immediately at the Contractor's expense.

1.10 LINE AND GRADE STAKES

A. Minimum standards for construction survey provided by the Jurisdiction will meet the requirements of Section 11,010. The Engineer will set the necessary stakes promptly upon notification by the Contractor that stakes are needed.

B. The work shall be performed in strict conformity with the contract documents and to the lines and grades as fixed by the Engineer, and shall be according to such instructions as may be given by the Engineer. When such stakes or lines are given by the Engineer, the Jurisdiction will be responsible for the correctness thereof, and the Contractor will be responsible for their proper use, interpretation, and preservation.

C. The Contractor shall protect and preserve in their original position all stakes, points, or marks set for the work by the Engineer. Where the Engineer shall consider such stakes, points, or marks to have been unnecessarily altered or destroyed, the Engineer may cause the expense of correcting or replacing them to be charged to the Contractor and the amount of such costs deducted from any monies due or which may become due to the Contractor under the contract.

1.11 PROVIDING JOB SITE UTILITIES

A. The Contractor shall make all necessary arrangements for the provision to the job site of all required utilities for the project. The Contractor shall arrange its work so it will not be delayed because such regulations or requirements relating to the use of utilities. All costs for the provision of utilities to the job site shall be borne by the Contractor.

B. Fire hydrants shall not be used by the Contractor or its subcontractors unless authorization for such use has been obtained from the appropriate water utility agency.

1.12 SALVAGE

A. When the contract documents specify salvage of materials for the Jurisdiction as part of the work, the material to be salvaged shall be carefully salvaged and delivered to the designated location in the best condition and ready for storage. When the contract documents provide for salvage of such materials by the Contractor, the Contractor shall salvage such materials and promptly remove them from the site.

B. The Contractor shall not allow inspection or sale of salvage materials to third parties at the site without written approval of the Jurisdiction.

1.13 PROTECTION OF WATER QUALITY AND WETLANDS

A. The Contractor shall comply with the requirements of the Clean Water Act (33 U.S.C. 1344 and 33 CFR 323) and Executive Order 11990. When it becomes necessary for the Contractor to work in waters of the United States, the Contractor shall be aware that a Section 404 permit may be required.

B. When required, the Contracting Authority will obtain a Section 404 permit for essential work on the right-of-way prior to the award of the contract. The Contractor shall adhere to the requirements of the permit. Activities occurring in or across waters of the United States not specifically reviewed and approved in the permit are not authorized. If the Contractor desires to use construction methods that are not specifically approved by the permit, the Contractor shall be responsible for obtaining approval in the form of a new Section 404 permit from the U.S. Army Corps of Engineers and possibly Iowa DNR. The Contractor shall not use construction methods that require additional mitigation by the Contracting Authority. The Contractor will not be granted additional compensation or contract time due to their request for a new permit. If, however, due to no fault of the Contractor, a Section 404 permit modification involving activities within the right-of-way is deemed necessary by the Engineer, additional contract time and/or compensation may be considered.

1.14 FINAL INSPECTION AND ACCEPTANCE

A. As soon as practicable after the completion of the work, it will be inspected thoroughly by the Engineer. The Contractor will be notified when the inspection is to be made so it or its representative may be present.

B. If the inspection reveals any defects in the work as contemplated by the specifications, such defects shall be repaired or unsatisfactory work shall be replaced, as the Engineer may direct, before final acceptance. The cost of all such repairs and replacement shall be borne by the Contractor, and no extension of the contract time shall be granted because of the time required to remedy such defects.

C. When the work is found to be satisfactory, it will be accepted as provided in Section 1090, 1.08 - Acceptance and Final Payment. Such final acceptance will not be reopened after having once been made, except on evidence of collusion, fraud, or obvious error.

1.15 ADDITIONAL CONTRACTOR RESPONSIBILITIES

If a form of automated machine guidance (AMG) is used for grading or paving operations, the following is required:

A. At least one week prior to the preconstruction meeting, submit to the Engineer for review a written AMG work plan which indicates the following:
   - Equipment type
   - Control software manufacturer and version
   - Proposed location of GPS base station for broadcasting differential correction data to rover units
   - Proposed locations where AMG will be utilized

B. Provide Engineer with up to 8 hours of formal training on Contractor's AMG systems.

C. For grading contracts, provide a rover for use by the Engineer.

D. Check and recalibrate, if necessary, the AMG system at the beginning of each work day.

E. Contractor will bear all costs associated with use of the AMG system, including but not limited to reconstruction of work that may be incurred due to errors in application of the AMG system. Correction of grade elevation errors and any associated quantity adjustments resulting from the Contractor's activities are to be done at no cost to the Contracting Authority.

END OF SECTION

CONTROL OF MATERIALS

1.01 MATERIALS SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

A. Materials used in the work shall meet all quality requirements of the contract documents. In order to expedite inspection and testing of materials, the Contractor shall notify the Engineer in writing of the proposed sources of those materials requested by the Engineer promptly after being awarded the contract. Any material shall be produced with a reasonably uniform quality and within requirements specified; the producer shall perform quality control tests and evaluations the producer believes necessary to control the product adequately. All materials for use in the project are subject to inspection and tests at any time prior to being incorporated into the work.

B. For the convenience of the Contractor, and when convenient to the Engineer, materials may be inspected at the site of production. Materials tested and found in compliance at the site of production may be later inspected for reasonably close conformity and normally will not be rejected except for obvious mistakes, contamination, quality change, or mishandling. To avoid later rejection, materials that usually show an extreme change in character or quality prior to or during the process of incorporation into the work should be produced to more rigid limits than those required by the specifications.

C. At the option of the Engineer, approval of the source, or approval of materials at the source prior to delivery, may be required. If it is found after trial that sources of supply for previously approved materials do not produce specified products or when conditions are such that use of unfit materials can not be prevented except by extraordinary inspection methods, the Contractor shall furnish materials from other sources. Before delivery, and at any time during the process of preparation and use, materials shall be subject to the approval of the Engineer.

D. Materials not previously inspected will be inspected at the project site. Acceptance at that time will be based on sampling and testing, producer's certifications, visual inspection, or any combination of these at the discretion of the Engineer.

E. Use of materials on the basis of the producer's certification, quality control tests, and evaluations may be permitted or required. The Engineer may require specific data obtained by qualified persons and procedures be provided with the material, when delivered. Certified gradation testing by a certified aggregate technician will be required for all aggregates to be furnished by the Contractor, and shall be done according to the current Iowa DOT Materials I.M. 209.

1.02 ALTERNATE PROCESSES, EQUIPMENT, OR MATERIALS AND OTHER SUBSTITUTIONS

A. General: In order to establish a basis of quality for the work, performance, or economy of operation, certain processes, types of machinery and equipment, or kind of material may be referenced in the contract documents by designating a manufacturer by name and referring to its brand or model numbers. Such reference is not intended to foreclose other processes, equipment or materials that will in the sole discretion of the Engineer meet, or exceed, the designated standards. There may be instances where the Engineer will not consider alternate processes, equipment, or materials.

B. Consideration:

1. The Jurisdiction may consider alternate processes, equipment, or materials for those specified in the contract documents; however, it is only an indication that the Jurisdiction will not foreclose consideration of the bidder’s/contractor’s request, and is not an approval. Following are the steps for consideration of alternate processes, equipment, or materials:

1.02 ALTERNATE PROCESSES, EQUIPMENT, OR MATERIALS AND OTHER SUBSTITUTIONS (Continued)

a. If a bidder/contractor desires to use alternate processes, equipment, or materials, the bidder/contractor shall contact the Engineer to confirm the Jurisdiction would consider alternate processes, equipment, or materials for those as specified in the contract documents.
b. Support/requirements for submissions of alternatives:
    1) The Engineer will consider and evaluate other products, equipment, methods, and systems only when such items are accompanied by full and complete technical data, test data, code compliance, and other relevant information, including samples and finishes where appropriate.
    2) The bidder/contractor shall submit design information, material compatibility, performance, durability, laboratory tests, chemical analysis, color, manufacturer's specifications, and other relevant information as proof of quality and integrity when presenting proposed alternatives to the Engineer for consideration. The bidder/contractor must include the kind, quality, design, and performance of the proposed materials and equipment.
    3) If alternate methods are proposed, the contractor shall furnish complete engineering plans covering the proposed change.
    4) It is the sole responsibility of the proposer of any alternative product to have pre-qualified the product proposed for its intended use for compliance with all applicable codes within the Jurisdiction prior to submittal to the Engineer for consideration.
c. In making an alternative request, the contractor shall be responsible for all costs including reimbursing the Engineer for services furnished and any time required to review the proposed change.
d. If the bidder/contractor desires to use alternate processes, equipment, or materials for those as specified in the contract documents, the bidder/contractor shall secure the written approval of the Engineer before entering an order therefore.
e. Proposed alternative processes, equipment, or materials that will in the sole discretion of the Engineer meet, or exceed, the designated standards will be given written approval to be used on the project as an "Approved Equal" or "Equivalent" to the specified item.
f. If approval as an "Approved Equal" or "Equivalent" is given by the Engineer, such approval will be on the condition that the bidder/contractor shall be fully responsible for producing construction work in reasonably close conformity with contract requirements.
g. In order to ensure fair competitive bidding, it is critical that all bidders base their bids on providing the material, equipment or process (including those trade named) fully complying with the contract documents.
h. The contractor shall not be entitled to any additional compensation if the Engineer does not approve the contractor's request for alternate processes, equipment, or materials after the contract is awarded. The bidder/contractor is solely at risk until the Engineer issues written notification of "Approved Equal" or "Equivalent."
i. The Jurisdiction reserves the right to adjust the contract price when the cost of an "Approved Equal" or "Equivalent" is less than the cost of the specified item. The contractor shall estimate the net savings of the proposed alternate and if the Engineer approves the proposal, a change order may be processed to reduce the contract amount by up to 50% of the estimated net savings of the "Approved Equal" or "Equivalent."

2. If the contract documents state that the Jurisdiction will not consider alternate processes, equipment, or materials, the bidder/contractor shall not propose any alternates to those specified in the contract documents.

1.03 SAMPLES AND TESTING

A. Each consignment of material shall be tested or inspected before being incorporated into the work and shall be approved by the Engineer in charge of the work before it is used. The Contractor shall allow such facilities for collecting and forwarding samples and subsequent testing as the Engineer may require.

B. Samples shall be supplied to allow ample time for testing without delaying the work. No material for which samples are requested shall be used until the samples have been approved. If necessary, work will be delayed or suspended, at no cost to the Jurisdiction, to permit the completion of all specified tests and examinations. Tests made on the samples of materials utilized for improvements constructed under these specifications will be made by the Jurisdiction at no cost to the Contractor.

C. All tests shall be made by the Jurisdiction testing laboratory, or at such independent testing laboratories as the Engineer shall approve. Except as otherwise specified, the testing of materials furnished for use under these specifications shall be done according to the methods described in the specific ASTM, AASHTO, AWWA, or other authorized specifications for each material. Results of all tests shall be submitted to the Engineer.

1.04 STORAGE OF MATERIALS

The Contractor shall be responsible for care and storage of materials delivered to the work site or purchased for use. Material delivered to the work site and damaged before actual incorporation in the work may be rejected by the Engineer even though it may have been previously acceptable. Stored materials shall be located to facilitate thorough inspections, to minimize environmental damage, and not interfere with operations.

1.05 UNACCEPTABLE MATERIALS

All materials not conforming to the requirements of the specifications at the time they are to be used shall be considered unacceptable, and all such materials will be rejected and shall be removed immediately from the work site unless otherwise instructed by the Engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given by the Engineer.

1.06 MATERIALS SUPPLIED BY THE JURISDICTION

When any materials are to be furnished by the Jurisdiction, the designation of such materials and the time of availability will be included in the contract documents.

1.07 MATERIALS SUPPLIED BY THE CONTRACTOR

A. Unless otherwise stated in the contract documents, all materials and equipment needed for, or to become a part of, the work shall be furnished by the Contractor. The Contractor shall assume full responsibility for ordering materials and equipment of the quality specified and of the quantity necessary, and shall be responsible for payment of the purchase and/or delivery cost of such materials and equipment.

B. All materials and equipment that become the property of the Jurisdiction as a part of the project shall be unused and newly produced or manufactured with original materials (as opposed to recycled or used materials), shall be state of the art for that material or equipment, and shall be properly stored to protect the integrity of the material and equipment. The Engineer may waive this provision and accept used or recycled material or equipment prior to submission of the bid. Such waiver must be in the form of an addendum.

END OF SECTION

LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

PART 1 - LEGAL RELATIONS

1.01 MUNICIPAL REGULATIONS, STATE, AND FEDERAL LAWS AND REGULATIONS

A. The Contractor shall at all times observe and comply with all applicable Federal, State, County, or City laws, ordinances, orders, and regulations.

B. References in these specifications to particular chapters or sections of the Iowa Code shall be to those chapters or sections as they appear in the current version of the Iowa Code. In the event such chapters or sections of the Iowa Code are subsequently amended, the specifications shall be deemed to refer to those chapters or sections as amended.

C. During the performance of this contract, the contractor (for itself), its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. Compliance with Regulations: The contractor shall comply with the Regulations relative to non-discrimination in Federally assisted programs of the DOT Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

2. Nondiscrimination: The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, national origin, sex, age, or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

3. Solicitations for Subcontracts, Including Procurement of Materials and Equipment: In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurement of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to non-discrimination on the grounds of race, color, national origin, sex, age, or disability.

4. Information and Reports: The contractor shall provide all information and reports required by the Regulations or directives issued pursuant there to, and shall allow access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Contracting Authority, the Iowa DOT, or FHWA to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information the contractor shall so certify to the Contracting Authority, the Iowa DOT, or the FHWA as appropriate, and shall set forth what efforts it has made to obtain the information.

5. Sanctions for Noncompliance: In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the Contracting Authority, the Iowa DOT, or the FHWA shall impose such contract sanctions as they may determine to be appropriate, including, but not limited to:
   a. Withholding of payments to the contractor under the contract until the contractor complies, and/or
   b. Cancellation, termination, or suspension of the contract, in whole or in part.

1.01 MUNICIPAL REGULATIONS, STATE, AND FEDERAL LAWS AND REGULATIONS (Continued)

6. Incorporation of Provisions: The contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurement of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the Contracting Authority, the Iowa DOT, or the FHWA may direct as a means of enforcing such provisions including sanctions for non-compliance: Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the Contracting Authority or the Iowa DOT to enter into such litigation to protect the interests of the Contracting Authority or the Iowa DOT; and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

1.02 GOVERNING LAW

The law of the State of Iowa shall govern this contract and all subcontracts for materials and services entered into by the Contractor.

1.03 PERMITS AND LICENSES

The Contractor shall procure all necessary permits for the construction of the work and for temporary excavations, obstructions, enclosures, and street openings arising from the construction and completion of the work described in the contract documents. The cost for all required Jurisdictional permits and licenses will be waived by the Jurisdiction. The Contractor shall be responsible for all violations of the law for any cause in connection with the construction of the work or caused by the obstruction of roads, streets, highways, or sidewalks, and shall give all requisite notices to the Jurisdiction or other public authorities in connection therewith.

1.04 PATENTS AND ROYALTIES

The Contractor shall defend, indemnify, and save the Jurisdiction harmless against all claims arising from alleged infringements of patents and royalties covering tools, machinery, processes, appliances, devices, or materials used in connection with the work. Unit prices provided in the proposal shall include payment of all necessary royalties or licenses.

1.05 USE AND OCCUPANCY PRIOR TO COMPLETION OF CONTRACT

The Contractor shall complete any portion or portions of the work in such order and at such time as the Engineer may require. The Jurisdiction shall have the right to use any completed or partially completed portions of the work at any time, but such possession and use shall not be deemed an acceptance of the work so used or any part thereof. If such prior use increases the cost of or delays the work, the Contractor shall be entitled to such extra compensation or extension of time, or both, as the Engineer may determine appropriate. When improvements are released to the Jurisdiction for public use prior to final approval and acceptance, the Contractor will be relieved of the responsibility for damages due to the elements or due to ordinary public use, but only the released and used portion of the improvements. Such release by the Contractor to the Jurisdiction for public use shall be directed in writing by the Engineer.

1.06 CONTRACTOR'S RESPONSIBILITY FOR THE WORK

A. Until the work is accepted by the Jurisdiction, it shall be in the custody of and under the charge, care, and control of the Contractor, who shall take every precaution against damage to the work by action of the elements or any other cause. The Contractor shall rebuild, repair, restore, and make good at its own expense, all damages to any portion of the work before acceptance thereof by the Jurisdiction. Issuance of any estimate or partial payment for work done will not be considered as final acceptance of any work completed.

1.06 CONTRACTOR'S RESPONSIBILITY FOR THE WORK (Continued)

B. If the Contractor completes a unit or portion of the work, the Jurisdiction may at its discretion accept such work and the Contractor may be relieved of further responsibility for such unit or portion of the work. Such partial acceptance shall not void or alter any of the terms of the contract, nor shall it constitute final acceptance of the work as provided in Section 1090, 1.08 - Acceptance and Final Payment.

1.07 RESPONSIBILITY FOR DAMAGE CLAIMS

The parties agree that it is their intent that there be no third-party beneficiaries to this contract. No provision of this contract or of any addendum, materials instructional memorandums, plans, proposal, special provision, developmental specification, supplemental specification, or general supplemental specification shall be construed as creating any third-party beneficiaries.

1.08 PERSONAL LIABILITY OF PUBLIC OFFICIALS

Neither the Engineer nor the Engineer's authorized representatives, agents, or assistants shall have any liability, either personally or as officials of the Jurisdiction, in carrying out any of the provisions of the Contract or in exercising any power or authority granted to them thereby. It being understood that in such matters they will act as the agents and representatives of the Jurisdiction.

1.09 WAIVER OF LEGAL RIGHTS

A. The Jurisdiction shall not be precluded or estopped by any measurement, estimate, or certificate made either before or after the completion and acceptance of the work and payment therefore, from showing the true amount and character of the work performed and the materials furnished by the Contractor, or from showing that any such measurement, estimate, or certificate is untrue or incorrectly made, or from showing that the work or materials do not in fact conform to the contract documents.

B. The Jurisdiction shall not be precluded or estopped, notwithstanding any such measurement, estimate, or certificate and payment in accordance therewith, from recovering from the Contractor and its surety such damages as it may sustain, and all outlay and expense it incurs, by reason of the Contractor's failure to comply with the terms of the Contract. Neither the acceptance by the Jurisdiction nor any of its representatives, nor any payment for acceptance of the whole or any part of the work, nor any extension of time, nor any possession taken by the Jurisdiction, shall operate as a waiver of any portion of the contract, or any powers herein reserved, or any right to damages herein provided. A waiver of any breach of the contract shall not be held to be a waiver of any other subsequent breach.

C. The Contractor hereby waives any claims it may hereafter be entitled to assert against the Jurisdiction, its officers, agents, employees, or consultants, on its behalf or on behalf of its employees, agents, subcontractors, sub-subcontractors, and suppliers, for loss of or damage to personal property, tools, or equipment owned by it or its employees, agents, subcontractors, sub-subcontractors, and suppliers, which loss or damage is sustained on the Jurisdiction's project property, or which occurs during work on the project, and the Contractor agrees to assume liability or responsibility for such claims and to procure insurance to cover its exposure in that regard.

1.10 ACCEPTANCE BY THE JURISDICTION - NOT A WAIVER OF CONTRACTOR'S OBLIGATIONS OR A WAIVER OF THE JURISDICTION'S RIGHTS

A. In various provisions of the contract documents, including these specifications, the Jurisdiction has reserved to itself or the Engineer the authority to test or inspect materials, equipment, or manufactured assemblies and to accept or reject those and other elements of the work.

1.10 ACCEPTANCE BY THE JURISDICTION - NOT A WAIVER OF CONTRACTOR'S OBLIGATIONS OR A WAIVER OF THE JURISDICTION'S RIGHTS (Continued)

B. In various provisions of the contract documents, including these specifications, the Jurisdiction has reserved to itself or the Engineer the authority to require the Contractor's preparation of shop drawings for review and to accept or reject same. If unanticipated and either unusual or complex construction procedures or site conditions occur, the Engineer may require the Contractor to submit such shop drawings as, in the judgment of the Engineer, are necessary to satisfactorily complete the proposed construction.

C. Acceptance or approval by the Engineer as therein provided shall not operate to relieve the Contractor of its obligation (1) to perform the work as required by the contract documents in a workmanlike manner and according to the standards for construction applicable to the type of work covered by this contract generally observed by contractors in this locale and (2) to provide materials and equipment meeting the quality requirements as provided in the contract documents. The Jurisdiction assumes no responsibility for errors in shop drawings and assumes the Contractor will use material complying with requirements of the contract documents or, where not specified, those of sound and reasonable quality, and will erect the subjects of such shop drawings according to recognized standards of first quality work or, when specified, according to standards of the contract documents.

D. No such acceptance by the Jurisdiction shall constitute a waiver by the Jurisdiction of its right to subsequently reject defective work, materials, or equipment. Further, no such acceptance by the Jurisdiction or the Engineer shall be deemed a waiver by the Jurisdiction of its right to recover from the Contractor all losses, damages, outlay, or expense it incurs, which is attributable to such defective work, materials or equipment, or manufactured assemblies, nor shall such acceptance or approval be deemed a waiver of the Jurisdiction's right to indemnity from the Contractor for damage or injury to third parties occasioned by such defective work, materials, or equipment.

1.11 BUSINESS ORGANIZATION REQUIREMENTS

The bidder, or contractor, as a business organization shall comply with the following:

A. A corporation, limited liability company, limited partnership, or other type of business organization governed under Iowa statutes must be registered with the Iowa Secretary of State, must use the name under which it is registered with the Iowa Secretary of State, must be authorized to do business in Iowa, and must be registered as a contractor with the Iowa Department of Labor.

B. A partnership, sole proprietorship, company operating under a trade name, or other type of business organization not governed under Iowa statutes should be registered in the Office of the County Recorder where it is located or where the work is to be performed, must use the name under which it is registered, and must be registered as a contractor with the Iowa Department of Labor. Prior to entering into contract, the designated low bidder, if it is not required to be registered with the Iowa Secretary of State, shall provide to the Jurisdiction the name and address of its registered agent or lawful representative upon whom legal notices and processes may be served. The registered agent or lawful representative must be an Iowa resident, an Iowa profit or nonprofit corporation, or a foreign profit or nonprofit corporation qualified to do business in Iowa.

C. A foreign business organization, organized under the laws of a state other than Iowa, shall file with the Engineer’s documentation that it has complied with all the provisions of this section prior to entering into a contract.

1.11 BUSINESS ORGANIZATION REQUIREMENTS (Continued)

D. If a bid is proposed to be submitted by two persons or entities as a joint venture, the names of the two persons or entities appearing on the documents must be followed by the notation – "a joint venture." In that instance, the bid must also be signed by authorized agents of both entities, and the bid security must indicate that it "applies to and covers the proposal for construction of (Project Name) submitted by the (principal on bond) and (name of other company), submitted as a joint venture proposal." A bid submitted by two persons or entities without any indication they are submitting it as a joint venture, without being signed by authorized representatives of both entities, and without bid security covering both entities as a joint venture, will be rejected.

1.12 CONSENT TO JURISDICTION OF IOWA DISTRICT COURT OR FEDERAL DISTRICT COURT IN IOWA

The Contractor agrees that any causes of action that accrue to it, or which by subrogation or assignment accrue to its sureties or insurers, arising out of or connected with this contract shall be brought in the Iowa District Court in and for the County where the Jurisdiction is located or in the United States District Court in and for the District where the Jurisdiction is located. Contractor further consents, on behalf of itself and its subrogees and assigns, to the jurisdiction of either the Iowa District Court in and for the County where the Jurisdiction is located or the United States District Court in and for the District where the Jurisdiction is located, as to any causes of action brought against it arising out of this contract or any work performed under it by Contractor or its subcontractors, and further agrees, on behalf of itself, its subrogees and assigns, to waive any and all objections to the jurisdiction of said court as to any such cause of action.

1.13 SEVERABILITY

It is the intent of the Jurisdiction and the Contractor that the lawful provisions of this contract shall be severable from any provisions of this contract that are hereafter declared to be illegal or void by a court of competent jurisdiction.

PART 2 - RESPONSIBILITIES TO THE PUBLIC

2.01 SANITATION

The Contractor shall arrange for the necessary sanitary conveniences, properly secluded, for the workers on the project. These shall be maintained in a manner inoffensive to the public and in compliance with the local health regulations.

2.02 CONVENIENCE AND SAFETY

A. Use of Streets: The Contractor is granted the privilege of using Jurisdictional roads, streets, or highways, as shown on the plans, for the purpose of doing work specified in the contract, but is not granted exclusive use of such roads, streets, or highways.

B. Protection of Workers and the Public: The Contractor shall erect and maintain good and sufficient guards, barricades, and signals at or near the work according to the MUTCD and all applicable laws, regulations, and specifications. The Contractor shall, in all cases, maintain safe passageways at all road crossings, crosswalks, and street intersections and shall do all other things necessary to prevent an accident or loss of any kind.

After November 24, 2008, all personnel shall wear ANSI 107 Class 2 apparel at all times when exposed to traffic or construction equipment in the right-of-way.

C. Convenience and Access: The Contractor shall handle the work in a manner that will cause the least inconvenience and annoyance to the general public and to the property owners abutting the work area. The Contractor shall also provide access to the abutting property to the greatest extent practicable.

D. Worker Safety: The Contractor shall comply with all current and future federal and state OSHA requirements. Nothing in this contract or any action by the Jurisdiction shall be interpreted or construed as a waiver of OSHA requirements. It is the Contractor's obligation to follow OSHA requirements and standards at all times.

E. Project Area or Work Site Safety:

1. In accordance with Section 1070, 1.06, until the work is accepted by the Jurisdiction, the work shall be in the custody of and under the charge, care, and control of the Contractor. The Contractor is also responsible for the project area or work site. The Contractor is solely responsible for the safety of everyone on its work site.

2. The Contractor should have a safety program; however, the Contractor need not submit a safety program to the Jurisdiction, and the Jurisdiction will not review or approve the Contractor’s safety program. The Jurisdiction assumes that the Contractor will maintain a safe worksite; however, the Jurisdiction’s staff will not intrude in the Contractor’s responsibility for safety issues.

3. The Engineer may assign some or all of the duties and responsibilities of the Engineer to an authorized representative for a given project. Nothing contained in this section or in the contract documents shall be construed as requiring or permitting the Engineer to direct the means, methods, sequences, or procedures, including safety measures, of performing any work under the contract or contract documents, except to assure that the quality of work conforms to these specifications and other provisions of the contract documents and that the contract will be completed as scheduled.

2.02 CONVENIENCE AND SAFETY (Continued)

4. The Engineer may appoint an authorized representative on the work site to monitor the materials used and the work done by the Contractor. The Engineer's authorized representative is not a safety inspector and is not responsible for monitoring, directing, or otherwise ensuring the safety of the Contractor, its subcontractors, its suppliers, or any others that may be on the work site.

5. Construction of the work included in the contract is by its nature dangerous work; and the Contractor is hereby notified that it is the Contractor's sole responsibility to provide as safe a working site as possible given the nature of the work. It is the Contractor's responsibility to notify and advise its employees, subcontractors, suppliers, and everyone on the worksite of the dangers associated with the work, and provide them with appropriate safety information to protect them from those dangers.

2.03 WORK AREA

A. The Contractor shall confine its work to the Jurisdiction's premises, including construction easements and construction limit lines as shown in the contract documents and verified by the Engineer. The Contractor shall not enter upon or place materials on any private property for which the Jurisdiction has not obtained an easement for such use. The Contractor agrees to defend, indemnify, and hold the Jurisdiction harmless from all suits and actions of every kind and description resulting from the Contractor's use of private property. Before beginning construction, the Contractor shall check with the Engineer for any special instructions concerning easements.

B. Temporary buildings, storage sheds, shops and office, etc., may be erected by the Contractor only with the prior approval of the Engineer and shall be built with labor and materials furnished by the Contractor without expense to the Jurisdiction. Such temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor, at its expense, after the completion of the work.

2.04 PROJECT AREA FOR THE WORK

A. Acquisition: Existing and proposed additional right-of-way or easements shown on the plans and/or in the contract documents will provide, without cost to the Contractor, adequate space for the performance of the work. If the contract documents do not contain a notice to the Contractor of non-acquired additional right of way or easements, as shown on the plans, and the Contractor provides documentation acceptable to the Engineer, compensation will be allowed for loss or damage occasioned by delays in securing said right-of-way or easements; and, if the need to acquire such additional right-of-way or easements is the sole and only cause of the impossibility of completing the work within the specified time, the Jurisdiction may grant an extension of time if requested by the Contractor. Before beginning construction, the Contractor shall obtain from the Engineer a list of any easements or right-of-way not acquired and any special instructions pertaining to properties affected by the work.

B. Location: Property lines, limits of easements, and limits of construction permits are indicated on the plans, and it shall be the Contractor's responsibility to confine its construction activities within those limits.

C. Use: The Contractor shall confine its equipment, storage of materials, and operation of work to the limits indicated by laws, ordinances, permits, or direction of the Engineer and shall not unreasonably encumber the premises with its materials.

No storage of flammable products or combustible materials shall be allowed below overhead portions of bridges, other highway structures, or existing overhead structures spanning or encroaching the public right-of-way or easements. When not in use, materials or products that present risk of fire hazards must be stored at least 15 feet from the footprint of overhead structural elements.

2.04 PROJECT AREA FOR THE WORK (Continued)

The Contractor shall comply with the Engineer's instructions regarding signs and advertisements.

D. Encroachments: Any damage resulting to persons or property from the Contractor's encroachment beyond the specified limits shall be the sole responsibility of the Contractor.

2.05 EXPLOSIVES

A. Use: The Contractor shall not blast any rock or other materials or allow the same to be done in prosecution of the work, unless it secures the Engineer's approval, proper insurance coverages, and a blasting permit when required.

B. Safety: The Contractor is solely responsible for all damage resulting from blasting operations performed by the Contractor or its agents. The Contractor shall use the utmost care to not endanger life or damage property; and whenever ordered by the Engineer, the number and size of the charges shall be reduced. Suitable coverages or mats shall be provided to confine all materials lifted by blasting within the limits of the excavation or trench. All explosives shall be stored in a secure manner and clearly marked according to all applicable laws and regulations.

C. Regulations: The Contractor shall abide by all existing Federal, State, and Local regulations regarding the use of explosives, including, but not limited to, Uniform Fire Code, Article 77, and National Fire Protection Association 495, Explosive Materials Code of the National Fire Codes.

2.06 TRAFFIC CONTROL

A. General:

1. The Contractor shall maintain traffic and shall provide and maintain traffic control devices according to the contract documents. If there is no specific traffic control plan, then the Contractor's traffic control devices shall meet the requirements of and be placed according to the current edition of MUTCD.

2. During construction, areas to be maintained for traffic shall be kept clear of all hazardous materials, including but not limited to construction debris, dust, and mud.

B. Closing Streets to Traffic:

1. Upon the Engineer's approval, the Contractor may close streets or parts of streets to vehicular traffic as soon as the construction work is started; such streets or parts of streets shall remain closed as long as construction work or condition of the finished work requires. The Engineer will determine how many streets or parts of streets may be closed by the Contractor at one time, and may refuse to allow the closing of additional streets until some of the improvement is finished and opened to traffic.

2. The Contractor shall notify the Engineer 48 hours in advance (excluding weekends) of closing any roads, streets, or public thoroughfares. No road or street shall be closed without prior approval from the Engineer.

3. The Contractor shall not remove, relocate, or reset any permanent Jurisdictional traffic control devices unless authorized to do so by the Engineer or contract documents. If a sign must be removed or relocated for any phase of construction, the Contractor shall notify the Engineer of the necessity for removal. The Engineer shall arrange for the removal, relocation, or resetting of permanent traffic control devices by Jurisdictional personnel as needed to allow the work to proceed. If Jurisdictional personnel are not available, the authorized Jurisdictional representative may give authorization to the Contractor to remove, relocate, or reset the permanent traffic control devices.

2.06 TRAFFIC CONTROL (Continued)

4. In the event the Contractor removes or relocates a traffic control sign without prior notice to or authorization from the Engineer, the Contractor shall bear all responsibility and liability to any person sustaining bodily injury or property damage on account thereof.

2.07 PROTECTION OF ABOVEGROUND AND UNDERGROUND FACILITIES

A. The Engineer has attempted to show on the plans all aboveground and underground facilities, including public and private utilities, which may be affected by the work. The location, depth, and size of each such facility shown on the plans is approximate only and is not guaranteed. Other underground facilities may exist and their location may not be presently known or identified. It is the Contractor's responsibility to determine the existence and exact location of all such facilities located within the construction area to avoid damage.

B. Where existing facilities are shown in the contract documents or encountered within the construction area, it shall be the responsibility of the Contractor to notify the operators of those facilities prior to beginning any construction activities. The Contractor shall allow access to those facilities for necessary modification of services. The Contractor shall support, sustain, and protect existing pipes, conduits, poles, wires, and other apparatus located under, over, along, across, or adjacent to the work site. If such utilities are damaged through Contractor's negligence, they will be repaired by the agencies having control of same, but the cost of such repairs shall be paid by the Contractor.

C. The Contractor shall, prior to commencing any excavation or other operation that may affect underground facilities, notify the "Iowa One Call" underground facility locate system, established pursuant to Iowa Code Chapter 480. The Contractor shall, if requested by the operator of an underground facility, assist in the location of its facilities; provided, however, the Jurisdiction shall not be responsible to the Contractor or to any operator of an underground facility for the cost of locating such facility, or for any damage to such facility that occurs in attempting to locate it, or for any damage to the facility occasioned by the Contractor's performance of work under the contract.

D. Claims for additional compensation will not be allowed to the Contractor for any interference, delay, or additional work occasioned by the location or adjustment of aboveground or underground facilities, or connections thereto.

2.08 PROTECTION OF PROPERTY

A. The Contractor shall continuously maintain adequate protection of all its work from damage and shall protect the Jurisdiction's property and adjacent private property from injury or loss arising in connection with the work. The Contractor shall repair or restore any such damage, injury, or loss to Jurisdiction property or adjacent private property.

B. Protect existing facilities, trees, and shrubs to remain in place. Any damage to existing trees or shrubs, branches, and root systems to remain and to be protected shall be repaired and/or pruned by an experienced tree surgeon or arborist. Do not disturb soil within 10 feet of the drip line of trees without notifying the Engineer. The Contractor shall mark the 10 foot limit from the drip line.

C. The Contractor shall continuously maintain its work area by undertaking mowing, weed control, and solid waste management in a manner matching the maintenance level of the area properties. Failure to do so within three working days after direction from the Engineer may cause the Jurisdiction to do the work and the cost thereof deducted from the Contractor’s next payment.

2.09 LAND MONUMENTS

A. The Contractor will be required to preserve all center stones, land monuments, or other property marks the Contractor may find in prosecuting the work. The Contractor shall notify the Engineer of the finding of any land monuments and shall not remove or disturb same until permission is given to do so, at which time the Contractor shall properly remove said landmarks under the direction of the Engineer.

B. For every land monument lost or destroyed by the Contractor, the Contractor may be charged, and such amount shall be deducted from any monies due or may become due to the Contractor under the contract.

2.10 DUST CONTROL

During construction operations, the Contractor shall be responsible for the control of dust to a degree compatible with the area in which the construction is being performed and with existing environmental regulations. In the event the Contractor does not control dust as specified, the Jurisdiction reserves the right to order dust control to be performed by other forces and withhold the cost thereof from any monies due or may become due to the Contractor under the contract.

2.11 ENVIRONMENTAL AND HISTORIC ITEMS

If contaminated soils, historical artifacts, or other environmental or historic items are encountered, stop work and notify the Engineer.

2.12 RAILROAD CROSSINGS

The authority for performing work beneath, at grade, or over railroad tracks will have been previously secured by the Jurisdiction. It shall be the Contractor's responsibility to contact the railroad company officials prior to beginning the work on railroad property or easements. The Contractor shall perform the work without damage to the facilities and property of the railroad or its lessees, and in strict observance of requirements for the safety of the railroad property and operations. All such work will be subject to the inspection of the railroad's representative. The Contractor shall protect, indemnify, and hold the Jurisdiction harmless from any and all damages resulting from its operations on railroad property or easements or in the construction of railroad crossings according to Section 1070, Part 3 - Bonds and Insurance.

2.13 BORROW AND WASTE SITES

A. Unless borrow or waste sites are designated on the plans or specified in the special provisions, the Contractor shall secure and operate such sites at its own expense.

B. In all cases, borrow and waste sites shall be operated in such a manner as to meet Federal, State, and local safety, environmental, and health requirements. Site operations, or the result of such operation, that create a definite nuisance or result in damage to public or private property will not be permitted. In all cases, sites shall be approved by the Engineer before use.

2.14 MAINTAINING POSTAL SERVICE

A. It shall be the Contractor's responsibility to contact the U.S. Postal Service to ascertain its requirements for the maintenance of postal service to residents or businesses in the vicinity of the work site according to the instructions of the Postal Service. The Contractor shall be responsible for mailboxes at temporary locations designated by the Postal Service, and at the completion of the work, the Contractor shall replace all mailboxes in locations and conditions satisfactory to the Postal Service.

B. Not less than 24 hours prior to removing any mailbox, the Contractor shall notify each affected resident or business addressee in writing advising them of the move and the location of their temporary mailbox during construction.

C. For each residential or business address affected by the work, the Contractor shall place a temporary mailbox at a location approved by the Postal Service. Temporary mailboxes shall be in place so postal service is maintained at all times. Any permanent mailbox that must be removed shall be stored on the property from which it is removed and at a sufficient distance from the work area to ensure it will not be damaged by construction activities.

2.15 FINISHING AND CLEANUP REQUIREMENTS

From time to time, as may be ordered by the Engineer, and immediately after completion of the improvement, the Contractor shall, at its expense, cleanup and remove all refuse and unused materials of any kind resulting from the work. Upon failure to do so within three working days after such request by the Engineer, the work may be done by the Jurisdiction and the cost thereof charged to the Contractor and deducted from its final payment. Upon completion of the work, the Contractor shall remove all its equipment and put the area of the work in a neat and clean condition and do all other cleaning necessary to complete the work in a workmanlike manner satisfactory to the Engineer.

PART 3 - BONDS AND INSURANCE

3.01 PERFORMANCE, PAYMENT, AND MAINTENANCE BOND

A. The lowest responsive, responsible bidder shall be required to file, before the contract is awarded, a surety bond for performance, payment, and/or maintenance on a form provided by the Jurisdiction and in penal sum equal to the total bid amount. Said bond shall be executed by a corporation authorized to contract as a surety in the state of Iowa. Said bond shall be filed in the specified number of copies as a part of the executed contract documents for the Jurisdiction's approval and award.

B. Said bond shall provide that the Contractor shall well and satisfactorily perform and execute the work in all respects, according to the contract documents therefore, and according to the time and conditions of the contract documents, and also that the Contractor shall pay all debts incurred by it in the prosecution of such work, including those for labor and materials furnished. Said bond may also provide for the maintenance of the improvement for the number of years stipulated in the contract documents, and shall remain in full force for the entire maintenance period. Said bond shall in all cases comply with the laws of the State of Iowa and shall be subject to the approval of the Jurisdiction.

C. Within the time period specified in the maintenance portion of the bond, the Contractor shall, as and when ordered by the Engineer, repair, replace, or rebuild such portions of the work found to be faulty because of materials or workmanship. After being notified of the need for repairs, the Contractor shall submit, within seven calendar days, a written report stating its intentions and schedule for completing the repairs for approval by the Engineer. If the Contractor fails to submit such written report or to make the repairs as approved by the Engineer, the Jurisdiction shall have the right to make such repairs and to collect from the Contractor or its surety all outlay and expense the Jurisdiction incurs in making the repair, and in attempting to enforce the terms of the contract and the bond against the Contractor and its surety.

3.02 INSURANCE REQUIREMENTS

A. The Contractor shall purchase and maintain insurance to protect the Contractor and the Jurisdiction against all hazards herein enumerated throughout the duration of the contract. Said insurance shall be provided by an insurance company or companies, “admitted” or “non-admitted” to do business in the State of Iowa, having an A.M. Best rating of no less than “B+.”

B. "Insurance," "insurance policy," or "insurance contract" when used in these specifications shall have the same meaning as "insurance policy" and "insurance contract" under Iowa Code Section 507B.2. All insurance required by this section shall provide coverage on an occurrence basis, not on a claims-made basis, and the person or other entity shall provide evidence of such coverage through an "insurance policy," "contract of insurance," or "certificate of insurance" that clearly discloses on its face coverage on an occurrence basis. Insurance coverage required for hazardous materials abatement including removal of lead, asbestos, PCB's, or the like may be provided on a claims-made basis when it is demonstrated to the satisfaction of the Jurisdiction that occurrence coverage is not reasonably available.

C. Except for workers compensation insurance, the Contractor shall purchase and maintain such insurance as will protect the Contractor and the Jurisdiction as set forth below, which may arise out of or result from the Contractor’s operations under the contract, whether such operations be by the Contractor, its subcontractors or consultants, suppliers, third parties, or the agents, officers, or employees of any of them. In addition, the Contractor shall purchase and maintain workers compensation insurance to cover its employees.

3.02 INSURANCE REQUIREMENTS (Continued)

1. Workers Compensation: A standard Workers Compensation policy approved for use in the State of Iowa shall be issued with the following coverages.
   a. Statutory Benefits covering all employees injured on the job by accident or disease as prescribed by Iowa Code Chapter 85.
   b. Employers Liability insurance with the following limits:

Bodily injury by accident	$500,000 each accident
Bodily injury by disease	$500,000 each accident
Bodily injury by disease	$500,000 policy limit

2. Commercial General Liability Insurance: No less comprehensive and no more restrictive than the coverage provided by a standard form Commercial General Liability Policy (ISO CG 0001 or its equivalent) with all standard exclusions with minimum limits shown below covering claims for damages because of bodily injury, personal injury, or damage to property that occur on the premises under contract or arise out of the operations in performance of the contract. Any additional exclusions shall be identified on the Certificate of Insurance and shall be subject to the review and approval of the Jurisdiction.

General Aggregate Limit	$2,000,000
Products' Completed Operations Aggregate Limit	$2,000,000
Personal and Advertising Injury Limit	$1,000,000
Each Occurrence Limit	$1,000,000
Fire Damage Limit (any one fire)	$50,000
Medical Damage Limit (any one person)	$5,000

This insurance must include the following features:

a. Coverage for all premises and operations. The policy shall be endorsed to provide the Designated Construction Project(s) General Aggregate Limit Endorsement (ISO CG 2503 or its equivalent).
b. Personal and advertising injury.
c. Operations by independent contractors.
d. Contractual liability coverage. If work to be performed by Contractor includes construction or demolition operations within 50 feet of any railroad property and affecting any railroad bridge or trestle, tracks, roadbeds, tunnel, underpass, or crossing, then such policy will include a Railroad's Contractual Liability Endorsement (ISO CG 2417 or its equivalent).
e. Coverage for demolition of any building or structure, collapse, explosion, blasting, excavation, and damage to property below the surface of the ground (XCU coverage).
f. Any fellow employee exclusions shall be deleted as it applies to managerial and supervisory employees.
g. The policy shall not contain a total or absolute pollution exclusion. Coverage shall be provided for pollution exposures arising from products and completed operations.
h. Products and completed operations shall be maintained for the duration of the work; and shall be further maintained for a minimum period of time after final acceptance and payment if required in the Special Provisions.
i. Contractual liability coverage will also include contractually assumed defense costs in addition to policy limits.
j. In lieu of including the Jurisdiction as an additional insured on the Contractor's Commercial General Liability Insurance, the Jurisdiction, at its option, may require the Contractor to provide an Owner's Protective Liability Policy by Special Provision, or may allow the Contractor to provide an Owner's Protective Liability Policy by Change Order. If an Owner's Protective Liability Policy is provided, the minimum coverage, limits, and exclusions shall be as shown above; and the Contractor's premium cost of obtaining such insurance shall be considered incidental to the work and shall not be subject to reimbursement by the Jurisdiction.

3.02 INSURANCE REQUIREMENTS (Continued)

3. Automobile Liability Insurance: Covers all owned, non-owned, hired, and leased vehicles with a minimum combined single limit of $1,000,000 per accident covering claims for damages because of bodily injury, personal injury, or damage to property that arise out of operations in performance of the contract. The insurance must include contractual liability coverage. Any fellow employee exclusion shall be deleted. The policy shall provide Auto Cargo Pollution Endorsement (ISO CA 99 48 or its equivalent), if required in the special provisions.

4. Railroad Protective Liability: If required by the Jurisdiction by special provision, or by an affected railroad, the Contractor shall procure and maintain Railroad Protective Liability Insurance naming the railroad as the insured with minimum limit for bodily injury and property damage liability of $2,000,000 per occurrence, $6,000,000 aggregate, or with such other limits as the railroad shall require. The original of said policy shall be furnished to the railroad and a certified copy of said policy shall be furnished to the Jurisdiction prior to any construction or entry upon the railroad easement premises by the Contractor.

5. Umbrella/Excess Insurance: At the Contractor's option, the limits specified in Section 1070, 3.02, C, 1, 2, 3 may be satisfied with a combination of primary and Umbrella/Excess Insurance. At the Jurisdiction's option, the minimum insurance limits specified above may be increased by special provision. This increase may be satisfied with a combination of primary and Umbrella/Excess Insurance.

6. Additional Insured Endorsements: Except for Workers Compensation, the insurance specified shall:
   a. Include the Jurisdiction as an additional insured, per Section 1070, 3.06, B; and
   b. Be primary to and not in excess of or contributory with any other insurance available to the Jurisdiction.

7. Reference to ISO: Wherever the term "ISO" appears in these specifications, any subsequent equivalent ISO form or non-ISO equivalent form may be used.

3.03 CONTRACTOR'S INDEMNITY - CONTRACTUAL LIABILITY INSURANCE

A. To the extent covered by the standard insurance forms listed in Section 1070, 3.02, the insurance shall include contractual liability insurance to cover all indemnification and hold harmless agreements and provisions in the contract documents, including the following provision.

B. To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Jurisdiction and its officers, agents, employees, and consultants from and against all claims, damages, losses, and expenses, including but not limited to, attorney's fees, arising out of or resulting from the performance or prosecution of the work by the Contractor, its subcontractors, agents, or employees; or arising from any neglect, default, or mismanagement or omissions by the Contractor, its subcontractors or consultants, suppliers, third parties, or the agents, officers, or employees of any of them in the performance of any duties imposed by the contract or by law; provided any such claim, damage, loss, or expense:

1. is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including economic damages and the loss of use resulting therefrom, and

3.03 CONTRACTOR'S INDEMNITY - CONTRACTUAL LIABILITY INSURANCE (Continued)

2. is caused in whole or in part by any act or omission of the Contractor, its subcontractors or consultants, suppliers, third parties, or the agents, officers, or employees of any of them, or anyone for whose acts any of them may be liable, regardless whether or not it is caused in part by a party indemnified hereunder.

   Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity that would otherwise exist as to any party or person described in this subsection.

C. In any and all claims against the Jurisdiction or the Engineer or any of their agents, officers, employees, or consultants by any employee of the Contractor, its subcontractors or consultants, suppliers, third parties, or the agents, officers, or employees of any of them, or anyone for whose acts any of them may be liable, the indemnification obligation under this subsection shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the Contractor or any subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

D. The obligations of the Contractor under this subsection shall not extend to the liability of the Engineer, the Engineer's agents, employees, or consultants, arising out of:

1. the preparation or approval of maps, drawings, opinions, reports, surveys, change orders, design standards, or specifications; or

2. the giving of or the failure to give directions or instructions by the Engineer, the Engineer's agents, employees, or consultants.

provided the preparation or the giving or failure to give directions or instructions is the sole proximate cause of the injury or damage.

E. If any litigation on account of such claims shall be commenced against the Jurisdiction, the Contractor, upon notice thereof from the Jurisdiction, shall defend the same at its sole cost and expense; and the record of any judgment rendered against the Jurisdiction on account of such claims for damages shall be conclusive as against said Contractor and entitle the Jurisdiction to recover the full amount thereof, with interest and cost, and attorney's fees incurred by said Jurisdiction, whether the Jurisdiction paid such amounts or not.

3.04 CONTRACTOR'S INSURANCE FOR OTHER LOSSES; WAIVER OF SUBROGATION

A. The Contractor shall assume full responsibility for all loss or damage from any cause whatsoever to any tools owned by the mechanics; or any tools, machinery, equipment, or motor vehicles owned or rented by the Contractor, its subcontractors or consultants, suppliers, third parties, or the agents, officers, or employees of any of them; or to any shed or other temporary structures, scaffolding and stagings, protective fences, and bridges belonging to the contractor, its subcontractors or consultants, suppliers, third parties, or the agents, officers, or employees of any of them, not covered by the Jurisdiction’s Builders Risk Insurance.

B. Contractor shall cause each of its subcontractors, consultants, suppliers, third parties, or the agents of any of them, to carry insurance sufficient to cover all loss to such materials, tools, motor vehicles, and equipment. All insurance carried by the Contractor, or its subcontractors, consultants, suppliers, third parties or the agents of any of them, covering risk of loss or damage to materials, tools, motor vehicles, and equipment used in the performance of the Work, shall provide a waiver of subrogation against the Jurisdiction. To the extent that any subcontractors, consultants, suppliers, third parties or the agents of any of them, do not provide such coverages, any uninsured loss shall be the sole responsibility of the Contractor.

3.05 PROPERTY INSURANCE

A. When stated in the special provisions, the Jurisdiction shall purchase and maintain property insurance, a.k.a. Builder's Risk Insurance, in the amount of the initial bid amount, or in an amount equal to the estimated value of actual building construction, whichever is less, as well as applicable modifications thereto for the entire work at the site on a replacement cost basis. Such property insurance shall be maintained, unless otherwise provided in the contract documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final acceptance of the work by the Jurisdiction. The insurance shall include interests of the Jurisdiction, the Contractor, subcontractors, and sub-subcontractors in the work. This property insurance covering the work will have a deductible of $5,000 for each occurrence, or as stated in the special provisions, which will be the responsibility of the Contractor.

B. Property insurance shall be on an all-risk policy form and shall insure against the perils of fire and extended coverage and physical loss or damage including, without duplication of coverage, flood and earthquake, theft, vandalism, malicious mischief, collapse, falsework, temporary buildings and debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for the Jurisdiction's services and expenses required as a result of such insured loss. Coverage for other perils shall not be required unless otherwise provided in the contract documents.

C. Unless otherwise provided in the contract documents, this property insurance shall cover portions of the work stored off the site, after written approval of the Jurisdiction, at the value established in the approval, and portions of the work in transit. Coverage for work stored off the site and in transit will be not less than 10% of the policy amount.

D. Boiler and Machinery Insurance: The Jurisdiction, at the Jurisdiction's option, may purchase and maintain Boiler and Machinery Insurance required by the contract documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Jurisdiction; this insurance shall include interest of the Jurisdiction, Contractor, subcontractors, and sub-subcontractors in the work, and the Jurisdiction and Contractor shall be named insureds.

E. Loss of Use Insurance: The Jurisdiction, at the Jurisdiction's option, may purchase and maintain insurance to insure the Jurisdiction against loss of use of the Jurisdiction's property due to fire or other hazards, however caused. In the event the Jurisdiction purchases such insurance, the Jurisdiction shall waive all rights of action against the Contractor for loss of use of the Jurisdiction's property, including consequential losses due to fire or other hazards, however caused.

F. If the Contractor requests in writing that insurance for risks other than those described herein or for other special hazards be included in the property insurance policy, the Jurisdiction shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate change order.

G. If during the project construction period, the Jurisdiction insures properties, real or personal or both, adjoining or adjacent to the site by property insurance under policies separate from those insuring the project or if after final acceptance, property insurance is to be provided on the completed project through a policy or policies other than those insuring the project during the construction period, the Jurisdiction shall waive all rights according to the terms of Section 1070, 3.05, I, for damages caused by fire or other perils covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

3.05 PROPERTY INSURANCE (Continued)

H. Before an exposure to loss may occur, the Jurisdiction shall file with the Contractor a copy of each policy that includes insurance coverages required by this section. Each policy shall contain all generally applicable conditions, definitions, exclusions, and endorsements related to this project. Each policy shall contain a provision that the policy will not be cancelled or allowed to expire until at least 30 calendar days prior written notice has been given to the Contractor.

I. Waivers of Subrogation: The Jurisdiction and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other, and (2) the Jurisdiction's consultants, separate contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this section or other property insurance applicable to the work, except such rights as they have to proceeds of such insurance held by the Jurisdiction as fiduciary. The Jurisdiction or Contractor, as appropriate, shall require of the Jurisdiction's consultants, separate contractors, if any, and the subcontractors, sub-subcontractors, agents, and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

J. A loss insured under the Jurisdiction's property insurance shall be adjusted by the Jurisdiction as fiduciary and made payable to the Jurisdiction as fiduciary for the insureds, as their interest may appear, subject to requirements of any applicable mortgagee clause and of Section 1070, 3.05, K. The Contractor shall pay subcontractors their shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require subcontractors to make payments to their sub-subcontractors in a similar manner.

K. The Jurisdiction as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five calendar days after occurrence of loss to the Jurisdiction's exercise of this power; if such objection be made, arbitrators shall be chosen according to Section 1040, 1.10, D, provided one arbitrator shall be appointed by the Jurisdiction, one by the party in interest making objection, and the third to be appointed by the two arbitrators thus chosen. Arbitration shall thereafter proceed as provided in Section 1040, 1.10, E through G. The Jurisdiction as fiduciary shall, in that case, make settlement with insurers according to the direction of such arbitrators. If distribution of insurance proceeds by arbitration is required, the arbitrators will direct such distribution.

L. Partial occupancy or use of the work shall not commence until the insurance company or companies provided property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Jurisdiction and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance.

M. Installation Floater: Under contracts where the Jurisdiction does not provide Builders Risk Insurance, the Jurisdiction may by special provision require the Contractor to provide coverage under an “Installation Floater” covering all materials, fixtures, equipment, and supplies provided for the job. Such insurance shall be on an “*all risk*” form in an amount equal to the maximum value of such materials, equipment, or supplies covered on the job site, off-premises at any temporary storage location, or in transit. The Installation Floater covering the equipment shall have a maximum deductible no greater than $5,000 for each occurrence, which will be the responsibility of the Contractor.

3.06 ENDORSEMENT NAMING JURISDICTION AS AN ADDITIONAL INSURED / CANCELLATION AND MATERIAL CHANGE / GOVERNMENTAL IMMUNITIES ENDORSEMENT

A. All liability insurance policies the Contractor is required to provide pursuant to this Section 1070, Part 3 - Bonds and Insurance shall be by endorsement name and designate the Jurisdiction as an additional insured.

B. The Additional Insured Endorsement shall include the following provisions:

The Jurisdiction, including all its elected and appointed officials, all its employees and volunteers, all its boards, commissions and/or authorities and their board members, employees, and volunteers, and all its officers, agents, and consultants, are named as Additional Insureds with respect to liability arising out of the Contractor's work and services performed for the Jurisdiction. This coverage shall be primary to the Additional Insureds, and not contributing with any other insurance or similar protection available to the Additional Insureds, whether other available coverage by primary, contributing, or excess.

The Additional Insured Endorsement shall be included on all Commercial General Liability, Automobile Liability, and Umbrella/Excess Insurance policies.

C. The Cancellation and Material Change Endorsement shall include the following provisions:

Thirty calendar days advance written Notice of Cancellation, Non-Renewal or Reduction in Insurance coverage and/or Limits, and 10 calendar days written Notice of Non-payment of Premium, shall be sent to the Jurisdiction at the office and attention of the Certificate Holder. This endorsement supersedes the standard cancellation statement on the Certificate of Insurance to which this endorsement is attached.

This Cancellation and Material Change Endorsement shall be included on insurance policies required by the SUDAS Standard Specifications.

D. All liability policies that include the Jurisdiction as an additional insured shall include a Governmental Immunities Endorsement, pursuant to Iowa Code Section 670.4, which endorsement shall include the following provisions:

1. Nonwaiver of Government Immunity: The insurance carrier expressly agrees and states the purchase of this policy and including the Jurisdiction as an Additional Insured does not waive any of the defenses of governmental immunity available to the Jurisdiction under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

2. Claims Coverage: The insurance carrier further agrees this policy of insurance shall cover only those claims not subject to the defense of governmental immunity under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

3. Assertion of Government Immunity: The Jurisdiction shall be responsible for asserting any defense of governmental immunity, and may do so at any time and shall do so upon the timely written request of the insurance carrier. Nothing contained in this endorsement shall prevent the carrier from asserting the defense of governmental immunity on behalf of the Jurisdiction.

4. Non-Denial of Coverage: The insurance carrier shall not deny coverage or deny any of the rights and benefits accruing to the Jurisdiction under this policy for reasons of governmental immunity unless and until a court of competent jurisdiction has ruled in favor of the defense(s) of governmental immunity asserted by the Jurisdiction.

3.06 ENDORSEMENT NAMING JURISDICTION AS AN ADDITIONAL INSURED / CANCELLATION AND MATERIAL CHANGE / GOVERNMENTAL IMMUNITIES ENDORSEMENT (Continued)

5. No Other Change in Policy: The insurance carrier and the Jurisdiction agree the above preservation of governmental immunities shall not otherwise change or alter the coverage available under the policy.

This Government Immunities Endorsement shall be included on all insurance policies that include the Jurisdiction as Additional Insured.

E. All liability policies purchased in the Jurisdiction's name shall include a Governmental Immunities Endorsement, pursuant to Iowa Code Section 670.4, which endorsement shall include the following provisions:

1. Nonwaiver of Government Immunity: The insurance carrier expressly agrees and states the purchase of this policy does not waive any of the defenses of governmental immunity available to the Jurisdiction under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

2. Claims Coverage: The insurance carrier further agrees this policy of insurance shall cover only those claims not subject to the defense of governmental immunity under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.

3. Assertion of Government Immunity: The Jurisdiction shall be responsible for asserting any defense of governmental immunity, and may do so at any time and shall do so upon the timely written request of the insurance carrier. Nothing contained in this endorsement shall prevent the carrier from asserting the defense of governmental immunity on behalf of the Jurisdiction.

4. Non-Denial of Coverage: The insurance carrier shall not deny coverage or deny any of the rights and benefits accruing to the Jurisdiction under this policy for reasons of governmental immunity unless and until a court of competent jurisdiction has ruled in favor of the defense(s) of governmental immunity asserted by the Jurisdiction.

5. No Other Change in Policy: The insurance carrier and the Jurisdiction agrees that the above preservation of governmental immunities shall not otherwise change or alter the coverage available under this policy.

This Government Immunities Endorsement shall be included in all Insurance Policies in the Jurisdiction's name.

3.07 PROOF OF INSURANCE

A. The Contractor shall, prior to the Jurisdiction's approval and execution of the Contract, provide to the Jurisdiction a certificate or certificates of insurance evidencing all required insurance coverages as required in this Section 1070, Part 3 – Bonds and Insurance, utilizing the ACORD certificate form, or equivalent, required by the Jurisdiction. The Certificate of Insurance requirement may be satisfied with a blanket certificate.

B. The Description of Operations on the Certificate of Insurance for the work must state either: 1) Blanket certificate of coverage of all work, services, or projects with the Jurisdiction, or 2) Identify the specific project by name and project number. The Contract will not be submitted for approval execution by the Jurisdiction until all certificates of insurance are correct and have received staff approval.

C. The Cancellation statement on the Certificate of Insurance shall be superseded by the Cancellation and Material Changes Endorsement, which shall be attached to the certificate.

3.07 PROOF OF INSURANCE (Continued)

D. All endorsements required for the work shall be attached to the appropriate Certificate or Certificates of Insurance and shall be, on the face thereof, listed by name.

E. If an Owner's Protective Policy is provided, the policy with appropriate endorsements shall be submitted to the Jurisdiction. The Contract will not be submitted for approval and execution by the Jurisdiction until the Owner's Protective Policy and all certificates of insurance are correct and have received staff approval.

3.08 NOTIFICATION IN EVENT OF LIABILITY OR DAMAGE

A. Upon the occurrence of any event, the liability for which is herein assumed by the Contractor, the Contractor agrees to forthwith notify the Jurisdiction in writing of such happening, which notice shall give the details as to the happening, the cause as far as can be ascertained, the estimate of loss or damage done, the names of witnesses, if any, and stating the amount of any claim.

B. In the event the Jurisdiction has or obtains actual knowledge of any event that may result in a claim, the liability for which is herein assumed by the Contractor, the Jurisdiction agrees to notify the Contractor of such event within a reasonable period of time after acquiring knowledge thereof; provided however, the Jurisdiction shall have no duty to inspect the project to obtain knowledge of such events; and provided further the Jurisdiction's failure to so notify the Contractor shall not relieve the Contractor of any liability or obligation herein assumed by the Contractor.

3.09 SAMPLE INSURANCE FORMS

See the SUDAS website (www.iowasudas.org) for examples of standard insurance forms.

END OF SECTION

PROSECUTION AND PROGRESS

1.01 SUBLETTING OR ASSIGNMENT OF CONTRACT

A. Work by Contractor:

1. The Contractor shall perform, with its own organization and forces, work amounting to no less than 30% of the total contract cost, except any items designated in the contract documents as "specialty items" may be performed by subcontract, and the cost of any such "specialty items" may be deducted from the total contract cost before computing the amount of work required to be performed by the Contractor with its own organization. Any items that have been selected as "specialty items" for the contract will be listed as such in the contract documents.

2. In order to meet this 30% requirement, the Contractor shall not purchase any materials for a subcontracted item, nor shall it place other contractor's employees on its payroll.

3. The Contractor shall not assign this Contract to another person, firm, or corporation without the prior consent of the Jurisdiction. The Jurisdiction may refuse to approve a proposed assignment of contract if such assignment would not be in the best interests of the Jurisdiction, or if such assignment would be contrary to law or public policy. An assignment of contract and all subcontracts shall be in writing.

B. Permission to Sublet:

1. The Contractor shall not sublet, assign, or otherwise dispose of any portion of the contract, except for the furnishing and transportation of materials, without a written "permission to sublet" order duly approved by the Jurisdiction.

2. Requests for permission to sublet, assign, or otherwise dispose of any portion of the contract shall be in writing and shall provide the name, address, telephone number, and representative of the organization that will perform the work, a description of the work is to be sublet, and the associated cost. When requested by the Engineer, the Contractor shall provide a written report showing the organization that will perform the work is particularly experienced and equipped for such work.

3. Consent to sublet, assign, or otherwise dispose of any portion of the contract shall not be construed to relieve the Contractor of any responsibility for the fulfillment of the contract or in any way create any contractual relationship between the subcontractor and the Jurisdiction.

C. Subcontracts:

1. Upon request of the Engineer, the Contractor shall submit a copy of each subcontract agreement within 10 calendar days.

2. The Contractor shall be responsible to include all conditions and requirements of the contract documents in all its subcontracts and enforce said requirements with its subcontractors.

1.02 CONTRACT TIME

A. When a completion date is specified in the contract documents, the contract time shall be the time from the starting date stated in the Notice to Proceed to the date specified for completion as shown in the contract, both dates inclusive. When working days or calendar days are specified in the contract documents, the contract time shall be the time as calculated with the number of working days or calendar days as specified in the contract and the starting date in the Notice to Proceed. The contract time may be extended by the Jurisdiction as provided in these specifications, in which event the contract time includes the new extension of time. The Contractor acknowledges that if it fails to complete the contract in said time, liquidated damages will be assessed against it as specified in Section 1080, 1.12 - Liquidated Damages.

1. Completion Date Contracts: The Contractor shall complete the contract on or before the completion date. Unless otherwise noted in the proposal form, the Contractor may commence work any time after receipt of the signed contract, specifications permitting and issuance of the Notice to Proceed. Section 1080, 1.06 will not apply. Liquidated damages will be assessed according to Section 1080, 1.12 for each calendar day beyond the completion date that the contract remains uncompleted.

2. Calendar Day Contracts: The Contractor shall complete the contract within the number of consecutive calendar days specified. The calendar day count will commence on the date specified by the Notice to Proceed. Section 1080, 1.06 will not apply. Liquidated damages will be assessed according to Section 1080, 1.12 for each calendar day beyond the specified number of calendar days that the contract remains uncompleted.

3. Working Day Contracts: The three types of start dates are as follows:

   a. Specified Start Date: Working days will be charged to the Contractor starting on the specified start date, the date noted in the Notice to Proceed, or 14 calendar days after execution of the contract, whichever is later. Starting work prior to the specified start date will be considered upon request, and working days will be charged when work starts.

   b. Approximate Start Date: It is expected the site will be available by the approximate start date. If it appears the site will not be available by the approximate start date, the Engineer will inform the Contractor of the delay and if possible the duration of the delay. The Contractor may commence work, weather and specifications permitting, any time after execution of the contract, after receipt of the Notice to Proceed, and on or after the approximate start date provided the site has become available. If work is started under these conditions, working days will be charged. Starting work before the approximate start date and before the site is available, will be considered only after the Contractor has submitted a signed waiver of any right to claim extra compensation for damages due to delays from any cause related to early commencement. If approved, working days will not be charged when working prior to the date of site availability. If the Contractor is working on the project when the site becomes available, working days will be first charged on the following day.

   c. Late Start Date: Unless otherwise noted in the proposal form, the Contractor may commence work any time after receipt of the signed contract, receipt of the Notice to Proceed, and weather and specifications permitting. Working days will begin to be charged whenever the Contractor starts work. Charging of working days will begin on the late start date if the Contractor has not started work prior to this date.

      If the Contractor wishes to start preliminary work prior to the late start date and move out intending to return at a later date to complete the project, the Contractor shall request approval from the Engineer for temporary suspension of work according to Section 1080, 1.08. Approval of suspension of work in this circumstance will be based on if the project area is in a condition that is at least as safe as it was before the start of the work. The Engineer will submit in writing to the Contractor approval for suspension of work and a computed revised late start date. The revised late start date will be computed by adding the working days used for the preliminary work to the late start date listed on the proposal form. The charging of the remainder of the working days will resume on the revised late start date or when the Contractor recommences work if prior to the revised late start date.

1.02 CONTRACT TIME (Continued)

B. Intermediate contract periods may be designated for completion of a specific item or certain portions of the contract. The contract period and the liquidated damages, if any, for each portion will be listed in the contract documents.

1.03 WORK PROGRESS AND SCHEDULE

A. The progress of the work shall be at a rate sufficient to complete the contract within the time allowed. The Contractor's sequence of operations shall be such as to cause as little inconvenience to the general public as possible.

B. After being awarded the contract, and if requested by the Engineer, the Contractor shall immediately prepare and submit to the Engineer for approval a progress schedule that will ensure the completion of the project within the time specified. Adequate equipment and forces shall be made available by the Contractor to start work immediately upon Notice to Proceed by the Engineer and to prosecute the work to completion according to schedule and within the time specified.

C. If it appears the rate of progress is such that the contract will not be completed within the time allowed, or if the work is not being executed in a satisfactory and workmanlike manner, the Engineer may order the Contractor to take such steps as necessary to complete the contract within the period of time specified or to prosecute the work in a satisfactory manner. If the Contractor fails to comply with such order within two weeks after receipt of the order, the Jurisdiction will have the right to declare the contract in default.

1.04 PRECONSTRUCTION CONFERENCE

The Engineer may schedule and conduct a preconstruction conference. The Contractor and the intended subcontractors, if known, shall participate in this conference. The Engineer will invite representatives of railroads and utilities and others having responsibilities or interest in the work.

1.05 NOTICE TO PROCEED

A. The return of the signed and executed contract to the Contractor shall serve as notice the contract bond is acceptable, the contract is in force, and the Contractor may complete arrangements for materials and other work according to the contract documents.

B. The Contractor shall begin work as specified in the Notice to Proceed issued by the Engineer and shall prosecute the work vigorously and continuously to completion, except when it is physically impossible to do so due to weather conditions or other unavoidable handicaps. The necessity of discontinuing and resuming work on any portion of the contract shall be determined by the Engineer.

C. The Jurisdiction may, if provided for in the contract documents, give a limited Notice to Proceed as to any portion of the work under the contract.

1.06 WEEKLY RECORD OF WORKING DAYS

A. On contracts with completion provisions based upon working days, the Engineer will furnish the Contractor a weekly statement showing the number of working days charged to the Contractor for the preceding week, the number of working days specified for completion of the project, the number of working days remaining to complete the contract, and the revised date for completion.

1.06 WEEKLY RECORD OF WORKING DAYS (Continued)

B. Working days will be charged under the following circumstances:

1. Prior to Commencement of Work: Beginning on the date designated in the Notice to Proceed, or beginning on the specified starting date or as soon thereafter as provided in the specifications, a working day will be charged for every calendar day other than Saturday, Sunday, or a recognized legal holiday. Working days will be charged for Saturdays if a mandatory six-day work week is specified in the contract documents.

2. After Commencement of Work: One full working day will be charged for any weekday, exclusive of Saturdays, Sundays, or a recognized legal holiday, when weather or other conditions (not under control of the Contractor) will permit construction operations to proceed for not less than 3/4 of a normal workday in the performance of a controlling item of work as determined by the Engineer. If such conditions allow operations to proceed for at least 1/2 but less than 3/4 of the normal working hours, one-half working day will be charged.

   Working days will not be charged for Saturdays (unless a mandatory six-day work week is specified in the contract documents), Sundays, and recognized legal holidays the Contractor does not work. As an incentive to the Contractor to expedite the work, working days will not be charged for Saturdays the Contractor does work, unless a mandatory six-day work week is specified. Working days will be charged for Sundays and recognized legal holidays if the contractor does work on the controlling item or work requiring inspection.

   When cure time of pavements and structural concrete is the controlling item of work, working days will be charged; this will not include Saturdays, Sundays, and recognized legal holidays according to the paragraph above.

   Upon written notice to the Contractor, the Engineer may suspend charging of working days on substantially completed contracts for up to 30 calendar days when only cleanup of the project site or minor work items remain. If the designated time has expired and the remaining work items and site cleanup remain uncompleted, the Engineer may restart charging of working days effective at the end of the designated period by providing written notice to the Contractor.

C. Any objection by the Contractor to such weekly determinations shall be deemed waived and shall not thereafter be made the basis of any claim, unless the Contractor shall, within seven calendar days after receipt of a weekly statement, file with the Engineer its written protest setting forth its objections and reasons. If the Contractor's objection to the working day count is made on the grounds it was unable to work due to causes beyond its control, the Contractor shall state its reasons in writing, furnish proof to establish its claim, and state the approximate number of calendar days it estimates it was delayed. The Engineer shall then determine the appropriate number of working days to be charged under the contract.

1.07 WORK ON SUNDAYS OR LEGAL HOLIDAYS

A. Except when an accelerated work schedule is required in the contract documents, no work requiring inspection will be allowed on Sundays or holidays observed by the Jurisdiction except with permission of the Engineer. The Contractor should request a determination of the holidays observed by the Jurisdiction.

B. Such work as may be required to properly maintain or protect completed or partially completed construction, or to maintain lights and barricades, will be permitted on Sundays or holidays without specific permission of the Engineer.

1.08 TEMPORARY SUSPENSION OF WORKING DAYS

When, in the judgment of the Engineer, unfavorable weather makes it impractical to secure acceptable results or other conditions warrant an order to suspend working days, the Engineer shall issue to the Contractor a written order to suspend working days wholly or on any part of the contract. When conditions are again favorable for prosecution of the working days, the Engineer shall issue to the Contractor a written order to resume the suspended working days. Orders to suspend working days will not be written for short intermittent shutdowns due to weather conditions. The Contractor shall take every precaution to prevent any damage or unreasonable deterioration of the work during the time of suspended operations.

1.09 EXTENSION OF TIME

A. Allowances for Delays: The Contractor expressly covenants and agrees that in undertaking to complete the work within the contract time, it has taken into consideration and made allowance for all delays and hindrances that would ordinarily be anticipated in performing such work.

B. Request for Extension of Time: Whenever the Contractor becomes aware of its inability to complete the work under the contract within the contract period, it shall request an extension in writing. Such request shall be submitted to the Engineer at least two weeks prior to the expiration of the contract time to allow for the Jurisdiction's action before termination. The submission or acceptance of a request for extension of time shall not guarantee such extension will be granted. The following items may be justification for extension of time:

1. **Weather:** Extension of time due to adverse weather conditions at the site, so unusual or severe as not to be reasonably anticipated, as determined by the Engineer, may be requested. An average or usual number of inclement working days when work cannot proceed are to be anticipated during the construction period and are not to be considered as warranting extension of time.

2. **Other Contractors:** An extension of time may be requested for delays caused by the noncompletion of essential work of other contractors, provided such noncompletion is the sole and only cause of delay, and where the Contractor has available on the site of the work all equipment, material, and labor necessary to proceed with the work.

3. **Change Orders:** An extension of time may be requested for delays caused by the issuance of a change order, where the work occasioned by the change order is the sole and only cause of the impossibility to complete the work within the specified time.

4. **Work Stoppage:** An extension of time may be requested for delays caused by a general work stoppage in the area or a work stoppage affecting this project that is beyond the control of the Contractor, or where the Contractor has taken in good faith all steps made available to it by law to resolve the causes thereof and to terminate such work stoppage.

5. **Acts by U.S. Government:** An extension of time may be requested for delays caused by any act taken by the United States government that would affect fabrication or delivery of materials or equipment to the work site.

6. **Court Proceedings:** An extension of time may be requested for delays caused by any court proceedings.

7. **Other Delays:** An extension of time may be requested for other delays encountered by the Contractor beyond its control and impossible for the Contractor to complete the contract within the specified time.

1.09 EXTENSION OF TIME (Continued)

C. Claims for Damages: The Contractor shall have no claim for damages for any extensions or delays provided or mentioned in the preceding portions of this section; but the Contractor shall, in such cases, be allowed to petition for such extension of time as the Jurisdiction may grant in writing on account of such delay, provided, however, the claim for such extension of time is made by the Contractor in writing to the Jurisdiction immediately after any such delay occurs.

D. Extension of Time Granted: No extension of time shall be granted or recognized except as specifically approved by the Jurisdiction in writing to the Contractor. Oral representations or agreements by Jurisdiction agents or employees regarding time extension shall not be binding on the Jurisdiction.

1.10 CONTRACTOR'S EMPLOYEES, METHODS, AND EQUIPMENT

A. Superintendent:

1. All work under the contract shall be performed under the continuous supervision of competent personnel, thoroughly experienced in the class of work specified.

2. Prior to beginning work, the Contractor shall give the Engineer, in writing, the name of the Contractor's official representative or superintendent for the project. The superintendent shall be capable of providing adequate supervision of the project and shall be responsible for receiving instructions, notices, and written orders from the Engineer. A change of the superintendent shall be reported to the Engineer in writing. Failure to provide adequate supervision of the project shall be grounds for the Engineer to require a change in supervision before allowing the work to proceed. The superintendent shall be responsible for reporting to the Engineer any inconsistencies, omissions, or lack of definite detail in the plans, special provisions, or contract documents that may be discovered.

3. The lack of proper supervision by the Contractor or by its supervisory personnel shall be just cause for termination of the contract.

B. Workers:

1. The Contractor shall employ competent and efficient workers for every kind of work. The Jurisdiction reserves the right to direct the suspension or discharge from the work any worker, employee, agent, overseer, foreman, or superintendent in the employ of the Contractor, who, in the opinion of the Engineer, shall be incompetent, negligent, unfaithful, insubordinate, or disorderly, and any such person shall immediately be suspended or discharged by the Contractor whenever so directed by the Engineer.

2. The Contractor shall not employ or hire any of the employees of the Jurisdiction without permission of the Engineer.

C. Methods and Equipment:

1. The methods and equipment used by the Contractor shall produce a satisfactory quality of work and shall be adequate to maintain the schedule of progress specified. Equipment used on any portion of the project shall be such, and its use so regulated, that no serious or irreparable damage to the roadway, adjacent property, or other streets or highways will result from its use. If damage does occur to the street or highway, suitable repairs shall be made at the Contractor's expense.

1.10 CONTRACTOR'S EMPLOYEES, METHODS, AND EQUIPMENT (Continued)

2. When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed in the contract documents, the Contractor is free to use any methods or equipment that will accomplish the contract work in conformity with the requirements of the contract documents, as demonstrated to the satisfaction of the Engineer.

3. When the contract documents specify that the construction be performed by use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer.

4. If the Contractor desires to use a method or type of equipment other than specified in the contract documents, the Contractor may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the method and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor shall be fully responsible for producing construction work in conformity with contract requirements.

5. If after trial use of the substituted methods or equipment, the Engineer determines the work produced does not meet the requirements of the contract documents, the Contractor shall discontinue use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the defective work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved, or in contract time, as a result of authorizing a change in methods or equipment under these provisions.

1.11 CONTRACTOR'S EQUIPMENT IDENTIFICATION

All vehicles and major construction equipment utilized on Jurisdiction's projects, with the exception of vehicles used for personal purposes and rented equipment bearing the name, address, and telephone number of the rental company, shall exhibit the Contractor's name in at least two locations on each piece of equipment. This identification can be either a decal or painted lettering of a type and size, and with a contrasting color, rendering it legible from a distance of no less than 50 feet.

1.12 LIQUIDATED DAMAGES

A. Time is of the essence of the contract. As delay in the diligent prosecution of the work may inconvenience the public, obstruct traffic, interfere with business, and/or increase costs to the Jurisdiction such as engineering, administration, and inspection, it is important the work be prosecuted vigorously to completion. Should the Contractor, or in case of default the surety, fail to complete the work within the contract time plus such extensions of time as may be allowed by the Jurisdiction, a deduction at the liquidated damages rate specified in the contract will be made for each and every calendar day or working day, whichever is specified, that such contract remains uncompleted after expiration of the contract time. In either event, the Contractor or the Contractor's surety shall be responsible for all costs incident to the completion of the work, and shall be required to pay to the Jurisdiction the liquidated damages stipulated in the proposal form.

B. The liquidated damages rate specified in the contract documents is hereby agreed upon as the true and actual damages due the Jurisdiction for loss to the Jurisdiction and to the public due to obstruction of traffic, interference with business, and/or increased costs to the Jurisdiction such as engineering, administration, and inspection after the expiration of the contract time, or extension thereof. Such liquidated damages may be deducted from any money due or to become due the Contractor under the contract, and the Contractor and its surety shall be liable for any liquidated damages in excess of the amount due the Contractor.

1.12 LIQUIDATED DAMAGES (Continued)

C. Allowing the Contractor to continue and finish the work, or any part of it, after the expiration of the contract time or extension thereof shall in no way operate as a waiver on the part of the Jurisdiction of any of its rights or remedies under the contract, including its right to liquidated damages pursuant to this provision.

1.13 BREACH OF CONTRACT

A. The Contractor's failure to perform in any of the following particulars shall constitute a breach of contract:

1. Failure by the Contractor to begin work at the time specified;

2. Failure by the Contractor to complete the work within the contract period or any extension thereof;

3. Failure or refusal by the Contractor to comply with an order of the Engineer within a reasonable time;

4. Contractor's persistent disregard of laws, ordinances, or instructions of the Engineer;

5. Contractor's repeated failure to provide sufficient workers, equipment, or materials to ensure the proper and timely completion of the work;

6. Failure or refusal by the Contractor to remove rejected materials;

7. Failure or refusal by the Contractor to replace, perform anew, or correct any defective or unacceptable work;

8. Contractor's discontinuance of the work without authorization by the Jurisdiction;

9. Bankruptcy or insolvency of the Contractor, or the making of an assignment for the benefit of creditors by the Contractor; or

10. Failure by the Contractor to carry on the work in an acceptable manner.

Upon Contractor's breach of the contract in any particular above, the Jurisdiction shall be entitled to give notice of default to the Contractor. The notice of default shall indicate how the contract has been breached and shall indicate what action the Contractor must take to cure such breach.

B. If the Contractor or its surety does not, within the time for cure provided in the notice of default, take action to cure such breach, the Contractor shall, at the direction of the Engineer, relinquish possession and control of the work, and the Jurisdiction shall thereupon have full power and authority, without violating the contract or bond, to take over the completion of the work, to appropriate or use any or all materials and equipment at the site that may be suitable and acceptable, to enter into agreements with others for the completion of said contract according to the terms and provisions thereof, or to use such other methods as in the Jurisdiction's opinion may be required for the completion of said contract in an acceptable manner.

1.13 BREACH OF CONTRACT (Continued)

C. The Contractor and its surety shall be liable for all outlay and expense incurred by the Jurisdiction, together with the costs of completing the work, and such costs may be deducted from any monies due or which may become due to the Contractor. In case the outlay and expense incurred by the Jurisdiction in completing the work is less than the sum that would have been payable under the contract if it had been completed by the Contractor, then the Contractor will be entitled to receive the difference. In case such outlay and expense exceeds the sum that would have been payable under the contract, then the Contractor and its surety shall be liable for and shall pay to the Jurisdiction the amount of said excess.

D. Neither the Jurisdiction, nor any officer, agent, or employee thereof, shall be in any way liable or accountable to the Contractor or the Contractor's surety for the method by which the completion of said work, or any portion thereof, may be accomplished, or for the price paid therefore. Neither by taking over the work nor by declaring the contract in default shall the Jurisdiction forfeit the right to recover damages from the Contractor or the Contractor's surety for failure to complete the entire contract.

E. The Contractor shall be liable for the Jurisdiction’s attorney fees incurred as a result of the Contractor’s breach of contract.

1.14 TERMINATION OF CONTRACTOR'S RESPONSIBILITY

The contract will be considered completed when the work has been accepted in writing by the Jurisdiction as provided in Section 1090, 1.08 - Acceptance and Final Payment hereof. Such final acceptance shall release the Contractor from all further obligation with respect thereto, except as to conditions and requirements as set forth in the bond and Jurisdiction's specifications regarding insurance.

END OF SECTION

MEASUREMENT AND PAYMENT

1.01 MEASUREMENT

The determination of quantities of work performed under the contract will be made by the Engineer, based upon the lines and grades as shown on the plans and as given during the progress of the work or as evidenced by approved tickets for weight or liquid measure or by measurements made by the Engineer. All items will be computed in the units shown in the contract.

1.02 SCOPE OF PAYMENT

A. The Contractor shall receive and accept the compensation provided in the contract at unit prices, if it be a unit price contract; or at the lump sum price, if it be a lump sum price contract, except as may be modified by change orders. The compensation provided for in the contract shall constitute full payment for furnishing all labor, equipment, tools, and materials and for performing all work contemplated and embraced under the contract; for all loss or damage arising out of the nature of the work or from the action of the elements; for all expenses incurred by, or in consequence of, the suspension or discontinuance of the said prosecution of the work or from any unforeseen difficulties or obstructions that may arise or be encountered during the prosecution of the work; and for all risks of every description connected with the prosecution of the work until the final acceptance of the work by the Jurisdiction.

B. Neither the payment of any progress payment nor of any retained percentage shall relieve the Contractor of any obligation to make good any defective work or material. Payment will be made only for materials actually incorporated in the work, except as provided in Section 1090, 1.05 - Progress Payments.

C. The contract price for any item shall be full compensation for all labor, materials, supplies, equipment, tools, and all things of whatsoever nature required for the complete incorporation of the item into the work the same as though the item were to read "in place," unless the contract documents shall provide otherwise.

1.03 LUMP SUM BREAKDOWNS

A. If the contract is based on a lump sum bid price, or contains one or more lump sum items for which progress payments are to be made, the Contractor shall prepare and submit a breakdown estimate covering each lump sum item to the Engineer for approval. The breakdown estimate shall show the estimated value of each kind or item of work. The sum of the lump sum items listed in the breakdown estimates shall equal the contract lump sum. Overhead and profit shall not be listed as separate items.

B. The breakdown estimate shall be approved by the Engineer before any progress payments are prepared. An unbalanced breakdown estimate providing for overpayment to the Contractor for items of work to be performed first will not be approved but shall be revised by the Contractor and resubmitted until acceptable to the Engineer.

1.04 PAYMENT FOR CHANGE ORDERS

A. The Contractor's claims for extra work will not be paid unless the extra work covered by such claims was authorized by a change order as specified in Section 1040, 1.07 - Change Orders.

B. Payment for extra work shall be made in one or more of the following ways as determined by the agreement between the parties to the contract prior to the starting of the work.

1.04 PAYMENT FOR CHANGE ORDERS (Continued)

1. Unit Prices: By unit prices contained in the Contractor's original proposal and incorporated in the construction contract, so far as the same may apply.

2. Supplemental Schedule: By supplemental schedule of prices to include costs of all equipment, material, labor, supervision, management, insurance, overhead, and incidentals, said schedule to be submitted by the Contractor upon request of the Engineer and to be accepted by the Jurisdiction.

3. Lump Sum: By an acceptable lump sum proposal from the Contractor.

C. The percentage markup to be allowed to the Contractor for extra work performed by a subcontractor shall be in accordance with the following:

1. 10% of the first $50,000 with a $100 minimum.

2. 5% of the portion over $50,000.

1.05 PROGRESS PAYMENTS

A. Limits: Progress payments made under the contract, unless provided otherwise by law, shall be made according to Iowa Code Chapter 573, and shall be made on the basis of monthly estimates of labor performed and material delivered and incorporated in to the work, as determined by the Engineer. Payment may be made for materials not incorporated into the project if they can be specifically identified and cost verified by invoice. Progress payment requests shall be accompanied by the documentation required in Section 1090, 1.07, B - Sales Tax and Use Tax.

B. Retainage: The Jurisdiction shall retain from each monthly progress payment 3% of the amount determined to be due according to the estimate of the Engineer.

C. Quantities: Quantities used for progress payments shall be considered as only approximate and provisional and shall be subject to recalculation, adjustment, and correction by the Engineer in subsequent partial payments and in the final payment. Inclusion of any quantities in a progress payment, or failure to disapprove the work at the time of any progress payment, shall not be construed as acceptance of the corresponding work or materials.

1.06 PAYMENT OF RETAINAGE

A. Retained funds shall be retained by the Jurisdiction for a period of 30 calendar days after the completion and final acceptance of the improvement by the Jurisdiction. If at the end of the 30 calendar day period claims are on file as provided, the Jurisdiction shall continue to retain from the unpaid funds, a sum equal to double the total amount of all claims on file. The remaining balance of the unpaid fund, or if no claims are on file, the entire unpaid fund, shall be released and paid to the Contractor.

B. The Jurisdiction, the Contractor, any claimant for labor or material who has filed a claim, or the surety on any bond given for the performance of the contract, may, at any time after the expiration of 30 calendar days, and not later than 60 calendar days, following the completion and final acceptance of said improvement, bring action in equity in the county where the improvement is located to adjudicate all rights to said fund, or to enforce liability on said bond, pursuant to Iowa Code Chapter 573. Upon written demand of the Contractor, served in the manner prescribed for original notices, on the person filing a claim, requiring the claimant to commence action in court to enforce the claim, an action shall be commenced within 30 calendar days, otherwise the retained and unpaid funds due the Contractor shall be released to the Contractor.

1.07 SALES AND USE TAX STATEMENT

A. At the completion of the contract and before final payment can be made thereon, the Contractor and all subcontractors shall file with the Engineer in triplicate, with original signatures on all three sets, a statement under oath on forms provided by the Iowa Department of Revenue and Finance showing the data with reference to sales, use, and service taxes required by Iowa Code Section 423.4, as amended. On projects with a total contract cost greater than $1 million or with supplies and materials in excess of 50% of the contract price and when directed by the Engineer, the Contractor shall submit with each progress pay estimate completed sales and use tax forms from the Iowa Department of Revenue listing all supplies and materials purchased since the previous progress payment.

B. If a Sales Tax Exemption Certificate(s) is issued by the Jurisdiction according to Section 1020, 1.08, no sales, use, or service statement is required.

1.08 ACCEPTANCE AND FINAL PAYMENT

A. Final payment will be based on the actual final total amount of the work accomplished and finally accepted by the Jurisdiction under the contract. Under no circumstances or conditions will the Contractor be paid anything for anticipated profits for the work, nor will it be paid for any work not actually included in the improvement. The Jurisdiction will not give final acceptance of the work until the Contractor has submitted all documentation required by the contract documents.

B. The Engineer shall, after determining the work has been finally and fully completed according to the contract documents, make a final estimate of the amount of work done and the value thereof.

C. Final acceptance of construction shall be defined as final approval of the project only in the sense that it has been constructed, cleaned up, and completed in apparent substantial compliance with the contract documents. Said final acceptance is stipulated to mean a written acceptance by the Jurisdiction.

D. It is mutually agreed between the parties to the contract that a certificate of completion of the project, submitted by the Engineer and approved by the Jurisdiction, shall constitute final acceptance of the work and materials included in the contract on the date of such approval, subject to the provision any such approval, acceptance, or payment as herein provided shall not constitute an acceptance of any unauthorized or defective work, or of any improper material.

END OF SECTION

Insert tab here called

DIVISION 2
Earthwork

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Details of Embankments and Rebuilding Embankments 2010.101

Designation of Roadway Earthwork Items 2010.102

EARTHWORK, SUBGRADE, AND SUBBASE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Clearing and Grubbing

B. Earthwork, Excavation, and Embankment Construction

C. Subgrade Preparation

D. Subbase Construction

E. Topsoil

1.02 DESCRIPTION OF WORK

Excavate and construct embankments, subgrades, and subbases.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Submit results of Standard Proctor and in-place density tests on compactions when required.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

If impractical, or if scheduling does not allow the removal of utilities before excavation, work around the utilities.

1.08 MEASUREMENT AND PAYMENT

A. Clearing and Grubbing by Units: The quantity of clearing and grubbing will be the quantity, in units, shown in the contract documents.

1. Measurement:

a. Trees 6 inches in diameter or greater will be counted and the circumference will be measured at a height of 18 inches above the ground. The diameter will be calculated by measuring the circumference to the nearest inch and dividing by 3.14. See Table 2010.01 for identification of units per tree for clearing, grubbing, and clearing and grubbing.

b. Stumps 6 inches in diameter or greater will be counted and the diameter, in inches, calculated by determining the average diameter at cutoff. See Table 2010.01 for identification of units per stump for grubbing.

1.08 MEASUREMENT AND PAYMENT (Continued)

c. Logs and down timber 6 inches in diameter or greater will be measured at a point 18 inches from the end of the log with greatest diameter or 18 inches from the base of the tree for down timber for clearing.
d. Hedge rows will be measured in linear feet and converted to units using a rate of 30 units per 100 linear feet of hedge row.
e. Brush will be measured in square feet and converted to units by using a rate of 0.8 units per 100 square feet of brush.
f. Growing corn will be measured in square feet and converted to units by using a rate of 0.2 units per 100 square feet of growing corn.
g. Vegetation removal will not be measured for payment.
h. Field fence removal, included in clearing and grubbing, will be measured in stations and converted to units at a rate of 6.0 units per station of fence.

For each tree or stump counted as identified in Items a, b, and c, units will be determined as identified in the following table:

Table 2010.01: Tabulation of Units for Removal of Trees and Stumps

Size Diameter	Unit		
	Clearing	Grubbing	Clearing and Grubbing
Over 6 in. to 9 in. incl.	1.1	2.8	3.9
Over 9 in. to 12 in. incl.	1.9	4.8	6.7
Over 12 in. to 15 in. incl.	2.8	6.6	9.4
Over 15 in. to 18 in. incl.	4.7	8.8	13.5
Over 18 in. to 24 in. incl.	8.4	13.6	22.0
Over 24 in. to 30 in. incl.	11.4	17.6	29.0
Over 30 in. to 36 in. incl.	22.0	28.0	50.0
Over 36 in. to 42 in. incl.	30.0	50.0	80.0
Over 42 in. to 48 in. incl.	40.0	80.0	120.0
Over 48 in. to 60 in. incl.	60.0	100.0	160.0
Over 60 in. to 72 in. incl.	80.0	120.0	200.0
Over 72 in.	120.0	160.0	280.0

2. **Payment:** Payment will be at the unit price per unit.

3. **Includes:** Unit price includes, but is not limited to, placement of backfill in area where roots have been removed, and removal and disposal of all materials.

B. Clearing and Grubbing by Area:

1. **Measurement:** Measurement will be the plan quantities for the total area of clearing and grubbing. If the limits for this item are not shown in the contract documents, they will be calculated from a need line or right-of-way line as indicated in the project plans.

2. **Payment:** Payment will be at the unit price per acre.

3. **Includes:** Unit price includes, but is not limited to, removal and disposal of all materials and placement of backfill in area where roots have been removed.

C. Clearing and Grubbing by Lump Sum:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be the contract lump sum price.

3. **Includes:** Lump sum price includes, but is not limited to, removing and disposing all materials and furnishing and placing backfill material in area where roots have been removed.

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Topsoil:

1. On-site Topsoil:

a. Measurement: Measurement will be in cubic yards and will be computed on the basis of a uniform 8 inch finished thickness, or as specified.

b. Payment:

1) Payment will be at the unit price per cubic yard.
2) Topsoil salvaged from excavated areas and paid as topsoil will not be included in excavation quantities for which payment is made.
3) Overhaul will not be paid.

c. Includes: Unit price includes but is not limited to, stripping and stockpiling topsoil; preparing the topsoil placement area by tillage or ripping; re-spreading the topsoil; additional tillage to address compaction during placement; and removal of clods, roots, stones, and other undesirable materials.

2. Compost-amended Topsoil:

a. Measurement: Measurement will be the same as for on-site topsoil.

b. Payment: Payment will be the unit price per cubic yard. Overhaul will not be paid.

c. Includes: Unit price includes but is not limited to, preparing the placement area by tillage or ripping and furnishing, transporting, placing, and incorporating compost.

3. Off-site Topsoil:

a. Measurement: Measurement will be in cubic yards and will be computed on the basis of a uniform 8 inch thickness, or as specified.

b. Payment: Payment will be at the unit price per cubic yard. Overhaul will not be paid.

c. Includes: Unit price includes, but is not limited to, preparing the placement area by tillage or ripping; furnishing, transporting, and spreading the off-site topsoil; completing tillage to address compaction during placement; and removal of clods, roots, stones, and other undesirable materials.

E. Class 10, Class 12, or Class 13 Excavation:

1. Measurement:

a. Measurement for Class 10, Class 12, and Class 13 material excavated from the project site and borrow areas will be the plan quantity in cubic yards, without final field measurement. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.

b. If either the Contractor or the Engineer desires actual measurements rather than using contract document quantities, that party must provide written notice to the other party prior to starting work.

1) If actual measurements are used, use cross-section surveys by the Engineer before and after work for the basis of computing the cubic yards of excavation. The extra survey cost will be paid by the party requesting the survey.
2) When the Engineer determines it is impractical to make cross-section surveys, use the truck count method, with a shrinkage factor, resulting in volume per truck type and size determined by the Engineer. Unless otherwise specified, use a shrinkage factor of 1.35 for Class 10 and Class 13 excavation. No shrinkage factor will be used for Class 12.

2. Payment:

a. Payment will be at the unit price per cubic yard.

b. Payment will not be made for excavation work done prior to the staking and, if necessary, cross-sectioning.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. Includes, but is not limited to:
a. Site preparation for, and the construction of, embankment, fills, shoulder backfill, and backfill behind curbs.
b. Overhaul.
c. Finishing the soil surface, including roadways, shoulders, behind curbs, side ditches, slopes, and borrow pits.
d. Repair or replacement of any fences that have been unnecessarily damaged or removed.

4. Does not include: Stripping, salvaging, and spreading 8 inches of topsoil, unless otherwise specified in the contract documents.

F. Below Grade Excavation (Core Out): If unsuitable or unstable soil is encountered below the 12 inches of subgrade, measurement and payment for removal and replacement of such materials is as follows:

1. Measurement: Will be measured and paid as extra work, unless otherwise specified in the contract documents.

2. Payment: To be considered for payment, the Engineer must order the removal and replacement of the material. Payment will be considered only in previously undisturbed areas and not in existing embankments or following proof rolling operations.

3. Includes: Payment includes, but is not limited to, equipment, tools, labor, disposal of unsuitable materials, dewatering, drying, furnishing, and placement of foundation materials as required by the Engineer, compaction and finishing of the excavated area, and all incidental work as may be required.

G. Subgrade Preparation:

1. Measurement: The area of the proposed pavement under which the subgrade preparation is performed, plus 2 feet on each side, will be measured in square yards.

2. Payment: Payment will be at the unit price per square yard.

3. Includes: Work includes, but is not limited to, excavating, manipulating, replacing, compacting, and trimming to the proper grade.

H. Granular Stabilization:

1. Measurement: Measurement will be in tons for the quantity of granular stabilization material required to replace unstable subgrade material removed. Measurement will be based on the scale tickets for the material delivered and incorporated into the project.

2. Payment: Payment will be at the unit price per ton for the quantity of granular stabilization material furnished and placed. Payment is in addition to subgrade preparation and use of other foundation options.

3. Includes: Unit price includes, but is not limited to, removal and disposal of unstable material and furnishing, hauling, placing, and compacting granular stabilization material.

1.08 MEASUREMENT AND PAYMENT (Continued)

I. Subgrade Treatment:

1. Measurement: The area of the proposed pavement under which each type of subgrade treatment is provided, plus 2 feet on each side, will be measured in square yards.

2. Payment:
a. Payment will be at the unit price per square yard for each type of subgrade treatment used.
b. Payment is in addition to subgrade preparation.

3. Includes: Work includes, but is not limited to, furnishing, placing, and incorporating the subgrade treatment material [cement, asphalt, fly ash, lime, geogrid (type), or geotextiles].

J. Subbase:

1. Measurement: The area of the proposed pavement under which each type and thickness of subbase is provided, plus 2 feet on each side, will be measured in square yards.

2. Payment: Payment will be at the unit price per square yard for each type and thickness of subbase.

3. Includes: Work includes, but is not limited to, furnishing, placing, compacting, and trimming to the proper grade.

K. Removals:

1. Structures:
a. Measurement: Each structure to be removed will be counted.
b. Payment: Payment will be at the unit price for each specified structure removed.
c. Includes: Unit price includes, but is not limited to, removal and disposal of structures.

2. Culverts:
a. Known Box Culverts:
1) Measurement: Each type and size of box culvert removed will be measured in linear feet from end to end along the centerline of the flowline.
2) Payment: Payment will be at the unit price per linear foot for each type and size of box culvert removed.
3) Includes: Unit price includes, but is not limited to, removal and disposal of box culverts.
b. Unknown Box Culverts: Removal of unknown box culverts will be measured and paid as extra work.
c. Known Pipe Culverts:
1) Measurement: Each type and size of pipe culvert removed will be measured in linear feet from end to end at the flowline.
2) Payment: Payment will be at the unit price per linear foot for each type and size of pipe culvert removed.
3) Includes: Unit price includes, but is not limited to, removal and disposal of pipe culverts.
d. Unknown Pipe Culverts: Removal of unknown pipe culverts will be measured and paid as extra work.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. Pipes and Conduits:

a. Known Pipes and Conduits:

1) Measurement: Each type and size of pipe and conduit removed will be measured in linear feet from end to end.

2) Payment: Payment will be at the unit price per linear foot for each type and size of pipe and conduit removed.

3) Includes: Unit price includes, but is not limited to, removal, disposal, and plugging, if specified, of pipes and conduits.

4) Abandoned Private Utilities: Removal of all private utility lines is the responsibility of the respective utility agency, and will not be measured or paid.

b. Unknown Pipes and Conduits: Removal of unknown pipes and conduits will be measured and paid as extra work.

4. Pavement: Comply with Section 7040.

L. Filling and Plugging of Pipe Culverts, Pipes, and Conduits:

1. Known Pipe Culverts, Pipes, and Conduits:

a. Measurement: Each type and size of pipe culvert, pipe, and conduit filled and plugged will be measured in linear feet from end to end.

b. Payment: Payment will be at the unit price per linear foot for each type and size of pipe culvert, pipe, and conduit filled and plugged.

c. Includes: Unit price includes, but is not limited to, furnishing and installing the plug and the flowable mortar as designated by the Engineer.

d. Abandoned Private Utilities: Filling and plugging of all private utility lines is the responsibility of the respective utility agency, and will not be measured or paid.

2. Unknown pipe culverts, pipes, and conduits: Filling and plugging of unknown pipe culverts, pipes, and conduits will be measured and paid as extra work.

M. Compaction Testing:

1. The Contractor will not be responsible for compaction testing or payment unless otherwise specified in the contract documents.

2. If the contract documents specify that the Contractor is responsible for compaction testing, performed by an independent testing laboratory hired by the Contractor, measurement and payment will be as follows:
   a. Measurement: Lump sum item; no measurement will be made.
   b. Payment: Payment will be the contract lump sum price.

3. The Contractor will be responsible for payments associated with all retesting resulting from failure of initial tests.

PART 2 - PRODUCTS

2.01 TOPSOIL

Use suitable topsoil of uniform quality, free from hard clods, roots, sod, stiff clay, hard pan, stones larger than 1 inch (1/2 inch for turfgrass seeding), lime cement, ash, slag, concrete, tar residue, tarred paper, boards, chips, sticks, or any undesirable material.

Use on-site topsoil, unless compost-amended or off-site topsoil is specified.

A. On-site Topsoil: On-site topsoil material is material excavated from the top 12 inches of the site. Use of on-site topsoil material is subject to the Engineer's approval.

B. Compost-amended On-site Topsoil: Amend low-quality on-site topsoil, not meeting the requirements specified for off-site topsoil, with a minimum of 1 inch of compost for every 3 inches of topsoil. Use compost meeting the requirements of mulch for pneumatic seeding in Section 9010, 2.07.

C. Off-site Topsoil: Contains at least 3% organic matter, according to ASTM D 2974, has a high degree of fertility, is free of herbicides that prohibit plant growth, has a pH level between 6.0 and 8.0, and meets the following mechanical analysis requirements:

Sieve	Percent Passing
1"	100
1/2"	95* to 97*
1/4"	40 to 60
No. 100	40 to 60
No. 200	10 to 30

* 100% for turfgrass

The Engineer will approve the source of off-site topsoil. Surface soils from ditch bottoms, drained ponds, and eroded areas, or soils that are supporting growth of noxious weeds or other undesirable vegetation, will not be accepted. The Engineer will determine if testing is necessary. The Contractor will be responsible for payment of the testing if the off-site topsoil does not meet the above requirements. If the testing verifies the off-site topsoil does meet the above requirements, payment for the testing will be the responsibility of the Jurisdiction.

2.02 EXCAVATION MATERIALS

All project site and borrow excavation will be classified as Class 10, Class 12, or Class 13 as defined below, and as indicated in the contract documents.

A. Class 10 Excavation:

1. Class 10 excavation includes all normal soil such as loam, silt, gumbo, peat, clay, soft shale, sand, and gravel. It includes fragmentary rock handled in the manner normal to this class of excavation.

2. Includes any combination of the above described materials and any other material not classified as Class 12 or Class 13.

2.02 EXCAVATION MATERIALS (Continued)

B. Class 12 Excavation:

1. Material deposits so firmly cemented together that they cannot be removed without continuous use of pneumatic tools or blasting.

2. Class 12 excavation includes the actual measured volume of granite, trap, quartzite, chert, limestone, sandstone, hard shale, or slate in natural ledges or displaced masses.

3. Also includes the estimated or measured volume of rock fragments or boulders that occur on the surface or in subsurface deposits mixed with soil, sand, or gravel when their size, number, or location prevents them from being handled in a manner normal to Class 10 excavation.

C. Class 13 Excavation:

1. Class 13 excavation includes all materials listed under the definitions of Classes 10 and 12, and any other material encountered, regardless of its nature.

2. This classification covers work commonly referred to as "unclassified excavation."

3. The contract documents will specify the limits for Class 13 excavation. Excavation within these limits will not be classified as Class 10 or Class 12 excavation.

D. Unsuitable or Unstable Materials:

1. Material encountered during excavation above or below grade that does not meet the suitable soil requirements in Section 2010, 2.03.

2. Rubbish and debris, including trees, stumps, waste construction materials, scrap metals, and other materials that cannot be buried or used for backfill or topsoil.

3. Moisture content does not determine suitability of materials.

E. Borrow: Unless otherwise provided in the contract documents, when the quantity of fill material required is not available within the limits of the project cross-sections or specific borrow areas as indicated, the Contractor should make up the deficiency from borrow areas provided by the Engineer, or furnish equivalent material from other borrow areas.

2.03 SUITABLE EMBANKMENT MATERIALS

Meet the following requirements for all soils provided for the construction of embankments:

A. Density of 95 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).

B. AASHTO M 145 group index of less than 30.

C. Liquid limit (LL) less than 50.

D. Soils not meeting these requirements are considered unsuitable soils, regardless of classification.

E. For soils to be placed below water, use clean granular material.

2.04 FOUNDATION MATERIALS

A. Select Subgrade Materials:

1. All soils required for select subgrade materials must be approved by the Engineer. Approval of materials and their use will be based on AASHTO M 145.
   a. Cohesive soils must meet all of the following requirements:
      1) 45% or less silt size fraction.
      2) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
      3) Plasticity index greater than 10.
      4) A-6 or A-7-6 soils of glacial origin.
   b. Granular soils must meet all of the following requirements:
      1) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
      2) 15% or less silt and clay.
      3) Plasticity index of 3 or less.
      4) A-1, A-2, or A-3 (0).

2. Crushed stone, crushed PCC, crushed composite pavement, or RAP; mixtures of gravel, sand, and soil; or uniformly-blended combinations of the above; as approved by the Engineer.

3. The Engineer may authorize a change in select subgrade materials subject to materials available locally at time of construction.

B. Granular Stabilization Materials:

1. Clean, crushed stone or crushed concrete, with the following gradation:

Sieve	Percent Passing
2 1/2”	100
2”	90 to 100
1 1/2”	35 to 70
1”	0 to 20
1/2”	0 to 5

2. The Engineer may authorize a change in gradation, subject to materials available locally at time of construction.

C. Subgrade Treatment:

1. Cement: Comply with Section 7010, 2.01, A.

2. Asphalt: Comply with AASHTO M 140.

3. Fly ash: Provide Class C meeting the requirements of ASTM C 618 with a minimum of 22% CaO; the Loss of Ignition requirements in Table 1 will not apply. Approval of source required.

4. Lime: Hydrated lime should meet requirements of ASTM C 207, Type N or AASHTO M 216, and others.

2.04 FOUNDATION MATERIALS (Continued)

5. Geogrid:

a. Rectangular or Square: Use an integrally-formed grid structure manufactured of a stress-resistant polypropylene material. Use Type 1 geogrid, unless Type 2 is specified. Meet the following minimum physical properties:

Table 2010.02: Geogrid (Rectangular or Square)

Property	Test Method	Units	Type 1[1]	Type 2
Aperture stability modulus at 20 kg-cm	Kinney[2] - 01	kg-cm/deg	3.2	6.5
Minimum true initial modulus in use				
Machine direction (MD)	ASTM D 6637	lb/ft	15,080	32,890
Cross machine direction (CMD)			20,560	44,725
Tensile strength, 2% strain				
MD	ASTM D 6637	lb/ft	270	410
CMD			380	590
Junction efficiency	GRI-GG2-87	%	93	93
Flexural rigidity	ASTM D 1388	mg-cm	250,000	750,000
Aperture size				
Minimum	N/A	in.	0.5	0.5
Maximum			2.0	2.0

[1] Geogrids meeting the requirements of Iowa DOT Article 4196.01, B and Materials I.M. 496.01 will be acceptable.
[2] Dr. Thomas C. Kinney, P.E. and US Army Corps of Engineers.

b. Multiaxial: Use punched and drawn polypropylene that is oriented in three substantially equilateral directions. Meet the following minimum physical properties:

Table 2010.03: Geogrid (Multiaxial)[1]

Property	Test Method	Units	Type 3	Type 4
Resistance to loss of load capacity				
Chemical resistance	EPA 9090 Immersion	%	100	100
Ultra-violet light and weathering (500 hrs)	ASTM D 4355	%	80	80
Junction efficiency	GRI-GG2-87 GRI-GG1-87	% of ultimate tensile strength	93	93
Radial stiffness (min.)	ASTM D 6637	lb/ft @ 0.5% strain	15,000	20,000
Rib pitch				
Continuous parallel rib pitch[2]	N/A	in.	3.2	3.2
Mid-rib depth[2]	N/A	in.	0.04-0.06	0.05-0.08
Mid-rib width[2]	N/A	in.	0.035-0.045	0.047-0.055
Node thickness	N/A	in.	0.11	0.13
Rib aspect ratio[3]	N/A	in.	> 1.0	> 1.0

[1] Values shown are minimum average roll values according to ASTM D 4759, unless indicated otherwise.
[2] Nominal dimensions.
[3] Ratio of the mid-rib depth to the mid-rib width.

6. Geotextiles: Use a woven or non-woven permeable fabric, manufactured of polymer fibers, meeting the requirements of Iowa DOT Article 4196.01, B, 5.

2.04 FOUNDATION MATERIALS (Continued)

D. Subbase:

1. Special Backfill:
   a. Comply with Iowa DOT Specifications Section 4132. The quality requirements of Iowa DOT Materials I.M. 210 for recycled pavements are waived.
   b. The Engineer may authorize a change in gradation subject to materials available locally at time of construction.

2. Granular Subbase:
   a. Comply with Iowa DOT Specifications Section 4121.
   b. The Engineer may authorize a change in gradation subject to materials available locally at time of construction.

3. Modified Subbase:
   a. Comply with Iowa DOT Specifications Section 4123.
   b. The Engineer may authorize a change in gradation, subject to materials available locally at time of construction.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Notification: Notify the Engineer prior to start of clearing and grubbing activities.

B. Tree Cutting:

1. **October 1 through March 31:** No restrictions on tree cutting.

2. **April 1 through September 30:** Cut trees only after authorized by the Engineer and upon receiving a copy of the Determination of Effect indicating no affect to threatened or endangered species is expected within the work area.

C. Removal: Remove the following items:

1. Trees and stumps, including roots, to a depth of at least 12 inches. Place backfill to fill the hole.

2. Logs and downed timber.

3. Hedge rows, brush, field fence, and agricultural products.

4. Vegetation and rubbish.

5. Other objectionable materials.

D. Disposal: Dispose of material from clearing and grubbing according to Iowa Administrative Code 567-23.2 and must meet local ordinances. If burning is not allowed, proceed as follows:

1. Process by chipping logs, downed timber, or brush for mulching material; or salvage logs and downed timber for firewood.

2. Other vegetation, including corn stubble, may be disked into the existing soil if approved by the Engineer.

3. Haul vegetative materials from clearing and grubbing that are not handled on the project to a yard waste disposal site.

4. Remove field fence and other non-vegetative materials from the project.

3.02 TOPSOIL

Prior to placement of all types of topsoil, finish excavation and embankment work according to the specified grades and cross-sections considering topsoil requirements; grade and slope all surfaces to drain away from buildings and prevent ponding. Conform to the grading plan within ± 2 inches. Till or rip constructed surface to a minimum depth of 4 inches to reduce compaction prior to topsoil placement.

A. On-Site Topsoil:

1. **Stripping and Salvaging:**
   a. Mow all weeds, grass, and growing crops or other herbaceous vegetation close to the ground and remove from the site. Shred sod by shallow plowing or blading and thorough disking. Thoroughly shred to allow the soil to be easily spread in a thin layer over areas to be covered. If allowed by the Engineer, herbicides may be applied, and vegetation may be incorporated into the topsoil.

3.02 TOPSOIL (Continued)

b. Remove an adequate amount of topsoil from the upper 12 inches of existing on-site topsoil to allow finish grading with a finished grade of 8 inches of salvaged topsoil. The topsoil may be moved directly to an area where it is to be used, or may be stockpiled for future use.

2. Spreading and Finish Grading:

a. Place topsoil at least 8 inches deep; smooth and finished grade according to the contract documents.
b. After finish grading the topsoil, till surface to a minimum depth of 4 inches. Remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (1/2 inch for turfgrass).

B. Compost Amended Topsoil: Furnish and spread compost a uniform thickness blended according to Section 2010, 2.01. Incorporate compost into underlying soil. Grade the compost amended soil. Till area a minimum depth of 4 inches to loosen surface from compaction during placement. Remove clods and stones and other undesirable materials.

C. Off-site Topsoil: Transport and spread 8 inches of approved off-site topsoil, unless otherwise specified. Grade and till the area a minimum depth of 4 inches to loosen surface from compaction during placement. Remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (1/2 inch for turfgrass).

3.03 EXCAVATION

A. Notification: Notify the Engineer prior to start of excavation activities.

B. Pavement Removal:

1. Cut surface pavement to full depth as required, and at designated removal lines.

2. Remove all pavement materials.
   a. If specified in the contract documents or allowed by the Engineer, process for re-use.
   b. Dispose of excess material as follows:
      1) Use as unsuitable soil according to this section.
      2) If specified in the contract documents, deliver and stockpile at a site designated by the Engineer.
      3) Otherwise, properly dispose of off-site.

3. Remove pavement material broken or damaged by the Contractor beyond designated removal lines to new line designated by the Engineer, and replaced at the Contractor′s expense.

4. Protect subgrade beneath existing pavement removal areas.

C. Excavation: Perform Class 10, 12, or 13 grading, as specified in the contract documents, to the prescribed grade.

D. Shaping of Borrows:

1. Ensure that borrow areas provided by the Contractor are regular in cross-section to allow accurate measurement.

2. Ensure that care is taken to blend to natural land forms and avoid unnecessary damage to the land.

3. Do not divert natural drainage of surface water onto adjoining owners, and be diligent in draining the surface water in its natural course or channel.

3.03 EXCAVATION (Continued)

4. Complete excavation in a way consistent with the existing natural drainage conditions.

E. Drainage:

1. Provide temporary drainage facilities to prevent damage to public or private interests when necessary to interrupt natural drainage or flow of artificial drains.

2. Restore original drainage as soon as work allows.

3. The Contractor is responsible for damage resulting from their neglect to provide erosion control or artificial drainage.

F. Unsuitable or Unstable Materials:

1. Remove unsuitable or unstable materials to a depth specified in the contract documents, or as directed by the Engineer.

2. The Engineer will determine the need for and type of backfill material, including select soil or granular subbase.

3. Remove all soft areas. Replace with approved materials.

4. If subbase materials are used, provide weight tickets at the time of delivery.

5. Dispose of unsuitable or unstable materials according to the requirements in this section.

G. Removal of Boulders: Remove all boulders with a minimum diameter of 6 inches.

H. Rock Excavation:

1. When excavation to the subgrade elevation results in a surface consisting of loose or solid rock:
   a. Excavate 1 foot below the finished subgrade elevation.
   b. Construct subgrade with suitable material.
   c. Conduct operations so the Engineer is given the opportunity to measure cross-section before placement of subgrade material.

2. When pre-splitting of rock cuts is necessary, the limits of the area and the procedure used will be subject to the approval of the Engineer.

3. Dispose of rocks and boulders 6 inches in diameter and greater off-site.

I. Removal or Filling of Pipe Culverts, Pipes, and Conduits: Remove, plug, and/or fill with flowable mortar, as directed by the Engineer.

3.04 EMBANKMENT CONSTRUCTION

A. Notification: Notify the Engineer prior to start of embankment activities.

B. Site Preparation:

1. Remove all ground cover from the area.

2. When an embankment is placed on or against an existing slope that is steeper than 3:1 and is more than 10 feet high, cut the slope into steps as the construction of the new embankment progresses. The steps should ensure that all sod or other potential sliding surfaces are removed. Cut each step or series of steps to approximate horizontal planes which have vertical slope dimensions of at least 3 feet.

3.04 EMBANKMENT CONSTRUCTION (Continued)

C. Depositing Embankment Material:

1. Except for rock fills and granular blankets, deposit embankment material in horizontal layers no greater than 8 inches in loose thickness. Do not incorporate vegetative materials in embankments. If some otherwise suitable soil contains small amounts of vegetative materials, such soils may be deposited outside of the shoulder line, within the outer 3 feet of the embankment.

2. When the width at the attained height is 30 feet or more, divide the area upon which the layer is to be placed into separate and distinct dump areas, having widths of at least 15 feet. If hauling equipment is operated within a dump area, cover the area with at least one passage of a tandem-axle disk, or two passages with a single-axle disk, prior to compaction.

3. Keep hauling equipment off dump areas of embankments 36 feet or more in width during compaction operations. Within 36 feet of a bridge or other limiting structure, or where the width of the embankment is less than 36 feet at the attained height, empty hauling units may travel on the dump area during compaction operations, as necessary to pass loaded hauling units. If the design width of the embankment is less than 30 feet at the attained height, hauling units will be allowed to travel through areas where compaction operations are in progress. When any hauling equipment is allowed to pass through compaction operations, do not require water, disking, and compacting equipment to deviate from their intended paths.

4. Deposit the material over the dump area as a separate and distinct operation. If the material, as deposited, contains an average of more than one lump per square yard, large enough to have at least one dimension greater than 12 inches, cover the area by at least one passage of a tandem-axle disk, or two passages of a single-axle disk. Use a disk that is designed and operated to cut and stir to the full depth of the layer.

5. After depositing and disking, if required, smooth the material to a uniform depth with a suitable motor patrol, bulldozer, or self-propelled sheepsfoot-type roller with a blade attachment. In addition to the initial smoothing operation, continue this smoothing and leveling of the lift during compaction, as necessary to provide a surface area free from ruts and other objectionable irregularities.

   Use the self-propelled sheepsfoot-type roller (meeting the requirements of Iowa DOT Article 2001.05) under the following conditions:
   a. Leveling must be done according to the prescribed rolling pattern.
   b. Compaction should be the primary function of the unit.
   c. Prevent spinning of the power drums.
   d. When, in the opinion of the Engineer, the unit cannot satisfactorily accomplish both leveling and rolling, use a separate dozer or motor patrol for the leveling operation prior to initiation of compaction.
   e. For embankments constructed primarily of sand or other granular material, the Contractor may substitute a pneumatic-tired roller meeting the requirements of Iowa DOT Article 2001.05.

6. Keep the outer portion of an embankment lower than its center, and wherever construction will be suspended for a period during which rain is likely to occur, roughen the surface to prevent erosion. This can be done by tracking, disking, or scarifying. Stones 6 inches and smaller in diameter may be placed in embankments, but distributed to avoid pockets. No stones larger than 3 inches may be placed within 1 foot of the finished subgrade elevation.

3.04 EMBANKMENT CONSTRUCTION (Continued)

D. Compaction with Moisture and Density Control: Compact with moisture and density control, unless Type A compaction is specified in the contract documents. See Section 2010, 3.09 for moisture and density requirements.

E. Type A Compaction: When Type A compaction is specified in the contract documents, compact as follows:

1. After the surface layer has been smoothed, and before material for the next layer is deposited on it, compact the layer with at least one passage of the sheepsfoot-type roller per inch of loose thickness of the layer, until the roller is supported entirely on its feet. The roller will be considered to be supported entirely on its feet when the tamping feet penetrate no more than 3 inches into an 8 inch lift or layer being compacted.

2. Determine if moisture content of the material is excessive or suitable for satisfactory compaction.
   a. Start rolling operations immediately after the smoothing operation, or delay them, and instead aerate the material in preparation for rolling.
   b. Perform aeration and compaction operations without unnecessary delay.
   c. Rolling operations made prior to any aeration operations for a lift will not be counted as any of the required coverages.

3. If the material is dry to the extent that it will not likely be satisfactorily compacted by rolling, moisten the material.
   a. The Engineer may order the material to be moistened uniformly before it is compacted.
   b. The Engineer may authorize the use of water in the final finishing of the roadbed.
   c. Delays from the ordering of moistening or drying will be at the Contractor's expense.

4. The Contractor may substitute compaction with moisture and density control for Type A Compaction, providing all testing as required, at the Contractor's expense.

3.05 USE OF UNSUITABLE SOILS

Unsuitable soils are not allowed in the right-of-way, unless otherwise specified in the contract documents or allowed by the Engineer.

3.06 SUBGRADE PREPARATION

Shape and consolidate subgrade in preparation for the placement of pavement.

A. Uniform Composition: Provide uniform composition of at least 12 inches below top of subgrade under new paving or subbase, plus 2 feet on each side. Use select subgrade materials unless granular stabilization materials or subgrade treatment is specified.

1. Subgrade Compaction in Fill Sections:
   a. Follow the compaction with moisture and density control requirements in Section 2010, 3.04.
   b. Construct in two 6 inch lifts.

2. Subgrade Compaction in Cut Sections:
   a. Excavate and stockpile the top 6 inches of subgrade.
   b. Scarify, mix, and re-compact the next 6 inches of subgrade.
   c. Replace, mix, and compact the top 6 inches of subgrade.
   d. Follow the compaction with moisture and density control requirements in Section 2010, 3.09.

3.06 SUBGRADE PREPARATION (Continued)

3. Remove stones over 3 inches from subgrade.

4. Construct to elevation and cross-section such that, after rolling, surface will be above required subgrade elevation.

B. Subgrade Stability:

1. Perform proof rolling no more than 7 days prior to paving operations with a truck loaded as approved by the Engineer using either:
   a. A single axle or tandem truck fully loaded with rock or soil to the top of the truck's sideboards; or
   b. A single axle truck loaded with a rear axle weight of 13,500 pounds and total vehicle weight of 20,000 pounds or a tandem axle truck loaded with rear axle weight of 34,000 pounds and a total weight of 46,000 pounds. Verify axle and truck weights by tickets from a certified scale.

2. Operate trucks at less than 10 mph. Make multiple passes for every lane. The subgrade will be considered to be unstable if, under the operation of the loaded truck, the surface shows yielding (soil wave in front of the loaded tires) or rutting of more than 2 inches, measured from the top to the bottom of the rut at the outside edges.

3. If soft or yielding areas are located, remove unstable materials and replace with suitable foundation materials as approved by the Engineer, meeting Section 2010, 2.04. Compact subgrade materials in cut sections as required by the Engineer. If stabilization material is used, place and compact as required for subbase.

4. If more than 7 days pass, unsuitable material was replaced, or if rain occurs before the paving operation begins, perform proof rolling again unless waived by the Engineer.

C. Final Subgrade: Complete final subgrade by excavation to grade by use of steel-shod template supported on side forms, support rollers, or by use of an automatically-controlled subgrade excavating machine.

D. Subgrade Check: Check subgrade elevation and grade by method approved by Engineer prior to paving.

E. Ruts: If ruts or other objectionable irregularities form in subgrade during construction, re-shape and re-roll subgrade before placing pavement. Fill ruts or other depressions with material similar to other subgrade material, and compact.

3.07 SUBGRADE TREATMENT

A. Lime, Cement, Fly Ash, or Asphalt:

1. Incorporate the subgrade treatment material uniformly during subgrade preparation to the depth and rate specified in the contract documents.

2. Place subgrade treatment in the areas specified in the contract documents for the width of the pavement, plus 2 feet on each side.

B. Geogrid or Geotextiles:

1. Install according to manufacturer's recommendations, on top of the prepared subgrade.

2. Place in the areas specified in the contract documents for the width of the pavement, plus 2 feet on each side.

3.08 SUBBASE

A. Subgrade: Compact subgrade and shape smooth before subbase material is placed.

B. Construction: Construct the specified type of subbase to the specified depth, plus 2 feet outside the pavement area.

C. Moisture and Density: Compact subbase and provide testing according to Section 2010, 3.09.

D. Final Elevation:

1. Trim to the design elevation and shape to the final template with an automatically-controlled trimming machine. Excess material may be salvaged and spread for use on any other approved project location or operation.

2. Conform to the design profile and cross-section to the extent that no point is higher than the designated elevation, and no point is lower than 0.05 foot below the design elevation.

3. Ensure that the top 1 inch of the subbase is uniformly moist prior to paving.

4. Do not allow hauling equipment and other traffic on completed subbase.

3.09 FIELD QUALITY CONTROL

A. Compaction Testing: If it is specified in the contract documents that the Contractor will conduct compaction testing, use the services of an independent testing laboratory approved by the Engineer.

B. Moisture Content and Density:

1. Ensure that moisture content falls within a range of optimum moisture to 4% above optimum moisture.

2. Compact cohesive soils to no less than 95% of maximum Standard Proctor Density; and cohesionless soils to no less than 70% of Relative Density.

C. Testing:

1. Lab Test: Determine laboratory density of material according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density) or ASTM D 4253 and ASTM D 4254 (Maximum and Minimum Index Density for Cohesionless Soils). Provide at least one analysis for each material type used unless provided by the Engineer.

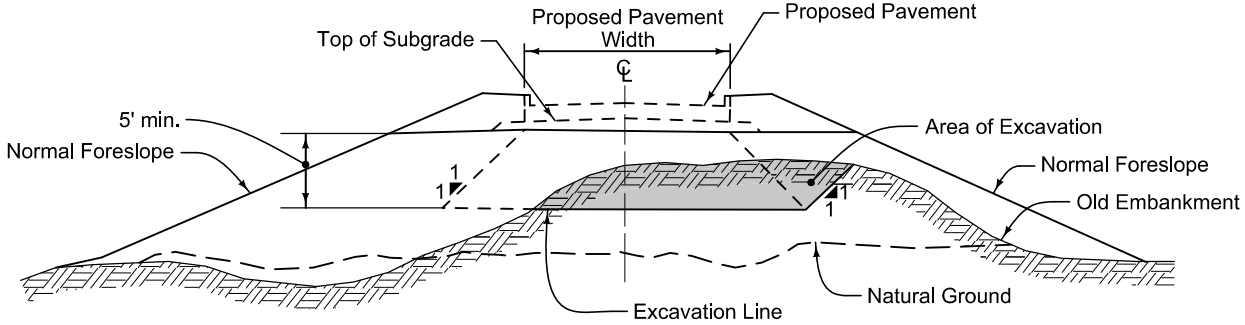
2. Field Test:
   a. Perform in-place field density and moisture testing according to ASTM D 6938 (nuclear) or ASTM D 1556 (sand cone) and ASTM D 2216 (moisture content).
   b. Frequency:
      1) Urban Section: Provide one test per lift per 150 feet. If section is less than 300 feet, perform at least two tests per lift.
      2) Rural Section: Provide one test for each 500 cubic yards of material placed, with at least two tests per lift.

3. Test only locations selected by the Engineer.

4. The Engineer may require additional testing if noncompliance or change in conditions occur.

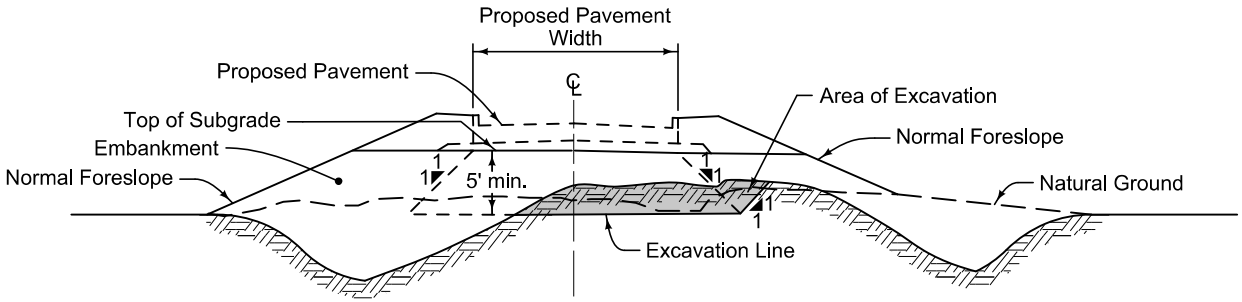
D. Test Failure: Rework, recompact, and retest as necessary until required compaction is achieved.

END OF SECTION

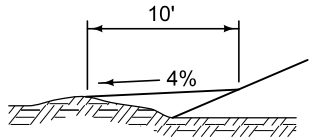


TYPICAL CROSS-SECTION: REBUILDING EMBANKMENT WHERE NATURAL GROUND IS GREATER THAN 5 FEET BELOW FINISHED GRADE LINE (1)

(1) Use only when new roadbed overlaps existing roadbed. Not for use on relocations or where new roadbed is to be built on natural ground.

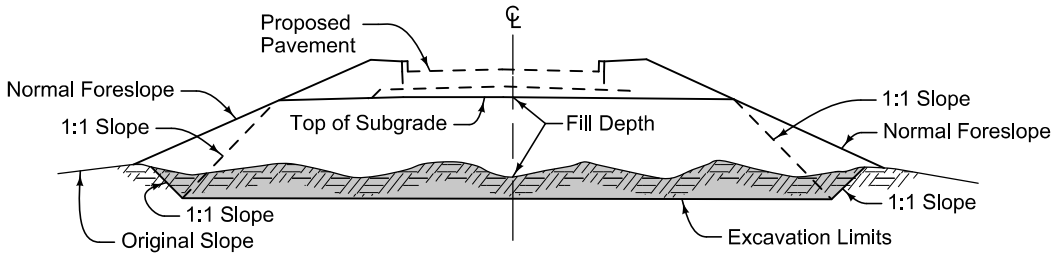


TYPICAL CROSS-SECTION: REBUILDING EMBANKMENT WHERE NATURAL GROUND IS LESS THAN 5 FEET BELOW FINISHED GRADE LINE (1)



TYPICAL TOE FILL CONSTRUCTION

Use care in setting toe fills. Ensure proper drainage in side ditches is maintained.



TYPICAL CROSS-SECTION: EXCAVATION OF PEAT, MUCK, OR OTHER MATERIAL NOT TO BE USED FOR THE CONSTRUCTION OF EMBANKMENTS

FIGURE 2010.101 | SHEET 1 OF 1

SUDAS

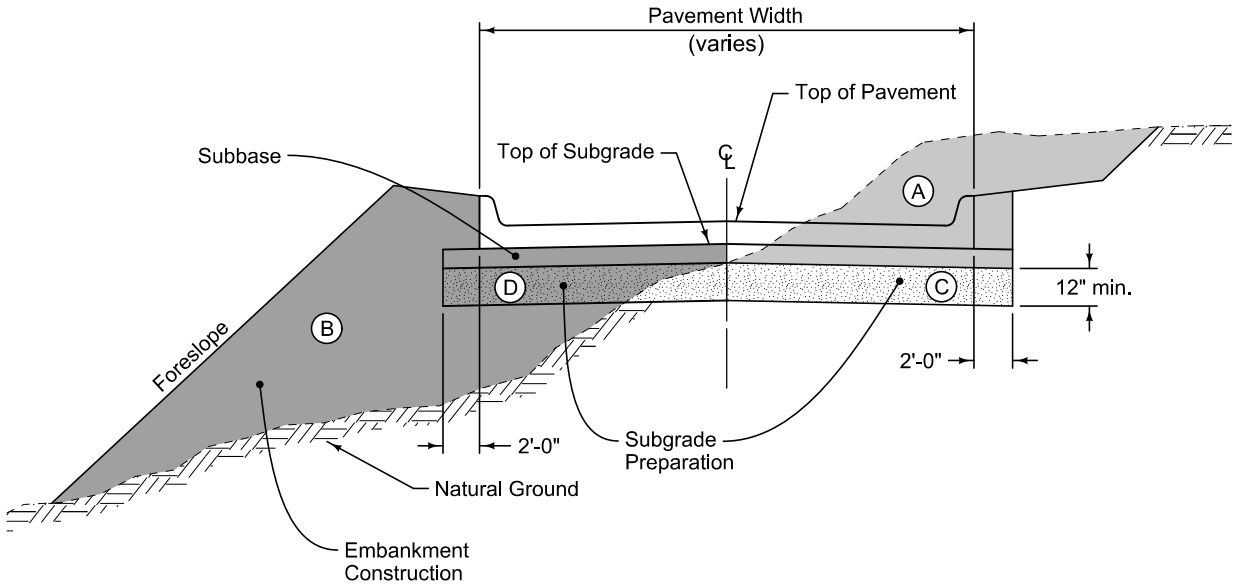
REVISION 3 10-21-14

2010.101

SHEET 1 of 1

SUDAS Standard Specifications

DETAILS OF EMBANKMENTS AND REBUILDING EMBANKMENTS



1. Embankment Construction: Compact with moisture and density control unless Type A Compaction is specified. Comply with Section 2010, 3.04.
2. Subgrade Preparation: Construct subgrade according to Section 2010, 3.06.
3. Subbase Construction: Construct subbase according to Section 2010, 3.08.

Key

- Excavation
- Fill
- Subgrade preparation

Type of Work	Area	Payment Method
Excavation	(A)	Excavation
Fill	(B)	Included in Excavation or Borrow
Subgrade Preparation	(C) & (D)	Subgrade Preparation

FIGURE 2010.102

SHEET 1 OF 1

SUDAS

REVISION 1 10-21-14

2010.102

SHEET 1 of 1

SUDAS Standard Specifications

DESIGNATION OF ROADWAY EARTHWORK ITEMS

Insert tab here called

DIVISION 3
Trench and Trenchless Construction

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Rigid Gravity Pipe Trench Bedding 3010.102

Flexible Gravity Pipe Trench Bedding 3010.103

Pressure Pipe Trench Bedding 3010.104

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Miscellaneous Pipe Bedding 3010.105

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TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trench Excavation for Pipe Systems

B. Trench Foundation Stabilization

C. Pipe Bedding and Backfill

1.02 DESCRIPTION OF WORK

A. Excavate trench for pipe installation.

B. Stabilize trench and install pipe bedding materials.

C. Place backfill material in trench.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Gradation reports for bedding materials.

B. Results of required testing.

C. Dewatering plan.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. General: The following items are incidental to the underground utility being installed and will not be paid for separately:

1. Standard trench excavation.
2. Removal and disposal of excess backfill material resulting from pipe installation.
3. Removal of abandoned private utilities encountered during trench excavation.
4. Furnishing and placing granular bedding material.
5. Placing and compacting backfill material.
6. Dewatering including, but not limited to, all equipment such as generators, pumps, rock for sump pits, discharge piping, and any extra excavation needed to facilitate dewatering according to stormwater regulations, as applicable.
7. Sheeting, shoring, and bracing.
8. Adjusting the moisture content of excavated backfill material to the range specified for placement and compaction.
9. Temporary support for existing water, sewer, gas, telephone, electric, and other utilities or services that cross the trench.

B. Rock Excavation:

1. Measurement: Measurement will be by cubic yards of rock removed.

2. Payment: Payment will be at the unit price per cubic yard for the quantity of rock removed.

3. Includes: Unit price includes, but is not limited to, furnishing the equipment and labor to break up, remove, and properly dispose of rock encountered in the trench.

C. Trench Foundation:

1. Measurement: Measurement will be in tons for the quantity of stabilization material required to replace material removed by over-excavation. Measurement will be based on the scale tickets for the material delivered and incorporated into the project. Trench foundation required to correct unauthorized over-excavation will not be measured.

2. Payment: Payment will be at the unit price per ton for the quantity of stabilization material furnished and placed.

3. Includes: Unit price includes, but is not limited to, removal and disposal of over-excavated material required to stabilize trench foundation; and furnishing, hauling, and placing stabilization material.

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Removal, Disposal, and Replacement of Unsuitable Backfill Material:

1. **Measurement:** Measurement will be in cubic yards for the quantity of backfill material required to replace unsuitable backfill material removed during standard trench excavation. Measurement will be based on compacted material in place.

2. **Payment:** Payment will be at the unit price per cubic yard for the quantity of the suitable replacement backfill material furnished.

3. **Includes:** Unit price includes, but is not limited to, removal, hauling, and disposal costs of the unsuitable material and the furnishing, hauling, and placing of the suitable replacement backfill material. Unit price does not include landfill costs for contaminated materials.

E. Special Pipe Embedment or Encasement:

1. **Measurement:** Measurement will be by the linear foot along the centerline of pipe for each type of special embedment or encasement.

2. **Payment:** Payment will be at the unit price per linear foot for each type of special pipe embedment or encasement.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing all required special pipe embedment or encasement materials.

F. PCC Pipe Support Over Existing Utility:

1. **Measurement:** Measurement will be by each location.

2. **Payment:** Payment will be at the unit price for each pipe support.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing PCC pipe supports and associated materials.

G. Reinforced PCC Beam Utility Line Support:

1. **Measurement:** Measurement will be by each location.

2. **Payment:** Payment will be at the unit price for each reinforced PCC beam utility line support.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing reinforced PCC beam utility line support and associated materials.

H. Trench Compaction Testing: If the contract documents specify that the Contractor is responsible for trench compaction testing, measurement and payment will be as follows.

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for trench compaction testing.

3. **Includes:** Lump sum price includes, but is not limited to, all payments associated with retesting resulting from failure of initial tests.

PART 2 - PRODUCTS

2.01 MATERIALS EXCAVATED FROM A TRENCH

A. Standard Trench Excavation: All materials encountered during trench excavation, except rock and over-excavation.

1. **Suitable Backfill Material:** Class II, Class III, Class IVA, or Class IVB as defined in Section 3010, 2.03.

2. **Unsuitable Backfill Material:** Includes, but is not limited to, the following materials:
   a. Soils not classified as suitable backfill material, as defined in Section 3010, 2.03.
   b. Individual stones or concrete chunks larger than 6 inches and averaging more than one per each cubic foot of soil.
   c. Frozen materials.
   d. Stumps, logs, branches, and brush.
   e. Trash, metal, or construction waste.
   f. Soil in clumps or clods larger than 6 inches, and without sufficient fine materials to fill voids during placement.
   g. Environmentally contaminated soils.
   h. Materials removed as rock excavation or over-excavation.

3. **Topsoil:** Class V material. Comply with Section 3010, 2.04.

B. Rock Excavation: Boulders or sedimentary deposits that cannot be removed in trenches without continuous use of pneumatic tools or blasting.

C. Over-excavation: Excavation of unsuitable or unstable material in trenches below the pipe zone, comply with Figure 3010.101.

2.02 BEDDING MATERIAL

A. Class I Material:

1. Crushed stone complying with the following gradation:

Sieve	Percent Passing
1 1/2”	100
1”	95 to 100
1/2"	25 to 60
No. 4	0 to 10
No. 8	0 to 5

2. The Engineer may allow the use of gravel or authorize a change in gradation subject to materials available locally at the time of construction.

3. The Engineer may authorize the use of crushed PCC for pipe sizes up to 12 inches.

4. Use aggregates having a percentage of wear, Grading A or B, not exceeding 50%, determined according to AASHTO T 96.

2.03 BACKFILL MATERIAL

A. Class II Material: Manufactured and non-manufactured open-graded (clean) or dense-graded (clean) processed aggregate, clean sand, or coarse-grained natural soils (clean) with little or no fines. Class II materials are further described in Table 3010.01.

Table 3010.01: Class II Materials

Type	Soil Group Symbol ASTM D 2487	Description	Percentage Passing Sieve Sizes		
			1 1/2 in.	No. 4	No. 200
Coarse-Grained Soils, clean	GW	Well-graded gravels and gravel-sand mixtures; little or no fines.	100%	< 50% of "Coarse Fraction"	< 5%
	GP	Poorly-graded gravels and gravel-sand mixtures; little or no fines.			
	SW	Well-graded sands and gravelly sands; little or no fines.		> 50% of "Coarse Fraction"	
	SP	Poorly-graded sands and gravelly sands; little or no fines.			
Coarse-Grained Soils, borderline clean to with fines	e.g. GW-GC, SP-SM	Sands and gravels that are borderline between clean and with fines.	100%	Varies	5% to 12%

B. Class III Material:

1. Natural coarse-grained soils with fines. Class III materials are further described in Table 3010.02.

2. Do not use where water condition in trench may cause instability.

Table 3010.02: Class III Material

Table	Soil Group Symbol ASTM D 2487	Description
Coarse-Grained Soils, with fines	GM	Silty gravels, gravel-sand-silt mixtures.
	GC	Clayey gravels, gravel-sand-clay mixtures.
	SM	Silty sands, sand-silt mixtures.
	SC	Clayey sands, sand-clay mixtures.

C. Class IVA Material:

1. Natural fine-grained inorganic soils. Class IVA materials are further described in Table 3010.03.

2. The Engineer will determine if material is not suitable for use as backfill material under deep fills, surface applied wheel loads, heavy vibratory compactors, tampers, or other conditions.

3. Do not use where water conditions in trench may cause instability.

4. Material is suitable for use in dry trench conditions only.

2.03 BACKFILL MATERIAL (Continued)

Table 3010.03: Class IVA Material

Type	Soil Group Symbol ASTM D 2487	Description
Fine-Grained Soils (inorganic)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity.
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clay, lean clay.

D. Class IVB Material:

1. Natural fine-grained inorganic (high elastic silts and plastic clays - fat clay) with a liquid limit greater than 50%. Class IVA materials are further described in Table 3010.04.

2. When approved by the Engineer, material may be used as final trench backfill in a dry trench.

3. Do not use in the pipe embedment zone.

Table 3010.04: Class IVB Material

Type	Soil Group Symbol ASTM D 2487	Description
Fine-Grained Soils (inorganic)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	CH	Inorganic clays of high plasticity, fat clays.

2.04 TOPSOIL

A. Class V Material:

1. Organic soils. Class V materials are further described in Table 3010.05.

2. Use only as topsoil outside of the pavement, unless otherwise specified or allowed by the Engineer.

3. Do not use in the pipe embedment zone.

Table 3010.05: Class V Material

Type	Soil Group Symbol ASTM D 2487	Description
Organic Soils (unsuitable for backfill)	OL	Organic silts and organic silty clays of low plasticity.
	OH	Organic clays of medium to high plasticity, organic silts.
Highly Organic (unsuitable for backfill)	PT	Peat and other high organic soils.

2.05 STABILIZATION (FOUNDATION) MATERIALS

A. Clean 2 1/2 inch crushed stone with the following gradation:

Table 3010.06: Stabilization Materials

Sieve	Percent Passing
2 1/2”	100
2”	90 to 100
1 1/2”	35 to 70
1”	0 to 20
1/2”	0 to 5

B. If specified, meet Iowa DOT Section 4128 for Gradation No. 13a screened over a 1 inch screen or the Engineer may authorize a change in gradation depending on materials available locally at time of construction.

C. Crushed concrete may be used, if approved by the Engineer, if it is within ± 5% of the gradation for each size of material.

2.06 SPECIAL PIPE EMBEDMENT AND ENCASEMENT MATERIAL

A. Concrete Cradle, Arch, or Encasement: Use Iowa DOT Class C concrete.

B. Flowable Mortar: Comply with Iowa DOT Article 2506.02.

C. CLSM:

1. Approximate quantities per cubic yard:
   a. Cement: 50 pounds
   b. Fly ash: 250 pounds
   c. Fine aggregate: 2,910 pounds
   d. Water: 60 gallons

2. A compressive strength of at least 50 psi compressive strength at 28 calendar days can be expected.

3. Comply with material requirements of Iowa DOT Article 2506.02.

D. Foamed Cellular Concrete:

1. If specified or approved by the Engineer, foamed cellular concrete may be substituted for flowable mortar.

2. Comply with Iowa DOT Article 2506.02.

3. Submit mix design to the Engineer. Include base cement slurry mix per cubic yard, expansion factor from the foaming agent, and wet density.

PART 3 - EXECUTION

3.01 TRENCH EXCAVATION

A. Notify the Engineer prior to the start of excavation activities.

B. Remove topsoil to a minimum depth of 12 inches and stockpile.

C. Excavate trench to required elevations and dimensions. Comply with Figure 3010.101.

1. Protect existing facilities, trees, and shrubs during trench excavation.

2. Place excavated material away from trench.

3. Grade spoil piles to drain. Do not allow spoil piles to obstruct drainage.

D. Unsuitable Backfill Material:

1. If unsuitable backfill material is encountered, notify the Engineer.

2. Remove rock, rubbish, boulders, debris, and other unsuitable backfill materials at least 6 inches below and on each side of the pipe.

3. Keep unsuitable backfill material separated from suitable backfill material and topsoil.

4. Restore trench to design dimensions using bedding or stabilization material.

3.02 ROCK OR UNSTABLE SOILS IN TRENCH BOTTOM

A. Notify the Engineer prior to over-excavation.

B. The Engineer will determine the need for over-excavation and trench foundation stabilization prior to installation of pipes and structures.

C. Comply with Figure 3010.101 for over-excavation of rock and wet or soft foundations.

3.03 TRENCH PROTECTION

A. Install adequate trench protection (sheeting, shoring, and bracing) to prevent ground movement or damage to adjacent structures, pipelines, and utilities.

B. Move trench boxes carefully to avoid disturbing pipe, bedding, or trench wall.

3.04 DEWATERING

A. Maintain water levels below the bottom of trench excavation.

B. Perform the dewatering operation according to the dewatering plan approved by the Engineer. The dewatering plan may be modified to meet actual field conditions, with approval of the Engineer.

C. Ensure operation of the dewatering system does not damage adjoining structures and facilities. Cease dewatering operations and notify the Engineer if damage is observed.

D. Discharged Water:

1. Do not discharge water into sanitary sewers.

2. Discharging water into storm sewers requires Engineer's approval.

3.04 DEWATERING (Continued)

3. Obtain permission of adjacent property owner prior to discharging water onto their property.

4. Maintain and control water discharge as necessary to prevent a safety hazard for vehicular and pedestrian traffic.

5. Direct water discharge away from electrical facilities or equipment.

6. Use dewatering equipment that will minimize disturbance from noise and fumes.

7. Protect discharge points from erosion. Provide sediment control for sediment contaminated water discharged directly from trench.

3.05 PIPE BEDDING AND BACKFILL

A. General: Comply with Figures 3010.101, 3010.102, 3010.103, 3010.104, and 3010.105, as appropriate.

1. Bedding and backfill used for pipe installation will depend on:
   a. Type of installation (water main, sanitary sewer gravity main, sanitary sewer force main, or storm sewer).
   b. Pipe material.
   c. Depth of bury.
   d. Pipe diameter.

2. After pipe installation, place remaining bedding material and immediately place backfill in trench.

3. Adjust the moisture content of excessively wet, but otherwise suitable, backfill material by spreading, turning, aerating, and otherwise working material as necessary to achieve required moisture range.

4. Adjust the moisture content of excessively dry, but otherwise suitable, backfill material by adding water, then turning, mixing, and otherwise blending the water uniformly throughout the material until the required moisture range is achieved.

5. Hydraulic compaction (flooding with water) is not allowed unless authorized by the Engineer.

6. Special Pipe Embedment and Encasement Materials:
   a. If specified, use concrete, flowable mortar, CLSM, or foamed cellular concrete as a substitute for pipe bedding, haunch support, or primary and secondary backfill.
   b. Secure pipe against displacement or flotation prior to placing special pipe embedment and encasement material.
   c. Place Class IV clay material for a waterstop and compacted to 90% of Standard Proctor Density. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content. If trench stabilization material is used, extend waterstop through stabilization material to the bottom of the trench.

B. Pipe Bedding:

1. Granular Material:
   a. Class I granular bedding material is required for all gravity mains. Use when specified for pressure pipes.
   b. Comply with Figures 3010.101, 3010.102, 3010.103, 3010.104, and 3010.105.

3.05 PIPE BEDDING AND BACKFILL (Continued)

c. Place bedding material in the bottom of the trench in lifts no greater than 6 inches thick. Consolidate and moderately compact bedding material.
d. Shape bedding material to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.
e. Install pipe and system components.
f. Place, consolidate, and moderately compact additional bedding material adjacent to the pipe to a depth equal to 1/6 the outside diameter of the pipe.

2. Suitable Backfill Material:
a. Only use with pressure pipe. Comply with Figure 3010.104.
b. Use suitable backfill material to shape trench bottom to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.

C. Haunch Support: Place from the top of the pipe bedding to the springline of the pipe.

1. Granular Material:
a. Place Class I material in lifts no greater than 6 inches thick.
b. Consolidate and moderately compact by slicing with a shovel or using other approved techniques.

2. Suitable Backfill Material:
a. Place in lifts no greater than 6 inches thick.
b. For Class II backfill material, consolidate and moderately compact by slicing with a shovel or using other approved techniques.
c. For Class III and Class IVA backfill materials, compact to at least 90% of Standard Proctor Density. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.

D. Primary and Secondary Backfill:

1. General:
a. For primary backfill, place from the springline of the pipe to the top of the pipe.
b. For secondary backfill, place from the top of the pipe to 1 foot above the top of the pipe.

2. Granular Material:
a. Place in lifts no greater than 6 inches thick.
b. Compact to at least 65% relative density.

3. Suitable Backfill Material:
a. Place in lifts no greater than 6 inches thick.
b. For Class II backfill material, compact to at least 65% relative density.
c. For Class III and Class IVA backfill materials, compact to at least 95% of Standard Proctor Density. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.

E. Final Trench Backfill:

1. Place suitable backfill material from 1 foot above the top of the pipe to the top of the trench.
a. Use no more than 8 inch thick lifts for backfill areas more than 3 feet below the bottom of pavement.
b. Use no more than 6 inch thick lifts for backfill areas less than or equal to 3 feet below the bottom of pavement.

3.05 PIPE BEDDING AND BACKFILL (Continued)

2. Place backfill material after recording locations of connections and appurtenances or at the Engineer's direction.

3. Class I and Class II Backfill Material:
   a. Compact to at least 65% relative density within right-of-way.
   b. Compact to at least 50% relative density outside right-of-way.

4. Class III and Class IVA Backfill Material:
   a. Compact to at least 95% of Standard Proctor Density within right-of-way.
   b. Compact to at least 90% of Standard Proctor Density outside right-of-way.
   c. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.

5. In areas to remain unpaved, terminate backfill material 8 inches below finished grade. Use topsoil for the final 8 inches above trench backfill material.

6. Terminate backfill material at subgrade elevation in areas to be paved.

3.06 TRENCH COMPACTION TESTING

A. General: When trench compaction testing is specified in the contract documents as the Contractor's responsibility, provide testing of trench backfill material using the services of an independent testing laboratory approved by the Engineer.

B. Soil Testing:

1. Cohesive Soils:
   a. Determine moisture-density relationships by ASTM D 698 (Standard Proctor). Perform at least one test for each type of cohesive soil used.
   b. Determine in-place density and moisture content. Use ASTM D 1556 (sand-cone method) and ASTM D 2216 (laboratory moisture content), or use ASTM D 6938 (nuclear methods for density and moisture content).

2. Cohesionless Soils:
   a. Determine maximum and minimum index density and calculate relative density using ASTM D 4253 and ASTM D 4254.
   b. For Class I granular bedding material, determine gradation according to ASTM C 136.

C. Field Testing:

1. Testing Frequency and Locations: Perform testing of the final trench backfill, beginning at a depth of 2 feet above the top of the pipe, as follows:
   a. Coordinate the timing of testing with the Engineer.
   b. The Engineer will determine the location of testing.
   c. For each 2 vertical feet of consolidated fill, provide tests at a maximum horizontal spacing of 200 feet and at all street crossings.
   d. Additional testing may be required by the Engineer in the event of non-compliance or if conditions change.
   e. If necessary, excavate to the depth and size as required by the Engineer to allow compaction tests. Place backfill material and recompact.

2. Test Failure and Retesting: Rework, recompact, and retest as necessary until specified compaction and moisture content is achieved in all areas of the trench. In the event of failed tests, the Engineer may require retesting as deemed necessary.

END OF SECTION

Refer to the contract documents for specific material and placement requirements.

(1) Required only when specified in the contract documents or when directed by the Engineer.

Key

OD = Outside diameter of pipe

D = Inside diameter of pipe

TW = Trench width at top of pipe

d = Depth of bedding material below pipe

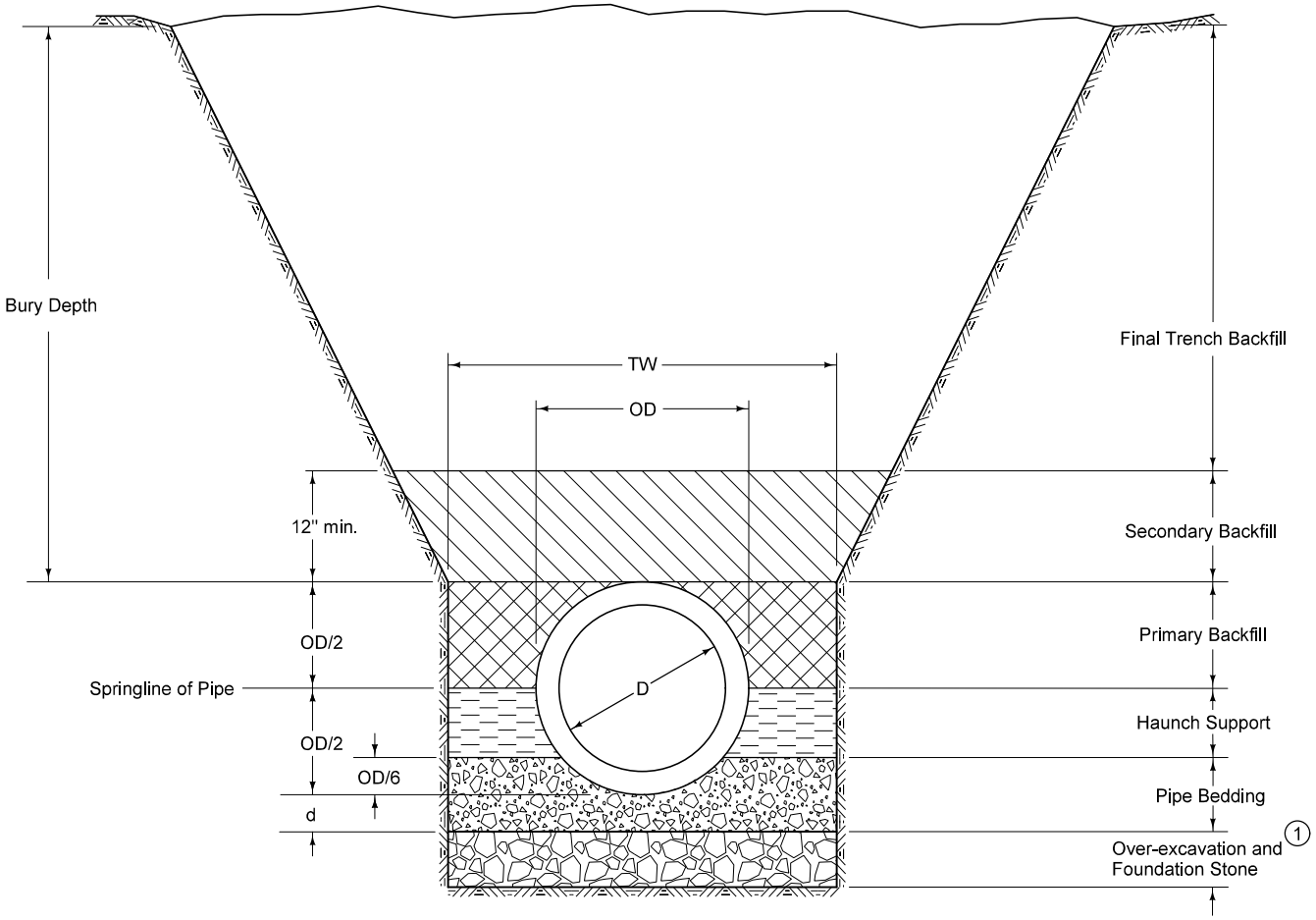


FIGURE 3010.101 SHEET 1OF 1

SUDAS | IOWADOT | REVISION 1 04-17-18

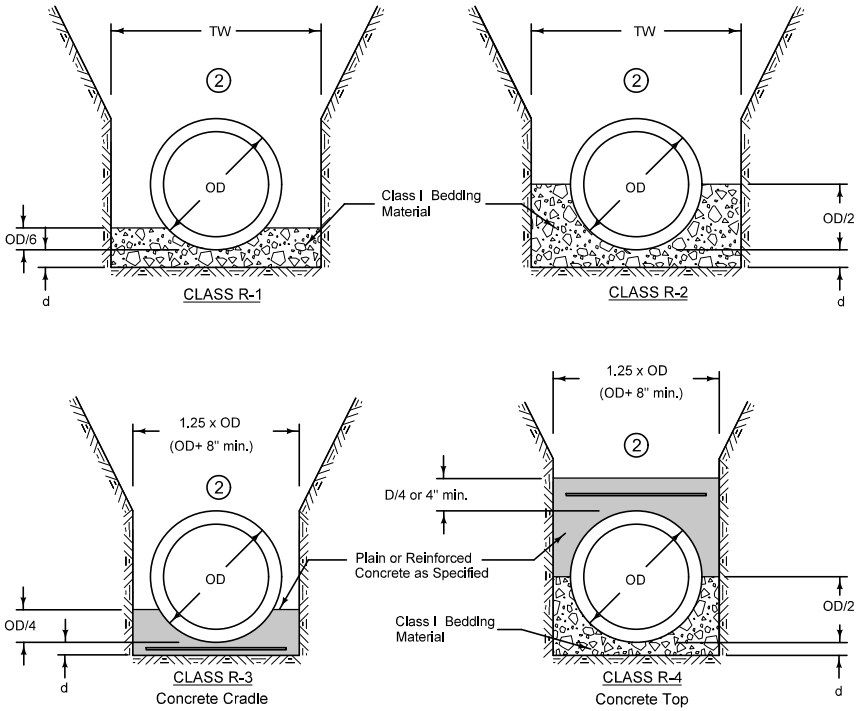
FIGURE 3010.101 | STANDARD ROAD PLAN | SW-101 | SHEET 1 of 1

REVISIONS: Replaced Iowa DOT and SUDAS logos.

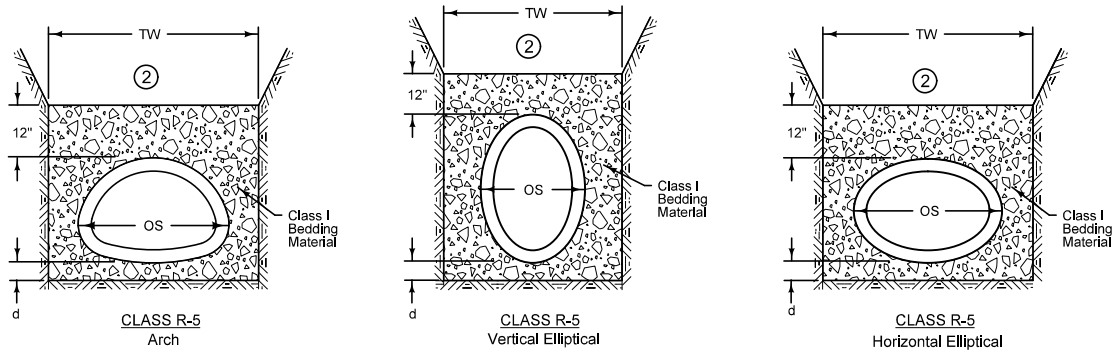
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

TRENCH BEDDING AND BACKFILL ZONES

RCP AND VCP CIRCULAR PIPE BEDDING ①



REINFORCED CONCRETE ARCH AND ELLIPTICAL PIPE BEDDING



Refer to sheet 2 for bury depth restrictions.

① Use Bedding Class R-1 or R-2 unless specified otherwise.

② Place remainder of bedding and backfill materials as specified in the contract documents.

Key

OD = Outside diameter of pipe

OS = Outside span of pipe

TW = Trench width at top of pipe:
Min. = OD+18 inches
Max.= 1.25xOD+12 inches OR
54 inches (whichever is greater)

d = Depth of bedding material below pipe:
OD/8 or OS/8, OR 4 inches
(whichever is greater)

FIGURE 3010.102 SHEET 1 OF 2

SUDAS | IOWA DOT

REVISION	
4	04-20-21

FIGURE 3010.102 | STANDARD ROAD PLAN | SW-102 | SHEET 1 of 2

REVISIONS: Added note DO NOT USE ON PRIMARY ROADWAYS.

Paul D. Wigard, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

RIGID GRAVITY PIPE TRENCH BEDDING

ALLOWABLE BURY DEPTH

CLASS III RCP

Pipe Diameter (in)	Class R-1 Bedding	Class R-2 Bedding	Class R-3 & R-4 Bedding		
			No Steel	As=0.4%	As=1.0%
12	7'	10'	15'	19'	27'
15	8'	10'	16'	19'	27'
18	8'	11'	16'	20'	40'
21	8'	11'	18'	26'	40'
24	8'	12'	23'	36'	40'
27	10'	15'	30'	40'	40'
30	11'	15'	29'	40'	40'
33	11'	15'	28'	40'	40'
36	11'	15'	27'	40'	40'
42	11'	15'	26'	38'	40'
48	11'	15'	26'	36'	40'
54	11'	15'	25'	34'	40'
60	11'	15'	25'	33'	40'
66	11'	15'	24'	32'	40'
72	11'	15'	24'	32'	40'
As = Area of Steel Reinforcing					

CLASS IV RCP

Pipe Diameter (in)	Class R-1 Bedding	Class R-2 Bedding	Class R-3 & R-4 Bedding		
			No Steel	As=0.4%	As=1.0%
12	12'	15'	23'	28'	40'
15	12'	16'	23'	30'	40'
18	13'	16'	29'	40'	40'
21	13'	18'	40'	40'	40'
24	16'	23'	40'	40'	40'
27	19'	30'	40'	40'	40'
30	19'	29'	40'	40'	40'
33	19'	28'	40'	40'	40'
36	19'	28'	40'	40'	40'
42	18'	27'	40'	40'	40'
48	18'	26'	40'	40'	40'
54	18'	25'	40'	40'	40'
60	18'	25'	40'	40'	40'
66	18'	25'	40'	40'	40'
72	18'	24'	40'	40'	40'
As = Area of Steel Reinforcing					

CLASS V RCP

Pipe Diameter (in)	Class R-1 Bedding	Class R-2 Bedding	Class R-3 & R-4 Bedding		
			No Steel	As=0.4%	As=1.0%
12	18'	23'	35'	40'	40'
15	19'	24'	40'	40'	40'
18	19'	30'	40'	40'	40'
21	25'	40'	40'	40'	40'
24	34'	40'	40'	40'	40'
27	40'	40'	40'	40'	40'
30	40'	40'	40'	40'	40'
33	40'	40'	40'	40'	40'
36	40'	40'	40'	40'	40'
42	37'	40'	40'	40'	40'
48	35'	40'	40'	40'	40'
54	33'	40'	40'	40'	40'
60	32'	40'	40'	40'	40'
66	31'	40'	40'	40'	40'
72	31'	40'	40'	40'	40'
As = Area of Steel Reinforcing					

EXTRA STRENGTH VCP

Pipe Dia. (in)	Bedding Class				
	R-1	R-2	R-3 & R-4		
			No Steel	As=0.4%	As=1.0%
6	25'	30'	30'	30'	30'
8	20'	26'	30'	30'	30'
10	18'	23'	30'	30'	30'
12	16'	20'	30'	30'	30'
15	15'	19'	28'	30'	30'
18	14'	18'	30'	30'	30'
21	15'	22'	30'	30'	30'
24	18'	28'	30'	30'	30'
27	20'	30'	30'	30'	30'
30	19'	29'	30'	30'	30'
33	20'	30'	30'	30'	30'
36	20'	30'	30'	30'	30'
39	19'	29'	30'	30'	30'
42	18'	26'	30'	30'	30'
As = Area of Steel Reinforcing					

CONCRETE ARCH PIPE

Pipe Size (in x in)	Equiv. Dia. (in)	Pipe Class	
		A-III	A-IV
18 x 11	15	6'	11'
22 x 13	18	6'	11'
26 x 15	21	6'	13'
29 x 18	24	7'	15'
36 x 22	30	8'	15'
44 x 27	36	8'	14'
51 x 31	42	8'	15'
58 x 36	48	8'	15'
65 x 40	54	8'	15'
73 x 45	60	8'	14'
88 x 54	72	9'	14'
Based on Class R-5 bedding			

HORIZONTAL ELLIPTICAL RCP

Pipe Size (in x in)	Equiv. Dia. (in)	Pipe Class	
		HE-III	HE-IV
14 x 23	18	12'	22'
19 x 30	24	15'	29'
22 x 34	27	15'	28'
24 x 38	30	15'	27'
27 x 42	33	15'	27'
29 x 45	36	15'	26'
32 x 49	39	15'	26'
34 x 54	42	15'	25'
38 x 60	48	15'	25'
43 x 68	54	15'	24'
48 x 76	60	15'	24'
53 x 83	66	15'	24'
58 x 91	72	15'	24'
63 x 98	78	15'	23'
68 x 106	84	15'	23'
Based on Class R-5 bedding			

VERTICAL ELLIPTICAL RCP

Pipe Size (in x in)	Equiv. Dia. (in)	Pipe Class			
		VE-III	VE-IV	VE-V	VE-VI
23 x 14	18	10'	15'	22'	33'
30 x 19	24	10'	16'	34'	40'
34 x 22	27	11'	20'	40'	40'
38 x 24	30	12'	23'	40'	40'
42 x 27	33	15'	30'	40'	40'
45 x 29	36	15'	29'	40'	40'
49 x 32	39	15'	29'	40'	40'
54 x 34	42	15'	28'	40'	40'
60 x 38	48	15'	27'	40'	40'
68 x 43	54	15'	27'	40'	40'
76 x 48	60	15'	26'	40'	40'
83 x 53	66	15'	25'	40'	40'
91 x 58	72	15'	25'	40'	40'
98 x 63	78	15'	25'	40'	40'
106 x 68	84	15'	24'	40'	40'
Based on Class R-5 bedding					

FIGURE 3010.102 SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 4 04-20-21

FIGURE 3010.102 | STANDARD ROAD PLAN | SW-102 | SHEET 2 of 2

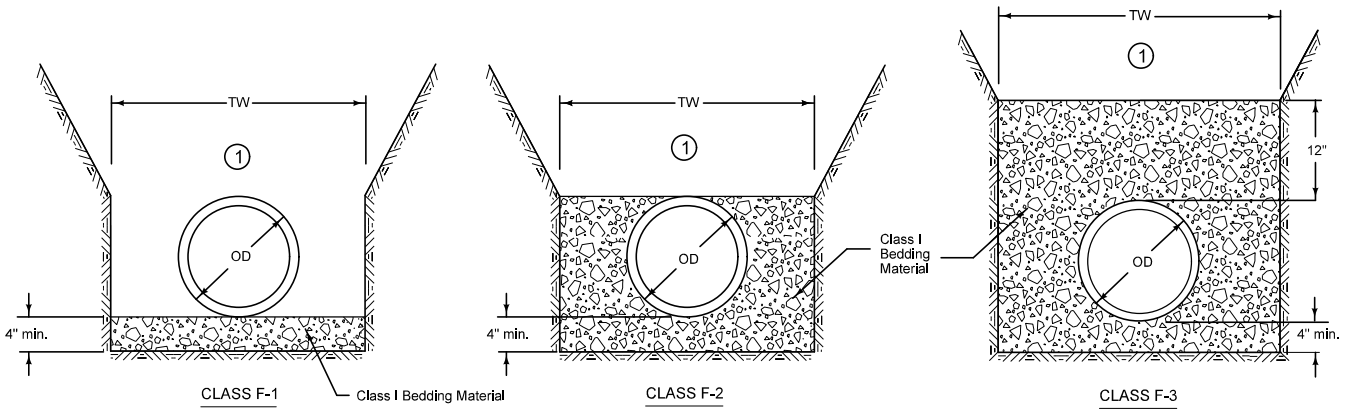
REVISIONS: Added note DO NOT USE ON PRIMARY ROADWAYS.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

RIGID GRAVITY PIPE TRENCH BEDDING

DO NOT USE ON PRIMARY ROADWAYS

BEDDING CLASSES



1. Place remainder of bedding and backfill materials as specified in the contract documents.
2. Minimum depth of bury 12 inches or as specified by the manufacturer.

ALLOWABLE BEDDING CLASSES

PIPE MATERIAL	STORM SEWER	SANITARY SEWER
Ductile Iron	F-1, F-2, F-3	F-1, F-2, F-3
HDPE	F-2, F-3	Not allowed
Polypropylene	F-2, F-3	F-3
PVC	F-2, F-3	F-3

Key

OD = Outside diameter of pipe

TW = Trench width at top of pipe:
Min. = OD+18 Inches OR 1.25xOD+12 Inches
(whichever is greater)

ALLOWABLE BURY DEPTH (2)

PVC PIPE

Pipe Diameter (in)	ASTM D 3034			ASTM F 679	ASTM F 949	ASTM F 1803	ASTM D 2680
	Solid Wall			Solid Wall	Corrug. Exterior	Closed Profile	Composite (Truss Type)
	SDR 23.5	SDR 26	SDR 35	SDR 35			
8	30'	28'	24'	---	24'	---	32'
10	30'	28'	24'	---	24'	---	32'
12	30'	28'	24'	---	24'	---	32'
15	30'	28'	24'	---	24'	---	32'
18	---	---	---	24'	24'	---	---
21	---	---	---	24'	24'	24'	---
24	---	---	---	24'	24'	24'	---
27	---	---	---	24'	---	24'	---
30	---	---	---	24'	24'	24'	---
33	---	---	---	24'	---	---	---
36	---	---	---	24'	24'	24'	---
42	---	---	---	24'	---	24'	---
48	---	---	---	24'	---	24'	---
54	---	---	---	---	---	24'	---
60	---	---	---	---	---	24'	---

DUCTILE IRON, AWWA C151, CLASS 52

Pipe Diameter (in)	Class F-1 Bedding	Class F-2 Bedding	Class F-3 Bedding
4	40'	40'	40'
6	40'	40'	40'
8	40'	40'	40'
10	40'	40'	40'
12	37'	40'	40'
14	31'	40'	40'
16	28'	37'	40'
18	25'	34'	40'
20	23'	32'	40'
24	20'	29'	38'
30	18'	23'	31'
36	18'	22'	30'
42	17'	21'	29'
48	16'	19'	27'
54	16'	19'	27'

HDPE PIPE

Pipe Diameter (in)	AASHTO M 294
12	8'
15	9'
18	9'
24	9'
30	9'
36	9'
42	8'
48	8'
54	8'
60	8'

POLYPROPYLENE PIPE

Pipe Diameter (In)	ASTM F 2764
12	24'
15	25'
18	22'
24	20'
30	22'
36	21'
42	22'
48	23'
54	21'
60	21'

SUDAS | IOWA DOT

REVISION: 4 | 04-20-21

FIGURE 3010.103 | STANDARD ROAD PLAN | SW-103

SHEET 1 of 1

REVISIONS: Added note DO NOT USE ON PRIMARY ROADWAYS.

Paul D. Wigand, SUDAS DIRECTOR

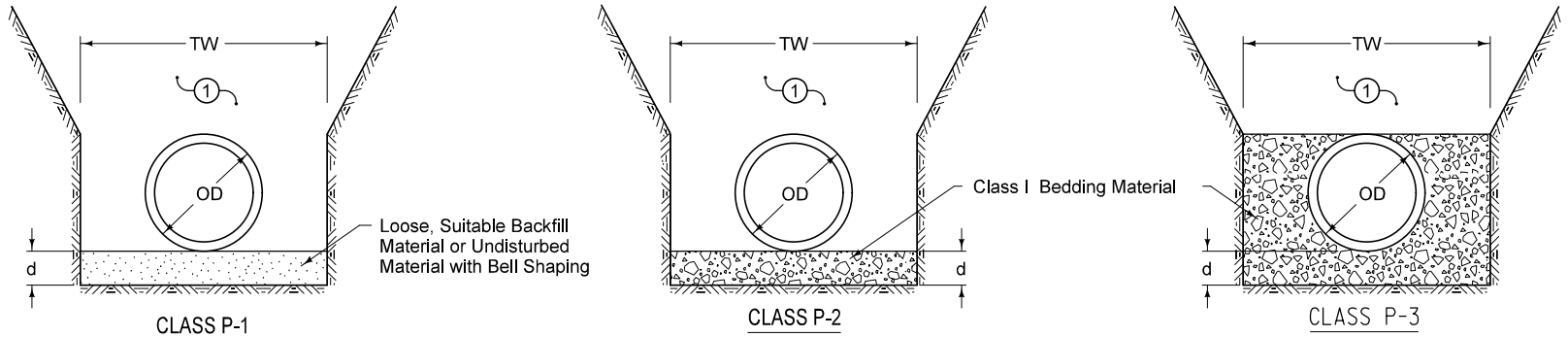
Stuart Nicholson, DESIGN METHODS ENGINEER

FLEXIBLE GRAVITY PIPE TRENCH BEDDING

FIGURE 3010.103 | SHEET 1 OF 1

DO NOT USE ON PRIMARY ROADWAYS

BEDDING CLASSES



ALLOWABLE BURY DEPTH

DUCTILE IRON, AWWA C151, CLASS 52

Pipe Diameter (inches)	Class P-1 Bedding	Class P-2 Bedding	Class P-3 Bedding
4	40'	40'	40'
6	40'	40'	40'
8	40'	40'	40'
10	36'	40'	40'
12	31'	40'	40'
14	26'	40'	40'
16	23'	37'	40'
18	20'	34'	40'
20	18'	32'	40'
24	16'	29'	38
30	13'	23'	31'
36	13'	22'	30'
42	13'	21'	29'
48	13'	19'	27'
54	13'	19'	27'

PVC, AWWA C900, DR18

Pipe Diameter (inches)	Class P-1 Bedding	Class P-2 Bedding	Class P-3 Bedding
4	19'	23'	40'
6	19'	23'	40'
8	19'	23'	40'
10	19'	23'	40'
12	19'	23'	40'
14	19'	23'	40'
16	19'	23'	40'
18	19'	23'	40'
20	19'	23'	40'
24	19'	23'	40'

(1) Place remainder of bedding and backfill material as specified in the contract documents.

Key

OD = Outside diameter of pipe

TW = Trench width at top of pipe:
Min. = OD+18 inches OR 1.25xOD+12 inches
(whichever is greater)

d = Depth of bedding material below pipe:
Min. = OD/8 OR 4 inches
(whichever is greater)

SUDAS | IOWADOT | REVISION 3 04-20-21

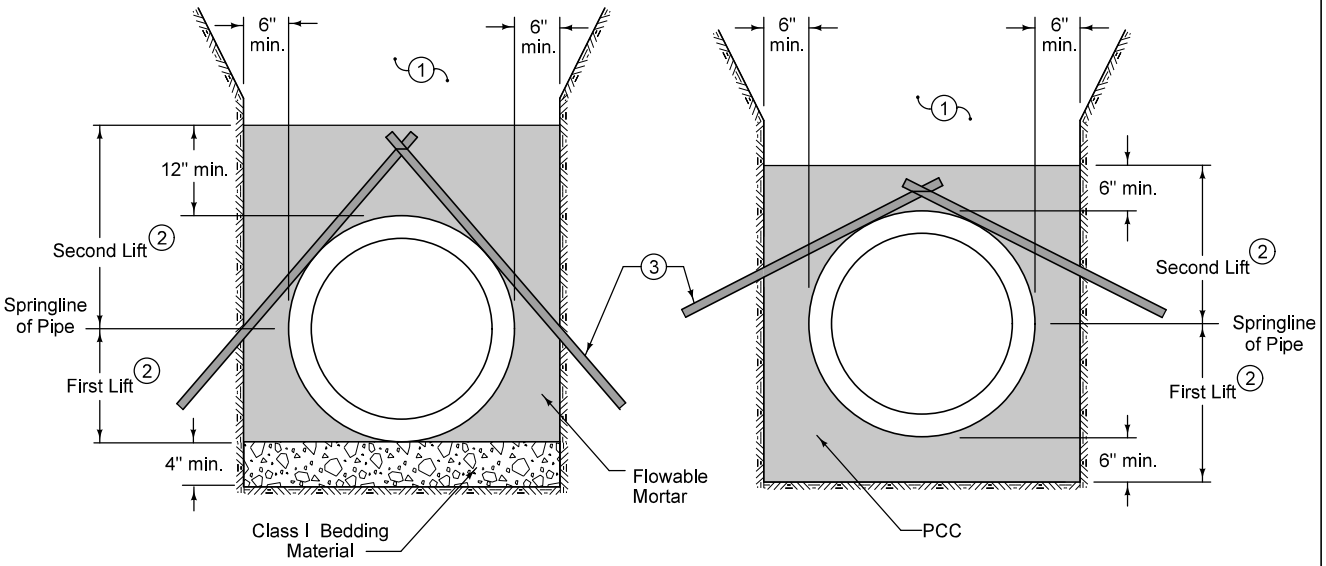
FIGURE 3010.104 | STANDARD ROAD PLAN | SW-104 | SHEET 1 of 1

REVISIONS: Added note DO NOT USE ON PRIMARY ROADWAYS.

Paul D. Wigant, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

PRESSURE PIPE TRENCH BEDDING

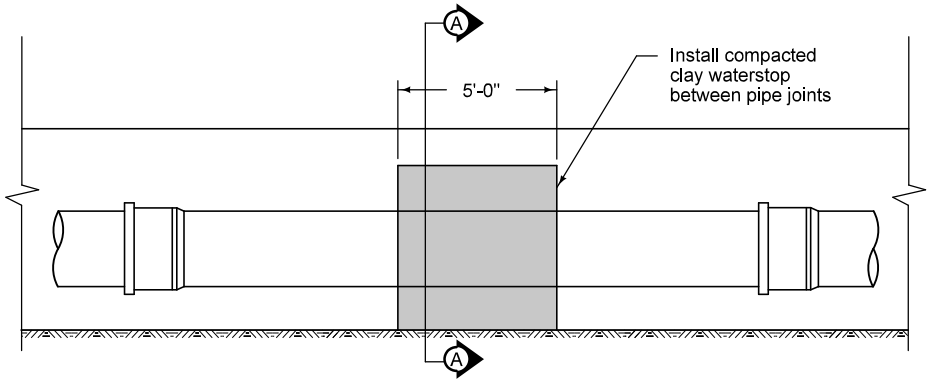
FIGURE 3010.104 SHEET 1OF 1



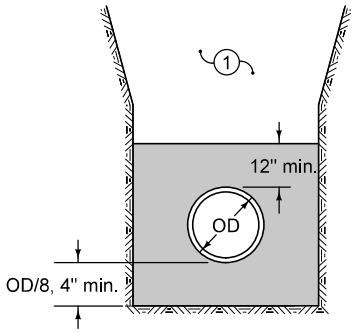
FLOWABLE MORTAR ENCASEMENT

PCC ENCASEMENT

1. Place remainder of bedding and backfill material as specified in the contract documents.
2. Place encasement material in two lifts, or as required to prevent pipe flotation. Allow previous lift to reach initial set prior to placing subsequent lifts.
3. Restrain pipe as necessary to prevent flotation.
4. When specified in the contract documents, install waterstops at a nominal spacing of 800 feet or at locations as specified by the Engineer.



PROFILE



SECTION A-A

WATERSTOP FOR TRENCHES 4

FIGURE 3010.105 SHEET 1 OF 1

SUDAS | IOWA DOT

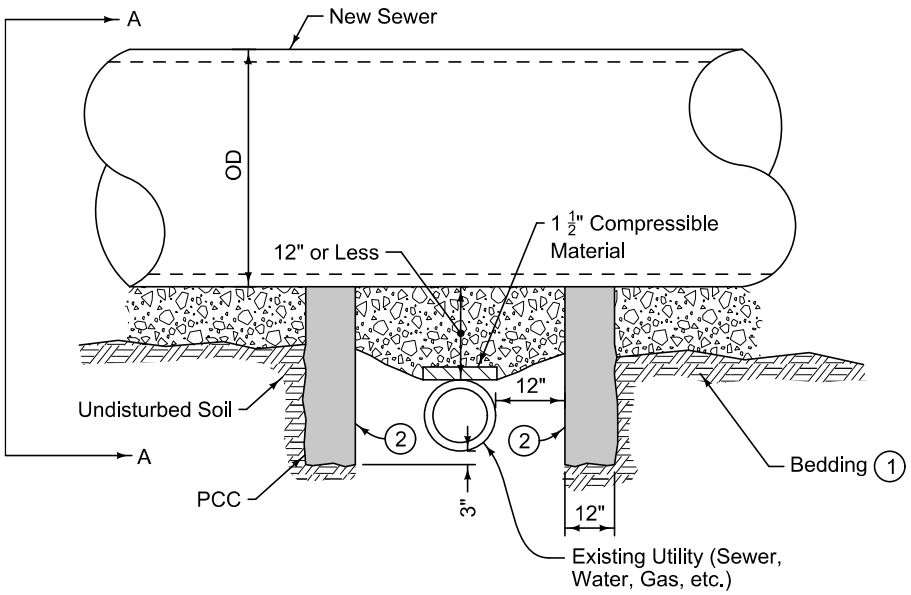
REVISION	
2	04-17-18

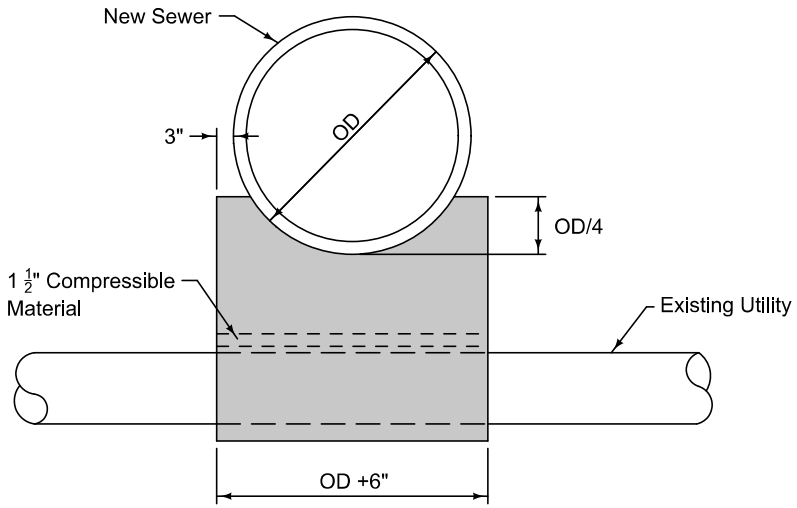
FIGURE 3010.105 | STANDARD ROAD PLAN | SW-105 | SHEET 1 of 1

REVISIONS: Replaced Iowa DOT and SUDAS logos.

Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

MISCELLANEOUS PIPE BEDDING





SECTION A-A

Install pipe support for all new sewers 12 inches in diameter or larger when clearance between bottom of new sewer and top of existing line is 12 inches or less.

1. Comply with Figure 3010.101.
2. Form interior surface of footings. Keep the 12 inch utility clear zone free of concrete.

OD = Outside pipe diameter

FIGURE 3010.901 | SHEET 1 OF 1

SUDAS

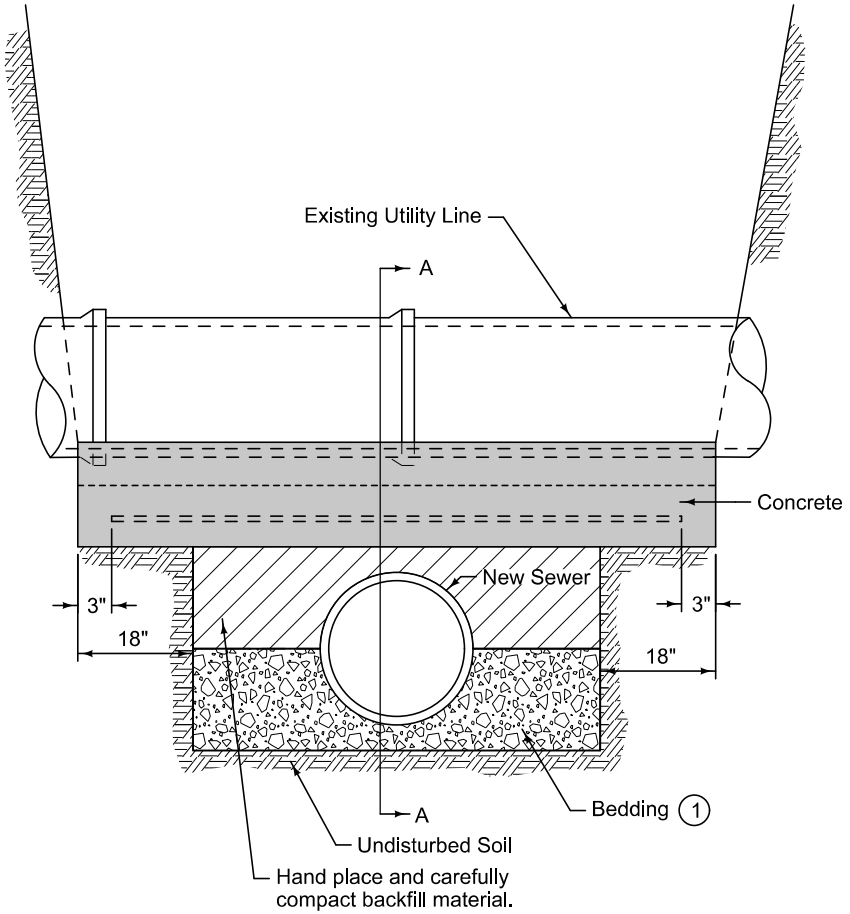
REVISION	
1	10-21-14

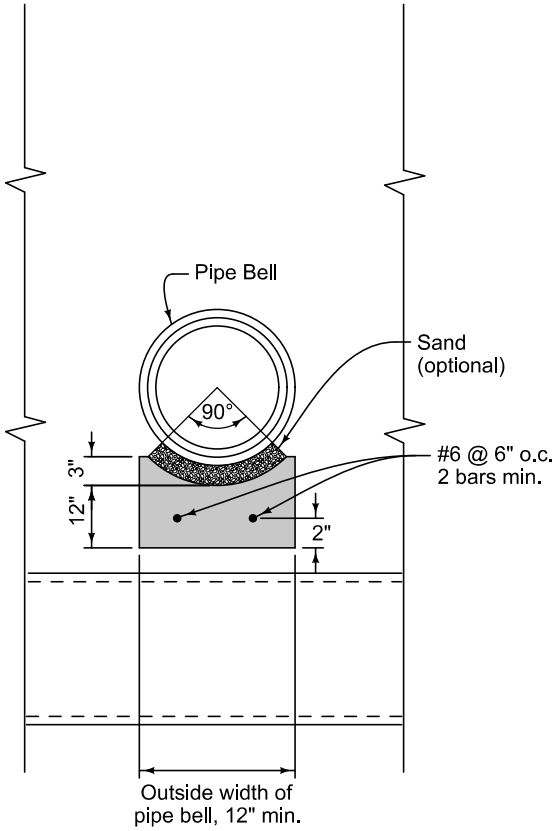
3010.901

SHEET 1 of 1

SUDAS Standard Specifications

SEWER PIPE SUPPORT
OVER EXISTING UTILITY LINE





SECTION A-A

Use reinforced concrete beam utility line support when new sewer excavation is crossing under an existing utility line (sewer lines, water lines, gas lines, etc.) as directed by the Engineer.

Allow concrete to cure a minimum of 48 hours before placing backfill material.

Special design required for trench width greater than 7 feet or trench depth greater than 15 feet.

(1) Comply with Figure 3010.101.

FIGURE 3010.902

SHEET 1 OF 1

SUDAS

REVISION	
1	10-21-14

3010.902

SHEET 1 of 1

SUDAS Standard Specifications

REINFORCED PCC BEAM
UTILITY LINE SUPPORT

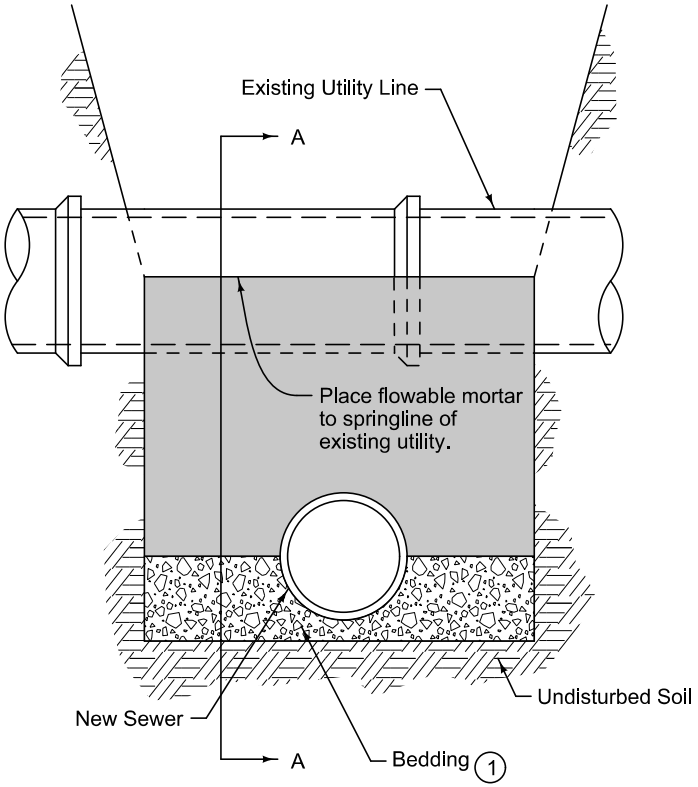
Use flowable mortar utility line support when new utility excavation is crossing under an existing utility line (sewer lines, water lines, gas lines, etc.) as directed by the Engineer.

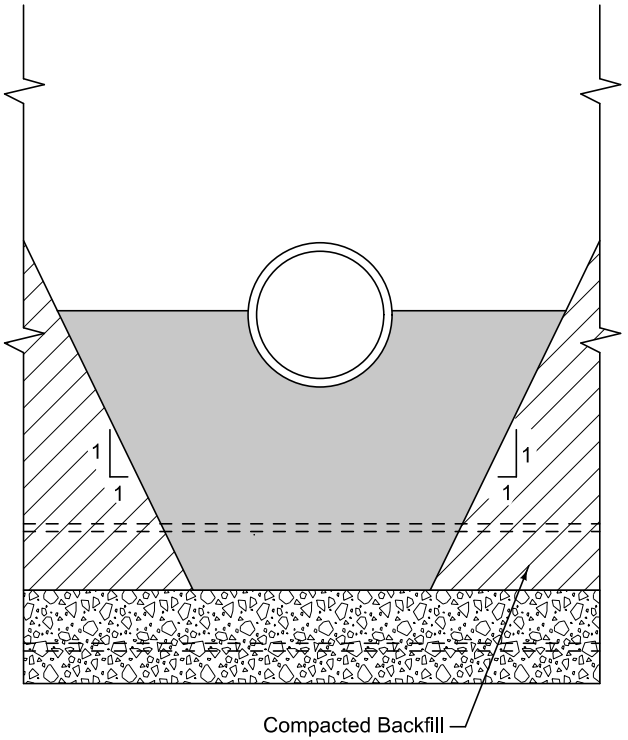
Allow flowable mortar fill to cure a minimum of 24 hours before placing backfill material.

Trim uncompacted backfill material away from slopes before pouring flowable mortar.

Side slopes of flowable mortar fill to be 1:1 or greater. See Section A-A

(1) Comply with Figure 3010.101





SECTION A-A

FIGURE 3010.903

SHEET 1 OF 1

SUDAS

REVISION	
1	10-21-14

3010.903

SHEET 1 of 1

SUDAS Standard Specifications

FLOWABLE MORTAR FILL
UTILITY LINE SUPPORT

TRENCHLESS CONSTRUCTION (BORING, JACKING, AND TUNNELING)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trenchless Installation of Carrier Pipe with Casing Pipe

B. Trenchless Installation of Carrier Pipe without Casing Pipe

1.02 DESCRIPTION OF WORK

A. Excavate launching and receiving pits.

B. Install casing or carrier pipe by trenchless methods.

C. Install carrier pipe inside casing pipe (if required).

D. Place backfill material in excavations.

E. Surface restoration for areas removed to determine utility locations.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Proposed installation methods and equipment.

B. Gradation reports for bedding materials if required.

C. Shop drawings of casing spacers and proposed spacing.

D. Dewatering plan (if required).

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

All items of work contained in this section are incidental to the underground utility pipe being installed and will not be paid for separately.

PART 2 - PRODUCTS

2.01 CARRIER PIPE

A. Carrier Pipe Installed within Casing Pipe:

1. **Sanitary Sewer Gravity Main:** Comply with Section 4010, 2.01.

2. **Sanitary Sewer Force Main:**
   a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 4010, 2.02.
   b. **Restrained Joint PVC Pipe:** Comply with Section 4010, 2.02.

3. **Storm Sewer:** Comply with Section 4020, 2.01.

4. **Culverts:** Comply with Section 4030, 2.01.

5. **Water Main:**
   a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 5010, 2.01.
   b. **Restrained Joint PVC Pipe:** Comply with Section 5010, 2.01.
   c. **Fusible Pipe:** Comply with Section 5011, 2.01.

B. Carrier Pipe Installed without a Casing Pipe:

1. **Sanitary Sewer Gravity Main:**
   a. **Reinforced Concrete Pipe:** Comply with Section 4010, 2.01.
   b. **Vitrified Clay Pipe:** Comply with Section 4010, 2.01.
   c. **Restrained Joint Ductile Iron Pipe:** Comply with Section 4010, 2.02.
   d. **Restrained Joint PVC Pipe:** Comply with Section 4010, 2.02.

2. **Sanitary Sewer Force Main:**
   a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 4010, 2.02.
   b. **Restrained Joint PVC Pipe:** Comply with Section 4010, 2.02.

3. **Storm Sewer and Culverts:**
   a. **Reinforced Concrete Pipe:** Comply with Section 4020, 2.01.
   b. **Reinforced Concrete Arch Pipe:** Comply with Section 4020, 2.01.
   c. **Reinforced Concrete Elliptical Pipe:** Comply with Section 4020, 2.01.
   d. **Reinforced Concrete Low Head Pressure Pipe:** Comply with Section 4020, 2.01.

4. **Water Main:**
   a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 5010, 2.01.
   b. **Restrained Joint PVC Pipe:** Comply with Section 5010, 2.01.
   c. **Fusible Pipe:** Comply with Section 5011, 2.01.

2.02 CASING PIPE

A. Pipe: Use only new, steel pipe meeting the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; ASTM A 53, Grade B; or API 5L X Grade. Pipe may be welded or seamless. Wall thickness will be as specified in the contract documents.

B. Joints:

1. Comply with American Welding Society Code D1.1. Weld all joints with full penetrating weld. Welders must be qualified according to Iowa DOT Article 2408.03, B. Welds must comply with Iowa DOT Materials I.M. 558.

2. Upon approval of the Engineer, an interlocking casing pipe connection system may be used in lieu of field welding the sections of casing pipe.

2.02 CASING PIPE (Continued)

C. Pipe Diameter: Minimum inside diameter as specified in the contract documents. If diameter is not specified, use a minimum inside casing diameter of at least 4 inches greater than the largest outside diameter of the carrier pipe, including pipe bells.

2.03 CASING SPACERS

A. Use manufactured casing spacers to position carrier pipe in casing. Do not use wood skids.

B. Meet the following material requirements:

1. HDPE Band/Panel and Riser: ASTM D 638.

2. Stainless Steel or Carbon Steel Band/Panel and Riser: Type 304 stainless steel according to ASTM A 240 or carbon steel according to ASTM A 36.
   a. Liner: Elastomeric PVC per ASTM D 149.
   b. Spacer Skid/Runner: Abrasion resistant polymer with a low coefficient of friction.
   c. Fasteners: Type 304 (18-8) stainless steel per ASTM A 193.

2.04 BACKFILL FOR ABANDONED TUNNELS

A. Use Iowa DOT Class C concrete, approximately 4 inch slump.

B. Flowable mortar, foamed cellular concrete, or CLSM according to Section 3010, 2.06.

2.05 BACKFILL MATERIAL

A. Excavated Materials: Comply with Section 3010 for classification of excavated materials. Use only suitable material for backfill material.

B. Special Fill Materials: For use where specified in the contract documents.

1. PCC: Use Iowa DOT Class C concrete, approximately 4 inch slump.

2. Flowable Mortar: Comply with Section 3010, 2.06.

3. CLSM: Comply with Section 3010, 2.06.

4. Foamed Cellular Concrete: Comply with Section 3010, 2.06.

2.06 CASING END SEAL

A. Manufactured: Minimum 1/8 inch thick manufactured synthetic rubber casing end seal with stainless steel bands and fasteners.

B. PCC: Comply with Section 6010. Do not use PCC casing end seals with flexible carrier pipes.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Notify the Engineer prior to the start of excavation activities.

B. Remove topsoil to a minimum depth of 12 inches and stockpile.

C. Excavate the minimum size pits necessary to safely and properly perform the work.

1. Protect existing facilities, trees, and shrubs during excavation.

2. Place excavated material away from trench.

3. Grade and shape spoil piles to drain and protect adjacent areas from runoff. Do not allow spoil piles to obstruct drainage. Stabilize stockpiles with seeding and provide sediment control around stockpiles.

D. Remove rock, rubbish, debris, and other materials not suitable for use as backfill.

3.02 SHEETING, SHORING, AND BRACING

Comply with Section 3010, 3.03.

3.03 DEWATERING

Comply with Section 3010, 3.04.

3.04 TRENCHLESS INSTALLATION

A. General: Select a method of installation that is appropriate for the soil conditions anticipated and will 1) allow the pipe to be installed to the desired line and grade within the specified tolerances; 2) prevent heaving or settlement of the ground surface or damage to nearby facilities; and 3) prevent damage to the carrier pipe and any lining materials within the carrier pipe.

1. Installation Methods:

- **a. Auger Boring:** A method that utilizes a rotating cutting head to form the bore hole and a series of rotating augers inside a casing pipe to remove the spoil.
- **b. Directional Drilling:** A method for installing pipe from a surface-launched drilling rig. A pilot bore is formed and then enlarged by back reaming and removing the spoil material. The pipe is then pulled in place.
- **c. Open-ended Pipe Ramming:** A method that involves driving a steel casing pipe with a percussive hammer. The front end of the casing pipe is open-ended. Spoils are removed from the pipe.
- **d. Pipe Jacking:** A method in which pipe is pushed into the ground with hydraulic jacks while soil is simultaneously excavated. Excavation is normally completed with a tunnel boring machine.
- **e. Microtunneling:** A method of pipe jacking using a remote controlled tunnel boring machine.
- **f. Utility Tunneling:** A method of forming large diameter tunnels. As excavation takes place at the front of the tunnel, a liner is constructed to temporarily support the tunnel. Upon completion of the tunnel, the pipe is pushed in place.
- **g. Other:** Other methods may be allowed with the Engineer's approval.

3.04 TRENCHLESS INSTALLATION (Continued)

2. Line and Grade:

a. Install pipe at line and grade that will allow the carrier pipe to be installed at its true starting elevation and grade within the specified maximum alignment deviation of the pipe centerline.

b. When no deviation tolerances are specified in the contract documents, apply the following maximum deviations to the carrier pipe.

1) Gravity Pipe:

a) Horizontally: $\pm$ 1.0 foot per 100 feet;

b) Vertically: $\pm$ 0.2 feet up to 100 feet; an additional $\pm$ 0.1 foot per 100 feet thereafter. Backfall in pipe is not allowed.

2) Pressurized Pipe:

a) Horizontally: ± 2.0 feet

b) Vertically: ± 1.0 foot. Maintain the minimum depth specified in the contract documents.

c. Greater deviation or interference with other identified facilities may be cause for rejection.

3. Deviation from Line and Grade:

a. Provided adequate clearance remains for proper installation of the carrier pipe, the Contractor will be allowed to correct deviations in grade of a casing pipe in order to achieve design grade of the carrier pipe by:

- Pouring an invert in the casing pipe, or
- Shimming the carrier pipe with casing spacers to a uniform grade.

b. Installations deviating from the specified tolerances that cannot be adjusted to conform to the specified tolerances may be rejected by the Engineer. If non-conforming installation is not rejected, provide all additional fittings, manholes, or appurtenances needed to accommodate horizontal or vertical misalignment, at no additional cost to the Jurisdiction.

c. Abandon rejected installation and place special fill materials, at no additional cost to the Jurisdiction. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required to replace rejected installations.

B. Casing Pipe or Un-cased Carrier Pipe Installation:

1. Install pipe by approved methods.

2. Use a jacking collar, timbers, and other means as necessary to protect the driven end of the pipe from damage.

3. Do not exceed the compressive or tensile strength capacity of the pipe during pushing or pulling operations.

4. Fully support bore hole at all times to prevent collapse. Insert pipe as soil is removed, or support bore with drilling fluid.

5. Fully weld all casing pipe joints. Use an interlocking connection system when approved by the Engineer.

6. Fill space between the inside of the bore hole and the outside of the pipe with special fill material if the space is greater than 1 inch.

C. Carrier Pipe Installation through Casing:

1. Clean dirt and debris from the interior of the casing pipe after installation.

3.04 TRENCHLESS INSTALLATION (Continued)

2. Install casing spacers on carrier pipe sections as necessary to support the pipe barrel according to the pipe manufacturer's recommendations subject to the following minimum requirements:
   a. Install a spacer within 1 foot of each side of the carrier pipe joint and at a maximum spacing of 6 feet.
   b. Do not allow the pipe to be supported by joint bells.
   c. Lubricate casing spacers with drilling mud or flax soap. Do not use petroleum-based lubricants or oils.

3. Ensure that thrust loads will not damage carrier pipe joints. Provide thrust collars between joint shoulders of concrete pipe.

4. Provide timbers for sufficient cushioning between the end of the pipe pushed and the jacking equipment to prevent damage to the pipe. Do not allow the steel jack face to thrust against the unprotected pipe end.

5. Position jacks so the resulting force is applied evenly to the entire end of the pipe.

6. Assemble pipe joints in the jacking pit before pushing the carrier pipe into the casing.

7. Close the end of the casing pipe around the carrier pipe with a casing end seal.

D. Annular Space Grouting: If specified, fill the annular space between the carrier pipe and the casing pipe with flowable mortar, foamed cellular concrete, or CLSM according to Section 3010. Batching, mixing, and placing may be started when the temperature is 34°F and rising. Cease mixing and placing when temperature is 38° F or less and falling.

1. Flowable Mortar and CLSM: Fill voids by staged grouting. Construct bulkheads at each end of the pipe. Ensure all voids are filled with flowable mortar by providing 2 feet of head when filling.

2. Foamed Cellular Concrete:
   a. Construct bulkheads sufficient to withstand pressure of grouting operation at each end of the pipe.
   b. Use sufficient grouting pressures to ensure all voids between the inner pipe and the casing pipe have been filled without collapsing or deforming the inner pipe by more than 5% of the diameter. Multiple grout lifts may be necessary. Follow manufacturer's recommendations.
   c. Check wet density at the beginning of the placement and a minimum of every 2 hours thereafter. Provide test results to the Engineer.
   d. If grout holes are utilized, insert cylindrical wood plugs or other approved plugs until grout has set. Fill holes with concrete after plugs have been removed.

3.05 PIT RESTORATION

A. Remove installation equipment and unused materials from the launching and receiving pits.

B. When the carrier pipe extends beyond the limits of trenchless installation and into the bore pit, place bedding and backfill material according to Section 3010, 3.05.

C. Place suitable backfill material in the pit. Apply the testing requirements of Section 3010, 3.06.

D. Restore the site to original condition or better.

3.06 UTILITY LOCATING SITE RESTORATION

Restore areas removed as a means to locate underground utilities according to Section 7040, 3.01, G for paved areas and Section 9010 for non-paved areas, unless otherwise directed by the Jurisdiction.

END OF SECTION

Insert tab here called

DIVISION 4
Sewers and Drains

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SANITARY SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sanitary Sewer Gravity Mains

B. Sanitary Sewer Force Mains

C. Sanitary Sewer Services

1.02 DESCRIPTION OF WORK

A. Construct sanitary sewer gravity and force mains.

B. Construct or relocate building sanitary sewer services, stubs, and connections.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Sanitary Sewer Gravity Main:

1. **Trenched:**
   - **a. Measurement:** Each type and size of pipe installed in a trench will be measured in linear feet along the centerline of the pipe from center of manhole to center of manhole.
   - **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
   - **c. Includes:** Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; pipe lining (if specified); furnishing, placing, and compacting bedding and backfill material; wyes and other fittings; pipe joints; pipe connections; testing; and inspection.

2. **Trenchless:**
   - **a. Measurement:** Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of pipe.
   - **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
   - **c. Includes:** Unit price includes, but is not limited to, furnishing and installing pipe; pipe lining (if specified); trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; pipe connections; testing; and inspection.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Sanitary Sewer Gravity Main with Casing Pipe:

1. Trenched:

a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe, from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; pipe lining (if specified); trench excavation; dewatering; furnishing, placing, and compacting bedding and backfill material; furnishing and installing annular space fill material; casing spacers; pipe connections; testing; and inspection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; pipe lining (if specified); trenchless installation materials and equipment; pit excavation; dewatering; and placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

C. Sanitary Sewer Force Main:

1. Trenched:

a. Measurement: Each type and size of pipe installed in an open trench will be measured in linear feet along the centerline of the pipe from the outside wall of the pumping station to the center of manhole, or from the center of manhole to the center of manhole.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill; wyes and other fittings; pipe joints; testing; and inspection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; pipe connections; testing; and inspection.

D. Sanitary Sewer Force Main with Casing Pipe:

1. Trenched:

a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

1.08 MEASUREMENT AND PAYMENT (Continued)

c. **Includes:** Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing, placing, and compacting bedding and backfill material; furnishing and installing annular space fill material; casing spacers; pipe connections; testing; and inspection.

2. **Trenchless:**
   a. **Measurement:** Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe.
   b. **Payment:** Payment will be made at the unit price per linear foot for each type and size of carrier pipe.
   c. **Includes:** Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

E. Sanitary Sewer Service Stub: The portion of the sanitary sewer service from the main to a point 10 feet outside of the right-of-way line or as specified in the contract documents (comply with Figure 4010.201).

1. **Measurement:** Each type and size of pipe will be measured in linear feet along the centerline of the pipe from the end of the pipe to the centerline of the sewer main.

2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of sanitary sewer service stub.

3. **Includes:** Unit price includes, but is not limited to, trench excavation; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; tap; fittings; testing; and inspection.

F. Sanitary Sewer Service Relocation: The portion of an existing sanitary sewer service in a zone of conflict.

1. **Measurement:** Each completed relocation will be counted.

2. **Payment:** Payment will be made at the unit price for each relocation.

3. **Includes:** Unit price includes, but is not limited to, removal of existing pipe, trench excavation, furnishing new pipe and bedding material, placing and compacting bedding and backfill material, connection back to existing service, compaction, testing, and inspection.

G. Sewage Air Release Valve and Pit:

1. **Measurement:** Each completed installation, including valve, accessories, and pit, will be counted.

2. **Payment:** Payment will be made at the unit price for each sewage air release valve and pit.

3. **Includes:** Unit price includes, but is not limited to, excavation; furnishing, placing, and compacting bedding and backfill material; and testing.

1.08 MEASUREMENT AND PAYMENT (Continued)

H. Removal of Sanitary Sewer:

1. **Measurement:** Each type and size of pipe removed will be measured in linear feet from end to end.

2. **Payment:** Payment will be at the unit price per linear foot for each type and size of pipe.

3. **Includes:** Unit price includes, but is not limited to, removal, disposal, and capping (if specified) of pipe; and furnishing, placing, and compacting backfill material.

I. Sanitary Sewer Cleanout:

1. **Measurement:** Each sanitary sewer cleanout will be counted.

2. **Payment:** Payment will be made at the unit price for each cleanout.

3. **Includes:** Unit price includes, but is not limited to, plug at the end of the main, fittings, riser pipe, cap with screw plug, casting, and concrete casting encasement.

J. Connection to Existing Manhole: Comply with Section 6010, 1.08, G.

K. Sanitary Sewer Abandonment, Plug:

1. **Measurement:** Each plug will be counted.

2. **Payment:** Payment will be made at the unit price for each plug installed.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary), cutting pipe (if required), furnishing and placing plug materials, and placing and compacting backfill material.

L. Sanitary Sewer Abandonment, Fill and Plug:

1. **Measurement:** Each size of sanitary sewer to be abandoned by filling and plugging will be measured in linear feet.

2. **Payment:** Payment will be at the unit price per linear foot for each size of pipe filled and plugged.

3. **Includes:** Unit price includes but is not limited to, trench excavation (if necessary), cutting pipe (if required), furnishing and placing pipe fill material, furnishing and placing plug materials, and placing and compacting backfill material.

PART 2 - PRODUCTS

2.01 SANITARY SEWER (Gravity Mains)

A. Solid Wall Polyvinyl Chloride Pipe (PVC) 8 inch to 15 inch:

1. Comply with ASTM D 3034, SDR 26, unless SDR 35 is specified.

2. Pipe stiffness per ASTM D 2412.
   a. SDR 26: Minimum pipe stiffness of 115 psi.
   b. SDR 35: Minimum pipe stiffness of 46 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12454 or 12364.

4. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

B. Solid Wall Polyvinyl Chloride Pipe (PVC) 18 inch to 48 inch:

1. Comply with ASTM F 679.

2. Pipe stiffness per ASTM D 2412, 46 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12454 or 12364.

4. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

C. Corrugated Polyvinyl Chloride Pipe (PVC) 8 inch to 36 inch:

1. Comply with ASTM F 949, smooth interior, corrugated exterior.

2. Pipe stiffness per ASTM D 2412.
   a. 8 inch to 10 inch: Minimum pipe stiffness of 115 psi, unless 46 psi is specified.
   b. 12 inch to 36 inch: Minimum pipe stiffness of 46 psi.

3. PVC resin meeting ASTM D 1784, Cell Classification 12454.

4. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

D. Closed Profile Polyvinyl Chloride Pipe (PVC) 21 inch to 60 inch:

1. Comply with ASTM F 1803.

2. Pipe stiffness per ASTM D 2412, 46 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12364.

4. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

2.01 SANITARY SEWER (Gravity Mains) (Continued)

E. Polyvinyl Chloride Composite Pipe (truss type PVC) 8 inch to 15 inch:

1. Comply with ASTM D 2680. Pipe constructed with truss-type structure between inner and outer PVC walls with voids filled with lightweight concrete.

2. Pipe stiffness per ASTM D 2412, 200 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12454.

4. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and F 477.

F. Reinforced Concrete Pipe (RCP) 18 inch to 144 inch:

1. General:
a. Comply with ASTM C 76 (AASHTO M 170).
b. Minimum Class IV (3000D), Wall B.
c. Tongue and groove joints.
d. Rubber O-ring or profile gasket flexible joint complying with ASTM C 443.

2. Pipe Lining:
a. Epoxy Coal Tar:
1) Coat interior pipe barrel and all joint surfaces with two-component coal-tar epoxy-polyamide black paint or approved equal.
2) Lining Material: Steel Structures Painting Council (SSPC) Specification No. 16, Table 1.
a) Minimum epoxy resin content 34% to 35% by dry film weight.
b) Minimum sag resistance 40 mils.
c) Minimum solids 80% by volume.
3) Apply according to lining material manufacturer's recommendations.
b. PVC:
1) Minimum thickness of 0.65 inch.
2) Locking extensions extruded from the same material as the liner a minimum of 0.375 inches tall spaced a maximum of 2.5 inches.
3) Liner to cover the entire interior of the concrete pipe.
4) Minimum tensile strength of liner is 2200 psi with a minimum elongation of 200% at breaking.
5) Meet EPA 9090 for chemical resistance.
6) Free of cracks, cleavages, pinholes, or other defects.
7) Joint sealer strip to be from the same material as the liner.
c. HDPE:
1) Minimum thickness of 0.064 inches according to ASTM D5199.
2) Minimum density of 0.90 g/cm^3.
3) Meet EPA 9090 for chemical resistance.
4) Locking extensions made from the same material as the liner with minimum pullout strength of 14,000 pounds per square foot.
5) Free of cracks, cleavages, pinholes, or other defects.
6) Joint sealer strip to be from the same material as the liner.
7) If gasketed joints, comply with ASTM F 477 and ability to withstand a minimum groundwater pressure equal to that of the pipe liner or 20 psi, whichever is greater.

G. Ductile Iron Pipe (DIP) 8 inch to 54 inch:

1. General:
a. Comply with AWWA C151.
b. Minimum thickness Class 52.

2.01 SANITARY SEWER (Gravity Mains) (Continued)

2. Interior Linings:
a. Provide interior lining for ductile iron pipe and fittings used for all gravity sewers and drop connections.
b. Use linings specifically designed for sanitary sewer applications, such as ceramic epoxy. Other lining types may be allowed upon approval of the Engineer.
c. Apply lining to interior of unlined ductile iron pipe and fittings according to the published specifications from the manufacturer.
d. Seal all cut ends and repair field damaged areas according to the manufacturer's recommendations.

3. Exterior Coating: Asphalt.

4. Joints: Push-on complying with AWWA C111.

5. Fittings: Mechanical complying with AWWA C110 or AWWA C153.

6. Polyethylene Encasement:
a. Comply with AWWA C105.
b. Minimum thickness of 8 mils.
c. Use for all ductile iron pipe and fittings in buried service.

H. Vitrified Clay Pipe (VCP) 8 inch to 42 inch:

1. Pipe and fittings complying with ASTM C 700.

2. Compression joints complying with ASTM C 425 for plain end pipe or bell and spigot pipe.

3. Test according to ASTM C 301.

I. Double Walled Polypropylene Pipe 12 inch to 30 inch:

1. Comply with ASTM F 2764.

2. Minimum pipe stiffness per ASTM D 2412, 46 psi.

3. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.

J. Triple Walled Polypropylene Pipe 30 inch to 36 inch:

1. Comply with ASTM F 2764.

2. Minimum pipe stiffness per ASTM D 2412, 46 psi.

3. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.

2.02 SANITARY SEWER FORCE MAINS

A. Ductile Iron Pipe (DIP) 4 inch to 54 inch: Comply with the DIP requirements in Section 4010, 2.01. If joint restraints are specified, comply with Section 5010, 2.03.

B. Polyvinyl Chloride Pipe (PVC): Comply with the requirements in Section 5010, 2.01 for PVC pipe. Provide restrained joints when specified.

C. Fusible PVC and HDPE Pipe: Comply with the requirements in Section 5011, 2.01.

2.02 SANITARY SEWER FORCE MAINS (Continued)

D. Sewage Air Release Valve:

1. **General:** Consists of an elongated tapered or conical body and a float to operate (open and close) under pressure without spillage. Provide valves suitable for pressures up to 150 psi. Use a float with a linkage connection to the seal plug assembly to prevent irregular air release and protect the connecting rod. Ensure the bottom of the valve body is sloped or funnel-shaped to encourage the accumulated sewage and solids to drain from the valve. Preserve a volume of air at all times between the liquid sewage and the seal plug assembly. Provide a flushing port with attachments for backwashing.

2. **Materials:**
   a. **Body and Cover:**
      1) Stainless Steel: ASTM A 351.
      2) Cast Iron: ASTM A 126, Grade B.
      3) Ductile Iron: ASTM A 536, Grade 65-45-12.
      4) Other corrosion resistant materials.
   b. **Internal Metal Components:** Stainless steel.
   c. **Float:** Stainless steel, ASTM A 240, Type 304 or Type 316, or foamed polypropylene.
   d. **Seal Plug Assembly:** Stainless steel, foamed polypropylene, EPDM rubber, Nitrile (Buna-N) rubber, and reinforced nylon.

3. **Tapping Saddle:** Stainless steel or nylon.

4. **Pit:** Construct according to Figure 4010.202.

E. Tracer Wire:
Comply with Section 5010, 2.05. Tracer wire will be required on all force mains.

F. Tracer Wire Station:

1. Two internal terminals with shunt.

2. Five to six foot plastic post (color as specified by the Jurisdiction).

3. Removable top cap with lock.

4. Decals indicating “Sewer Force Main” or similar language.

2.03 CASING PIPE

Comply with Section 3020, 2.02 for casing pipe requirements.

2.04 SANITARY SEWER SERVICES

A. Connection to Main:

1. **PVC Main:**
   a. Preformed wye or tee service fitting with integral bell and spigot joints with elastomeric seals complying with ASTM D 3034 or ASTM F 949.
   b. Preformed saddle wye or saddle tee for service tap complying with ASTM D 3034 or ASTM F 949.
   c. PVC plastic meeting ASTM D 1784, Cell Classification 12454.

2.04 SANITARY SEWER SERVICES (Continued)

2. PVC Composite Main:
a. Preformed wye or tee service fitting with integral bell and spigot joints with elastomeric seals complying with ASTM D 3212.
b. Preformed saddle wye or saddle tee for service tap complying with ASTM D 2680.

3. RCP Main: Preformed saddle wye or saddle tee service tap designed for use with RCP.

4. VCP Main:
a. Precast VCP wye or tee service fitting complying with ASTM C 700 for pipe and ASTM C 425 for compression joints.
b. Preformed saddle wye or saddle tee service tap designed for use with VCP.

5. DIP Main:
a. Use DIP wye or tee fittings complying with AWWA C110 or AWWA C153.
b. Preformed saddle wye or tee services tap designed for use with DIP. Cut the hole for the tap with equipment designed for application.

B. Wye and Tee Pipe Stop: All saddle wye or saddle tee fittings must provide integrally molded pipe stop in the branch for positive protection against service pipe insertion beyond the inside of sewer main pipe wall.

C. Service Pipe: Use products as required by local plumbing code or regulations, if applicable. Otherwise, use the following:

1. PVC:
a. Comply with ASTM D 3034, minimum thickness SDR 23.5 minimum pipe stiffness of 153 psi as per ASTM D 2412.
b. PVC plastic meeting ASTM D 1784, Cell Classification 12454.
c. Integral bell and spigot type rubber gasket joint complying with ASTM D 3212.

2. DIP: As specified for sanitary sewer force main, including polyethylene encasement.

D. Connection to Existing Service: Comply with Section 4050, 2.06.

2.05 SANITARY SEWER SERVICE RELOCATIONS

A. Comply with Section 4010, 2.04 for all materials used for sanitary service relocation.

B. Use the same nominal size as the existing service being relocated.

2.06 SANITARY SEWER CLEANOUT

Comply with Figure 4010.203.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify measurements at site. Make necessary field measurements to accurately determine pipe makeup lengths or closures.

B. Examine site conditions to ensure construction operations do not pose hazards to adjacent structures or facilities.

3.02 GRAVITY SEWER INSTALLATION

A. General:

1. Install watertight plug to prevent water from entering the existing sewer system.
2. Clean pipe interior and joints prior to installation. Keep pipe clean during construction.
3. Begin at the lowest point in the line. Lay groove or bell end pointing upstream unless otherwise specified.
4. Assemble joints according to Section 4010, 3.04.
5. Use a saw to cut ends of pipe flush with inside wall of manholes and structures. Do not use hammer or other means to break pipe.
6. Provide manholes as specified in the contract documents.
7. Install cap, plug, or bulkhead at exposed ends of pipe upon completion of construction or whenever pipe installation is not in progress.

B. Trenched:

1. Excavate trench and provide pipe bedding and backfill material as specified in Section 3010.
2. Prepare trench bottom to design line and grade so that only minor movement of the pipe is necessary after installation.
3. Lay pipe to design line and grade. Set field grades to invert of pipes.
4. Provide uniform bearing for full pipe barrel length. Excavate bell holes as necessary for uniform support of pipe barrel on bedding material.
5. Do not lay pipe in water or on saturated soil or bedding, or allow water to rise in trench around pipe prior to placing backfill material.
6. Do not disturb installed pipe and bedding when using movable trench boxes and shields. Block or anchor pipe as necessary to prevent joint displacement.
7. Install wye or tee service fitting at each location specified in the contract documents.

C. Trenchless: Comply with Section 3020.

3.03 SANITARY SEWER INSTALLED WITHIN A CASING PIPE

Comply with Section 3020, 3.04 for installation of sanitary sewer within casing pipe.

3.04 GRAVITY MAIN PIPE JOINTING

A. General:

1. Clean joint surfaces to remove soil or foreign material prior to jointing pipe.

2. Assemble joints according to pipe manufacturer's recommendations. Use equipment that does not apply damaging forces to pipe joints.

B. Polyvinyl Chloride Pipe (PVC) and Polyvinyl Chloride Composite Pipe (truss-type):

1. Coat rubber gasket and joint with soap-based lubricant immediately prior to closing joint.

2. Seal ends of PVC composite and closed profile pipe at manholes with the coating recommended by the manufacturer.

C. Reinforced Concrete Pipe (RCP): Coat rubber gasket and joint with soap-based lubricant immediately prior to closing joint.

D. Ductile Iron Pipe (DIP):

1. Push-on Joint: Coat gasket and joint with soap-based lubricant immediately prior to closing joint.

2. Mechanical Joint: Wash plain end, bell socket, and gasket with soap solution. Press gasket into socket, set gland, and tighten bolts uniformly.

E. Polypropylene Pipe: Coat gasket and bell with lubricant immediately prior to closing joint.

F. Connections between Dissimilar Pipes:

1. Use manufactured adapters or couplings approved by the Engineer.

2. Where adapters or couplings are not available, the Engineer may authorize use of a Type PC-2 concrete collar as shown on Figure 4020.211.

3.05 FORCE MAIN INSTALLATION

A. General: Install according to Section 5010.

B. Tracer Wire:

1. Required for all force main installations. Comply with Section 5010.

2. Install tracer wire station at each end of the force main and at additional locations specified in the contract documents.

3. Bury end of tracer wire station 2 feet and compact.

3.06 SANITARY SEWER SERVICE STUBS

A. Provide sanitary sewer service stubs at locations specified in the contract documents.

B. Install wye or tee for each service connection.

1. Connection of sanitary service to new sewer main, except RCP:
   a. Use only factory wye or tees.
   b. Install according to manufacturer's requirements and Section 4010, 2.04 and 3.04 for joints.

3.06 SANITARY SEWER SERVICE STUBS (Continued)

2. Connection to existing sewer main and new RCP:
   a. Cut sewer main for service tap with hole saw or sewer tap drill.
   b. Use preformed saddle wye or saddle tee for service tap. Use a gasketed saddle with rigid pipe mains and a solvent-cemented saddle with PVC mains.
   c. Install according to the manufacturer's requirements, but always attach with at least two stainless steel band clamps.

C. Install service stub from sewer main to a location 10 feet beyond the right-of-way line or as specified in the contract documents. Comply with Figure 4010.201.

1. Install according to Section 4010, 3.02.

2. Install service stub with a slope between 2% and 5% for 4 inch pipes, and between 1% and 5% for pipes 6 inches and greater.

3. Terminate end of service stub 10 to 12 feet below finished ground elevation or as specified in the contract documents.

4. If the depth of the sewer main causes the service to exceed a depth of 12 feet or a slope of 5%, install a service riser.

5. For undeveloped properties, place watertight stopper, cap, or plug in end of sanitary sewer service. Mark the end of the service line as required by the Jurisdiction or as specified in the contract documents.

6. For reconnection of new service pipe with existing service pipe, comply with the Jurisdiction's plumbing code.

3.07 SANITARY SEWER SERVICE RELOCATION

A. Relocate existing sanitary sewer services that conflict with new storm or sanitary sewer installations. Existing services located within a conflict zone from 6 inches below the bottom of the proposed sewer pipe to 2 inches above the top of the proposed sewer pipe require relocation.

B. When a conflicting service is encountered:

1. Determine grades and elevations of the existing service and proposed main.

2. Determine the extent of service replacement necessary to relocate the service outside of the conflict zone while maintaining a minimum 1% slope on the sewer service.

3. If it is not feasible to maintain a minimum slope of 1% on the relocated service, a special design and additional work may be required. Stop work and contact the Engineer. Do not remove sewer service unless directed by the Engineer.

4. If service relocation with a minimum slope of 1% is feasible, proceed with removal and replacement of the existing sanitary sewer service.
   a. Length of replacement varies. Remove the existing service to the extent necessary to move the service out of the conflict zone.
   b. Use all new materials complying with Section 4010, 2.04.
   c. Re-install the service according to Section 4010, 3.02.
   d. Maintain a minimum 1% grade on relocated service.

3.08 SANITARY SEWER ABANDONMENT

A. Plug:

1. Prior to placing the sewer plug, the Engineer will verify the sewer line is not in use.

2. Construct sewer plug by completely filling the end of the pipe with concrete. Force concrete into the end of the pipe for a distance of 16 inches, or one-half the pipe diameter, whichever is greater.

B. Fill:

1. Prior to filling the sewer, the Engineer will verify the sewer line is not in use.

2. If specified in the contract documents, fill the line to be abandoned with flowable mortar, foamed cellular concrete, or CLSM (comply with Section 3010) by gravity flow or pumping.

3. Batching, mixing, and placing may be started when temperature is 34°F and rising. Cease mixing and placing when temperature is 38°F or less and falling.

3.09 CONNECTION TO EXISTING MANHOLE

Comply with Section 6010, 3.05.

3.10 SANITARY SEWER CLEANOUT

Provide cleanouts where specified in the contract documents. Comply with Figure 4010.203.

3.11 TOLERANCES

Apply the following tolerances to utilities installed by open trench construction. For trenchless construction, comply with Section 3020.

A. Gravity Main:

1. Do not allow horizontal and vertical alignment to vary from design line and grade at any structure by more than 1% of the inside diameter of the pipe or 1/4 inch, whichever is larger.

2. Do not allow the horizontal alignment of the pipe to vary from design line at any point along the pipe by more than 1% of the inside diameter of the pipe.

3. Low spots holding water exceeding the following depths for each pipe size will be considered unacceptable and must be removed and reinstalled to proper grade.

Pipe Diameter	Maximum Low Spot Depth
8”	1/2”
10”	1/2”
12”	3/4”
15”	3/4”
18” and Larger	5% of Pipe Diameter*

* Measured to the nearest 1/2”

B. Force Main: Do not allow horizontal and vertical alignment of trenched force mains to vary from design line and grade by more than 3 inches.

3.12 CONFLICTS

A. Horizontal Separation of Gravity Sanitary and Combined Sewers from Water Mains: Separate gravity sanitary and combined sewer mains from water mains by a horizontal distance of at least 10 feet unless:

1. The top of a sewer main is at least 18 inches below the bottom of the water main, and

2. The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

3. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, provide a linear separation of at least 2 feet and one of the following:
   a. Construct sanitary and combined sewers of water main materials meeting the requirements of Section 5010, 2.01.
   b. Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

B. Horizontal Separation of Water Mains from Sanitary and Combined Sewer Manholes: Ensure water pipes do not pass through or come in contact with any part of a sanitary or combined sewer manhole. Maintain a minimum horizontal separation of 3 feet.

C. Separation of Sanitary Sewer Force Mains from Water Mains: Separate sanitary sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

1. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of Section 5010, 2.01 and

2. The sewer force main is laid at least 4 linear feet from the water main.

D. Separation of Sanitary and Combined Sewers and Water Main Crossovers:

1. Vertically separate sanitary sewers crossing under any water main by at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, do not place the sewer closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases.

2. Where the sanitary sewer crosses over or is less than 18 inches below a water main, utilize one of the following within 10 feet measured edge-to-edge horizontally, centered on the crossing:
   a. Construct sewer pipe of water main material.
   b. Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

3.13 CLEANING, INSPECTION, AND TESTING

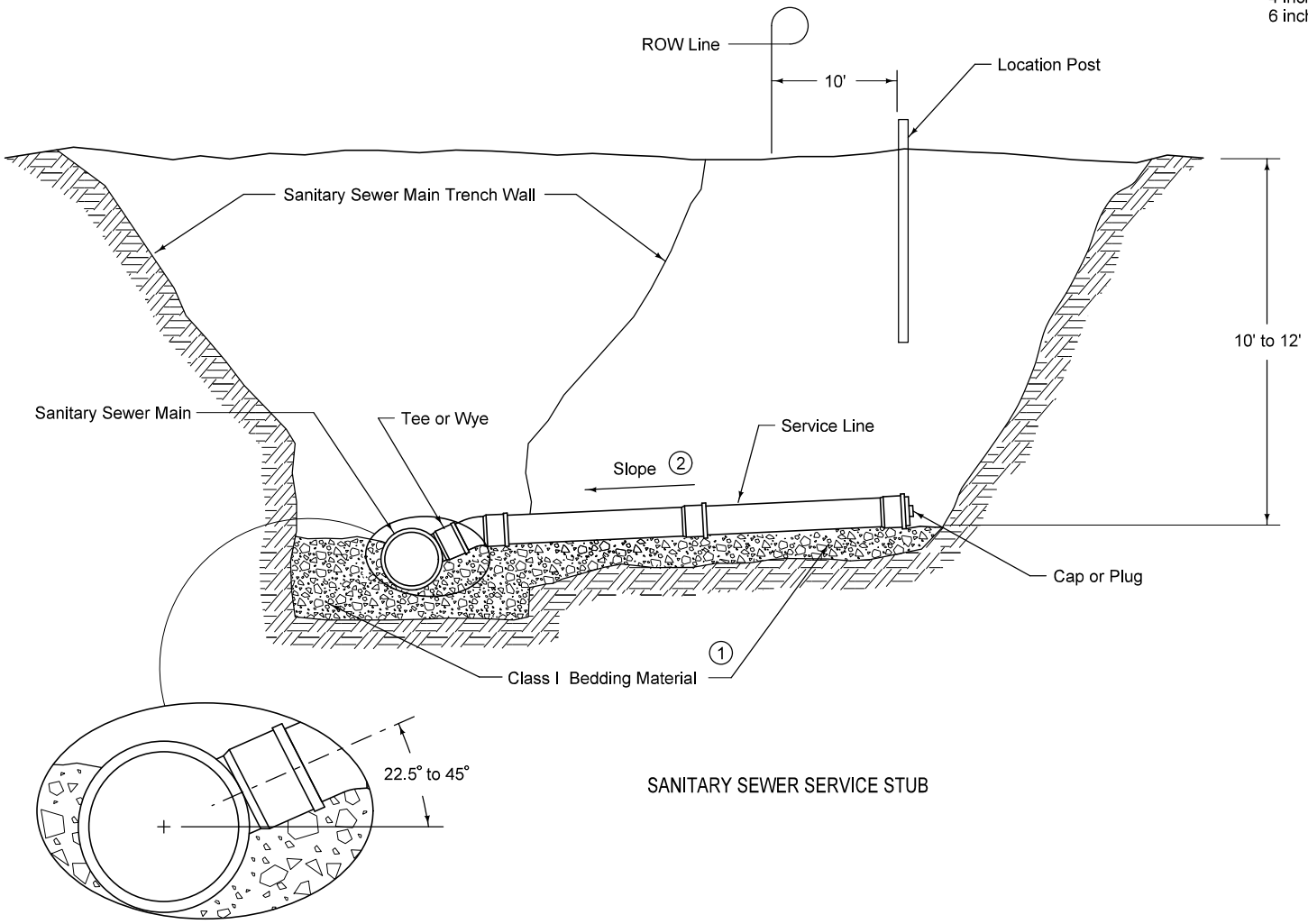
Clean, inspect, and test sanitary sewer per Section 4060.

END OF SECTION

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① Place bedding and backfill material as required for sewer main.

② Service Line Slope:
4 inch: 2% to 5%
6 inch and greater: 1% to 5%



SANITARY SEWER SERVICE STUB

FIGURE 4010.201 | SHEET 1 OF 2

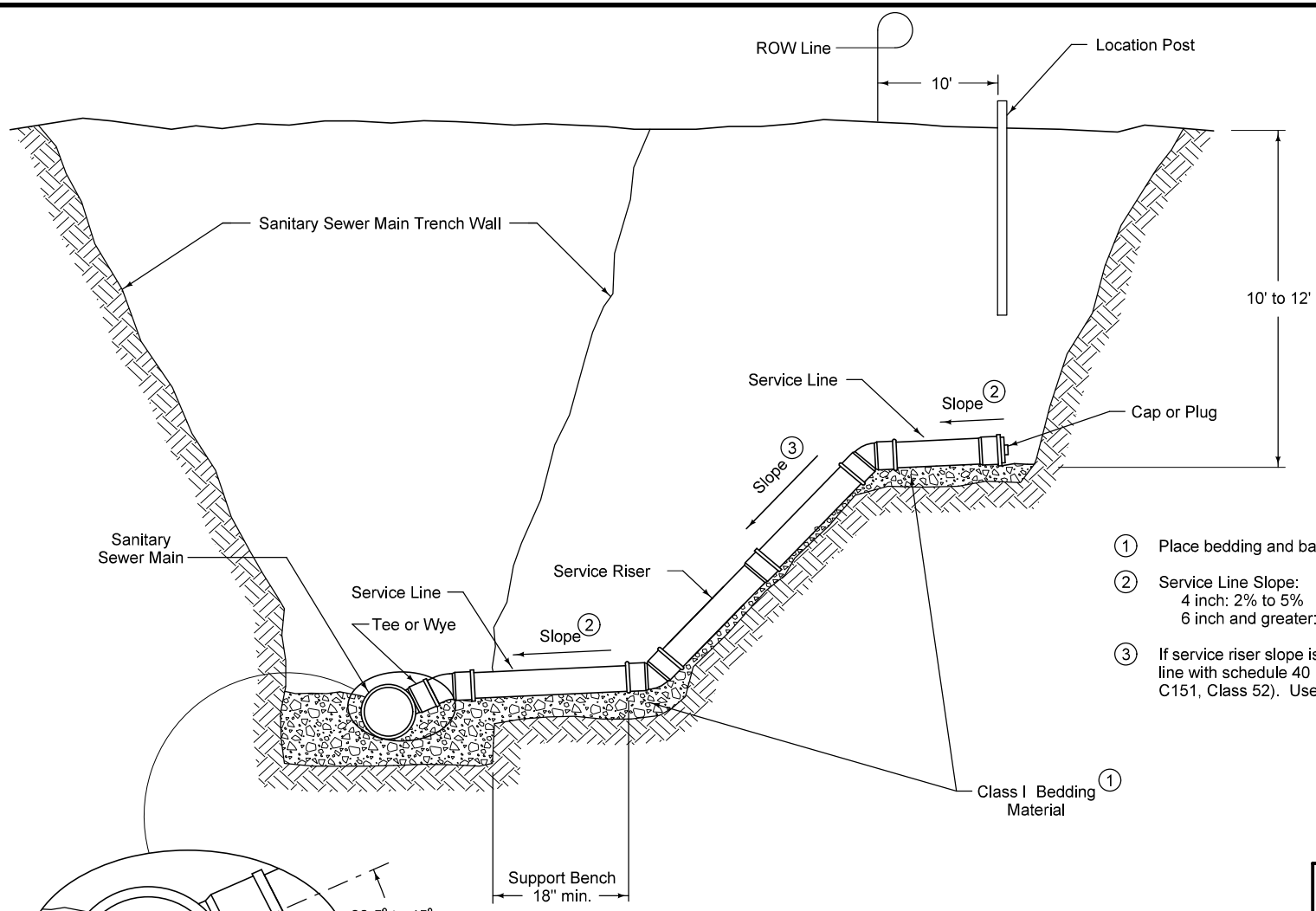
SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 4010.201	STANDARD ROAD PLAN	SW-201
		SHEET 1 of 2

REVISIONS: Changed 1 to I on Bedding Material

Paul D. Wigand
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SANITARY SEWER SERVICE STUB



SANITARY SEWER SERVICE STUB WITH RISER

1. Place bedding and backfill material as required for sewer main.
2. Service Line Slope:
   4 inch: 2% to 5%
   6 inch and greater: 1% to 5%
3. If service riser slope is steeper than 1:1, construct riser of entire service line with schedule 40 PVC (ASTM D 1785) or ductile iron (AWWA C151, Class 52). Use single length of pipe for riser, if possible.

FIGURE 4010.201 | SHEET 2 OF 2

SUDAS | IOWA DOT

REVISION	
2	04-21-20

FIGURE 4010.201 | STANDARD ROAD PLAN | SW-201 | SHEET 2 of 2

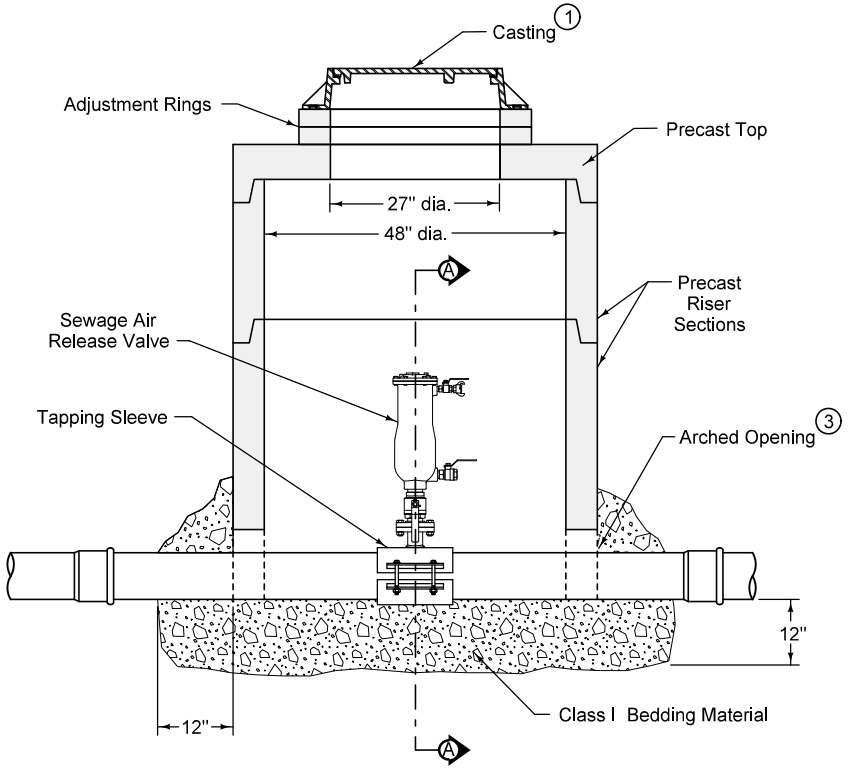
REVISIONS: Changed 1 to I on Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR

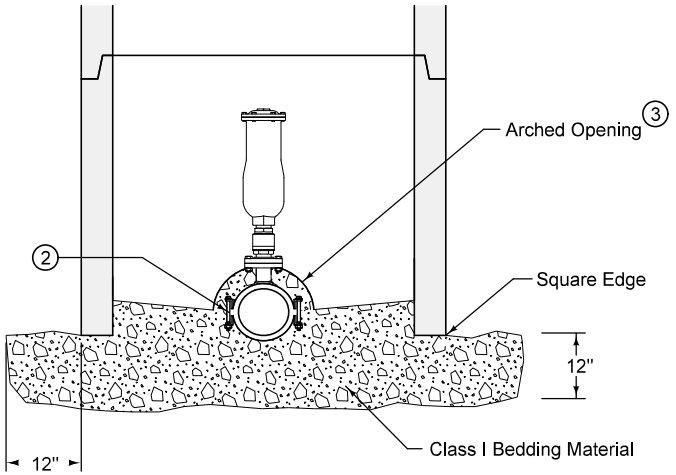
Stuart Nicholson, DESIGN METHODS ENGINEER

SANITARY SEWER SERVICE STUB

1. SW-601 Type A or SW-602 Type G casting.
2. Place bedding material to springline of pipe.
3. Prevent riser from bearing on pipe by providing an arched opening with a diameter up to 6 inches larger than pipe diameter.



TYPICAL SECTION



SECTION A-A

SUDAS	IOWADOT	REVISION 2 04-21-20
FIGURE 4010.202	STANDARD ROAD PLAN	SW-202 SHEET 1 of 1

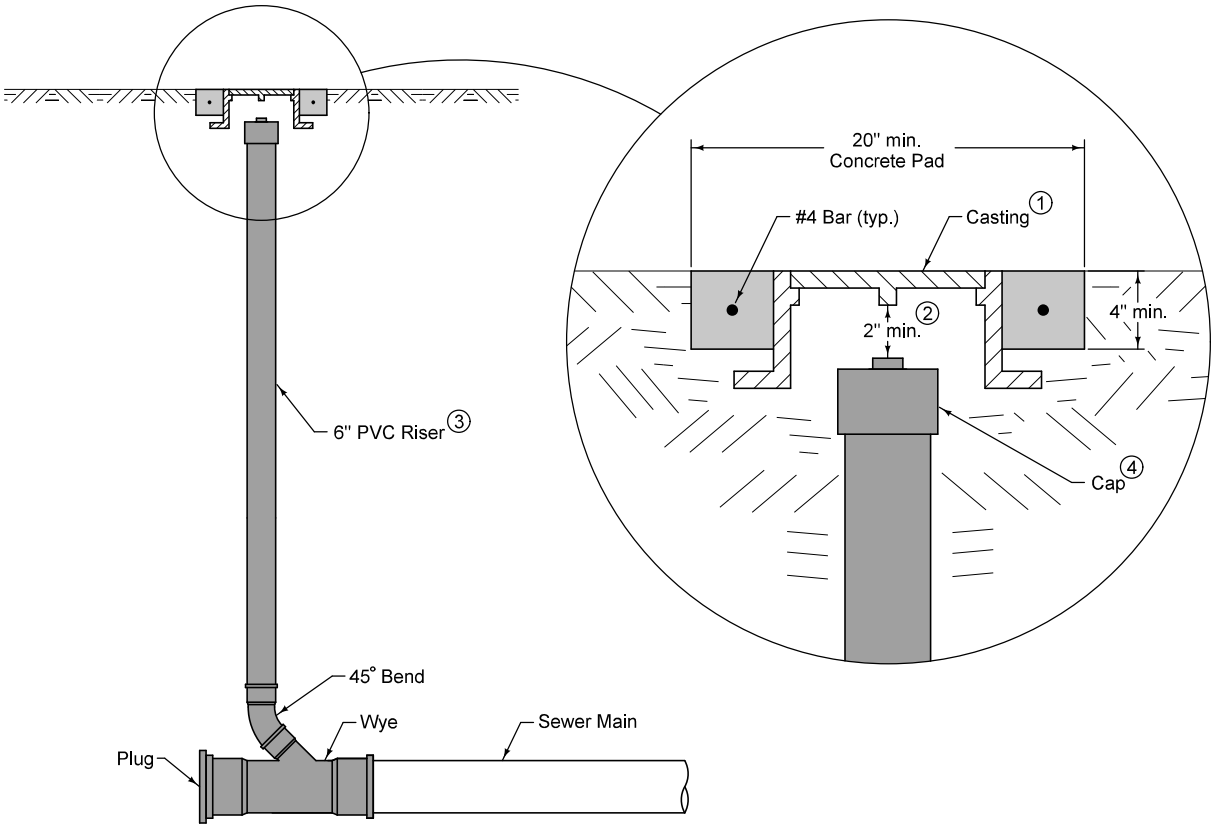
REVISIONS: Changed 1 to I on Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

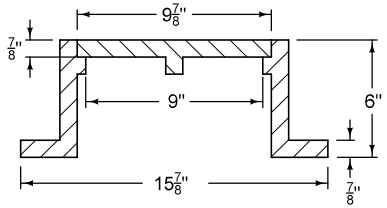
SEWAGE AIR RELEASE VALVE PIT

FIGURE 4010.202 SHEET 1 OF 1

1. Standard duty casting complying with AASHTO M 306. Mark lid with "Sanitary" or "Sanitary C.O."
2. Do not allow casting to bear on top of riser pipe.
3. 6 inch PVC Service Pipe
4. Threaded PVC cap or iron body ferrule with brass screw plug



CLEANOUT



CASTING 1

(Dimensions are nominal)

SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 4010.203	STANDARD ROAD PLAN	SW-203 SHEET 1 of 1

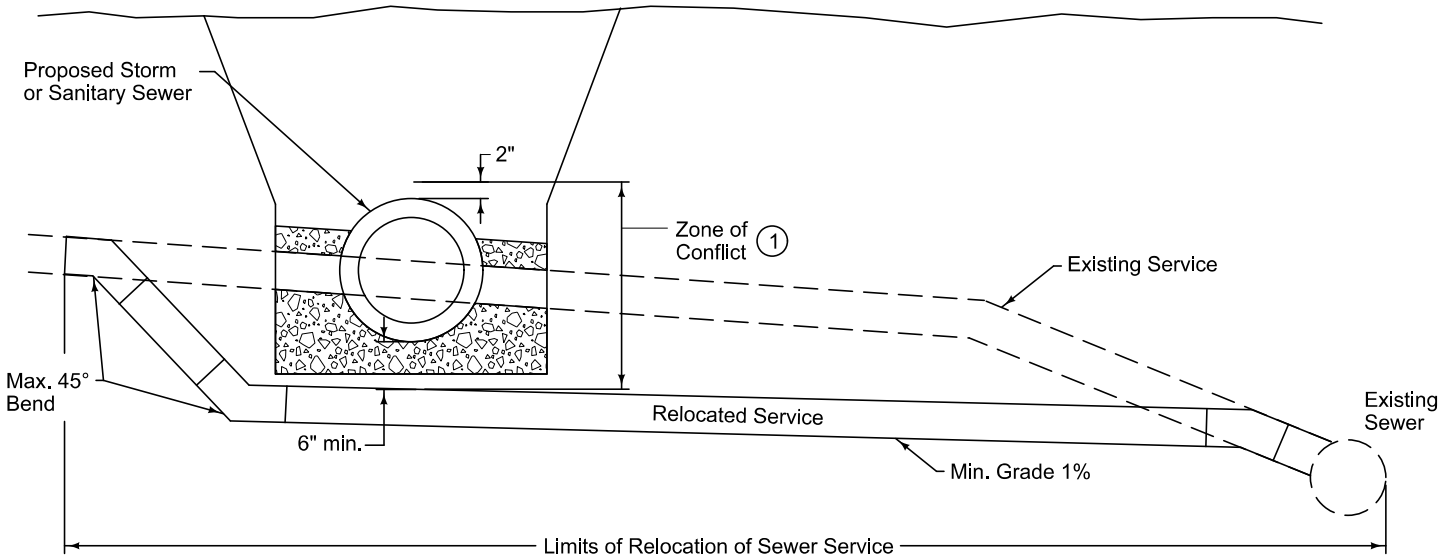
REVISIONS: Replaced Iowa DOT and SUDAS logos.

Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

SANITARY SEWER CLEANOUT

FIGURE 4010.203 SHEET 1 OF 1

(1) Zone of conflict is from 6 inches below the bottom of sewer pipe to 2 inches above the top of pipe.



	Service Status	Contractor's Responsibility	Compensation
1.	Service located outside zone of conflict	Provide protection; if damaged, repair according to local government's plumbing code	Incidental to other work
2.	Service located in zone of conflict	Relocate service according to Section 4010, 3.07	Bid item; sanitary sewer service relocation
3.	Service located in zone of conflict, but elevations do not allow simple relocation as detailed above; special design required	Relocate service as directed by the Engineer	Change order

FIGURE 4010.901 | SHEET 1 OF 1

SUDAS

REVISION 1 10-21-14

4010.901

SHEET 1 of 1

SUDAS Standard Specifications

RELOCATE SANITARY SEWER SERVICE IN CONFLICT WITH NEW SEWER

STORM SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Storm Sewers

B. Abandonment of Storm Sewers

1.02 DESCRIPTION OF WORK

A. Construct storm sewers.

B. Abandon storm sewers.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Storm Sewer:

1. Trenched:

a. Measurement: Each type and size of pipe installed in a trench will be measured in linear feet along the centerline of the pipe from center of intake or manhole to center of intake or manhole. Where the end of the pipe discharges to a ditch or waterway, measurement will be to the end of the pipe, exclusive of aprons. Lengths of elbows and tees will be included in the length of pipe measured.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; joint wrapping; wyes and other fittings; pipe joints; pipe connections; testing; and inspection.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; pipe connections; testing; and inspection.

B. Storm Sewer with Casing Pipe:

1. Trenched:

a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing, placing, and compacting bedding and backfill material; furnishing and installing annular space fill material; casing spacers; pipe connections; testing; and inspection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

C. Linear Trench Drain:

1. Measurement: Measurement will be in linear feet from end to end.

2. Payment: Payment will be at the unit price per linear feet of linear trench drain installed.

3. Includes: Price includes, but is not limited to, furnishing and installing the linear trench drain including all appurtenances; furnishing and placement of PCC transition; furnishing, excavation, and backfill of discharge pipe; connection to manhole or intake, if required; installation of apron, if required.

D. Removal of Storm Sewer:

1. Measurement: Each type and size of pipe removed will be measured in linear feet from end to end.

2. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe removed.

3. Includes: Unit price includes, but is not limited to, removal, disposal, and capping (if specified) of pipe; and furnishing, placing, and compacting backfill material.

1.08 MEASUREMENT AND PAYMENT (Continued)

E. Connection to Existing Manhole or Intake: Comply with Section 6010, 1.08, G.

F. Storm Sewer Abandonment, Plug:

1. **Measurement:** Each plug will be counted.

2. **Payment:** Payment will be made at the unit price for each plug installed.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary), cutting pipe (if required), furnishing and placing plug materials, and placing and compacting backfill material.

G. Storm Sewer Abandonment, Fill and Plug:

1. **Measurement:** Each size of storm sewer to be abandoned by filling and plugging will be measured in linear feet.

2. **Payment:** Payment will be at the unit price per linear foot for each size of pipe filled and plugged.

3. **Includes:** Unit price includes but is not limited to, trench excavation (if necessary), cutting pipe (if required), furnishing and placing pipe fill material, furnishing and placing plug materials, and placing and compacting backfill material.

H. Aprons: Comply with Section 4030 for pipe aprons, apron footings, and apron guards.

PART 2 - PRODUCTS

2.01 STORM SEWERS

A. Reinforced Concrete Pipe (RCP):

1. Comply with ASTM C 76.

2. Minimum Class III, Wall B (Iowa DOT Class 2000D).

3. Use tongue and groove joints wrapped with engineering fabric, unless a rubber O-ring or profile gasket complying with ASTM C 443 is specified.

B. Reinforced Concrete Arch Pipe (RCAP):

1. Comply with ASTM C 506.

2. Minimum Class A-III (Iowa DOT Class 2000D).

3. Use tongue and groove joints wrapped with engineering fabric, unless a rubber O-ring or profile gasket complying with ASTM C 443 is specified.

C. Reinforced Concrete Elliptical Pipe (RCEP):

1. Comply with ASTM C 507.

2. Minimum Class HE III (Iowa DOT Class 2000D) or Class VE III (Iowa DOT Class 2000D).

3. Use tongue and groove joints wrapped with engineering fabric, unless a rubber O-ring or profile gasket complying with ASTM C 443 is specified.

D. Reinforced Concrete Low Head Pressure Pipe (RCPP):

1. Comply with ASTM C 361; minimum Class C 25.

2. Use tongue and groove joints. Comply with ASTM C 361 for rubber O-rings or profile gaskets.

E. Polyvinyl Chloride Pipe (PVC):

1. Use pipe complying with the following:
   a. Types of PVC pipes:
      1) Corrugated exterior, smooth interior, ASTM F 949.
      2) Solid wall, ASTM D 3034 or ASTM F 679.
      3) Closed profile, ASTM F 1803.
      4) Composite, ASTM D 2680.
   b. PVC plastic meeting ASTM D 1784, Cell Classification 12454.
   c. Minimum pipe stiffness of 46 psi.
   d. Integral bell and spigot joints with elastomeric seals according to ASTM D 3212 and ASTM F 477.

2. Use of this pipe material requires specific approval by the Engineer.

2.01 STORM SEWERS (Continued)

F. High Density Polyethylene Pipe (HDPE):

1. Use pipe complying with the following:
   a. AASHTO M 294, Type S corrugated exterior and smooth interior.
   b. Minimum pipe stiffness at 5% deflection according to ASTM D 2412.
   c. Integral bell and spigot joints with elastomeric seals complying with ASTM F 477.
   d. Maximum 5% deflection of the average inside diameter by testing after installation according to Section 4060, 3.04.

2. Use of this pipe material requires specific approval by the Engineer.

G. Corrugated Metal Pipe (CMP):

1. Use pipe complying with the following:
   a. AASHTO M 36, Type I.
   b. Zinc coating complying with AASHTO M 218.
   c. Corrugated steel circular section with annular or helical corrugations.
   d. Gage of pipe according to Iowa DOT Standard Road Plan DR-104 or as specified in the contract documents.
   e. Coupling bands with annular or helical corrugations to match pipe ends.

2. Use of this pipe material requires specific approval by the Engineer.

H. Spiral Rib Pipe:

1. Use pipe complying with the following:
   a. ASTM A 760 Type 1R.
   b. Corrugation profile of 3/4 inch by 3/4 inch by 7 1/2 inches.
   c. Type 2 aluminized steel complying with ASTM A 929.
   d. Minimum thickness of 0.064 inch. Use gage of pipe according to manufacturer's requirements.
   e. Coupling bands complying with manufacturer's recommendations.

2. Use of this pipe material requires specific approval by the Engineer.

I. Coated Corrugated Metal Pipe:

1. Use in corrosive soil or effluent conditions, or where specified in the contract documents or required by the Engineer.

2. Comply with AASHTO M 274. Use gage of pipe according to Iowa DOT Standard Road Plan DR-104 or as specified in the contract documents.

3. Use of this pipe material requires specific approval by the Engineer.

J. Corrugated Metal Arch Pipe (CMAP):

1. Use pipe complying with the following:
   a. AASHTO M 36, Type II.
   b. Zinc coating complying with AASHTO M 218.
   c. Corrugated steel Type I pipe reformed into a pipe-arch having an approximately flat bottom.
   d. Coupling bands with annular corrugations or helical corrugations to match pipe ends.
   e. Gage of pipe according to Iowa DOT Standard Road Plan DR-104.

2. Use of this pipe material requires specific approval by the Engineer.

2.01 STORM SEWERS (Continued)

K. Spiral Rib Arch Pipe:

1. Use pipe complying with the following:
   a. ASTM A 760 Type IIR.
   b. Corrugation profile of 3/4 inch by 3/4 inch by 7 1/2 inch.
   c. Type 2 aluminized steel complying with ASTM A 929.
   d. Minimum thickness of 0.064 inch. Use gage of pipe complying with manufacturer's requirements.
   e. Coupling bands complying with the manufacturer's recommendations.

2. Use of this pipe material requires specific approval by the Engineer.

L. Polypropylene Pipe:

1. Comply with the following for 12 inch to 30 inch pipe:
   a. Double walled pipe meeting ASTM F 2764.
   b. Minimum pipe stiffness per ASTM D 2412, 46 psi.
   c. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.

2. Comply with the following for 30 inch to 60 inch pipe:
   a. Triple walled pipe meeting ASTM F 2764.
   b. Minimum pipe stiffness per ASTM D 2412, 46 psi.
   c. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.

3. Use of this pipe material requires specific approval by the Engineer.

M. Bituminous Joint Primer: Material intended for use in priming concrete joints. Comply with the requirements of ASTM D 41.

N. Engineering Fabric: Comply with Iowa DOT Article 4196.01.

O. Non-Shrink Grout: Comply with Iowa DOT Materials I.M. 491.13.

2.02 LINEAR TRENCH DRAIN

Comply with approved manufacturer's requirements and Iowa DOT Materials I.M. 449 (MAPLE), as well as complying with Figure 6010.521. Provide certification indicating continuous trench drain meets AASHTO M 306 for 40,000 pound proof load.

2.03 CASING PIPE

Comply with Section 3020, 2.02 for casing pipe requirements.

2.04 PIPE APRONS

Comply with the requirements of Section 4020, 2.01 and Section 4030, 2.01 for the pipe material of which the apron is constructed. Supply concrete pipe aprons according to Figure 4030.222 and Figure 4030.223. Supply CMP pipe aprons according to Figure 4030.225.

2.05 APRON FOOTINGS

Comply with the requirements of Section 6010 for reinforcing steel and structural concrete used in apron footings.

2.06 APRON GUARD

Use smooth or deformed steel bars, ASTM A 615, Grade 40 or Grade 60, or merchant quality, in the construction of the apron guard. Hot dip galvanize the apron guard according to ASTM A 123.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify measurements at site; make necessary field measurements to accurately determine pipe makeup lengths or closures.

B. Examine site conditions to ensure construction operations do not pose hazards to adjacent structures or facilities.

3.02 PIPE INSTALLATION

A. General:

1. Clean pipe interior and joints prior to lowering into trench. Keep pipe clean during construction.

2. Begin at the lowest point in the line. Lay groove or bell end pointing upstream unless otherwise specified.

3. Place pipe with lifting holes at the top of the pipe and fill lift hole with non-shrink grout or manufactured plugs.

4. Assemble joints as specified by the pipe manufacturer.

5. Use a saw to cut ends of pipe flush with inside wall of manholes, intakes, and structures. Do not use hammer or other means to break pipe.

6. Provide manholes and intakes as specified in the contract documents.

7. Use watertight stopper, plug, or other approved means to protect the exposed upstream ends of the pipe and prevent soil sediment from entering the storm sewer system.

B. Trenched:

1. Excavate trench and provide pipe bedding and backfill material as specified in Section 3010.

2. Prepare trench bottom to design line and grade so that only minor movement of the pipe is necessary after installation.

3. Lay pipe to design line and grade. Set field grades to invert of pipe.

4. Provide uniform bearing for full pipe barrel length. Excavate bell holes as necessary for uniform support of pipe barrel on bedding material.

5. Do not lay pipe in water or on saturated soil or bedding, or allow water to rise in trench around pipe prior to placing backfill material.

6. Do not disturb installed pipe and bedding when using movable trench boxes and shields. Block or anchor pipe as necessary to prevent joint displacement.

C. Trenchless: Comply with Section 3020.

3.03 STORM SEWER INSTALLED WITHIN A CASING PIPE

Comply with Section 3020, 3.04 for installation of storm sewer within casing pipe.

3.04 LINEAR TRENCH DRAIN

A. Install according to the manufacturer's requirements and the contract documents.

B. Use duct tape or wood block to prevent intrusion of concrete during installation and paving.

C. Connect to existing intake or manhole according to Section 6010, 3.05 or discharge to an open drainageway/ditch.

3.05 PIPE JOINTING

A. General:

1. Clean joint surfaces to remove soil or foreign material prior to jointing pipe.

2. Assemble joints according to pipe manufacturer's recommendations. Use equipment that does not apply damaging forces to pipe joints.

B. Reinforced Concrete Pipe (RCP), Reinforced Concrete Arch Pipe (RCAP), and Reinforced Concrete Elliptical Pipe (RCEP):

1. Comply with Figure 4020.211 for pipe joint wrapping. Secure engineering fabric in place to prevent displacement while placing backfill material.

2. If a rubber O-ring or profile gasket is specified for RCP, coat the rubber gasket and joint with soap-based lubricant immediately prior to closing the joint.

3. Place pipe such that joint openings on the outside or inside of the pipe do not exceed 1/2 inch.

C. Reinforced Concrete Low Head Pressure Pipe (RCPP); Polyvinyl Chloride Pipe (PVC) and Corrugated PVC Pipe; Polypropylene Pipe; and High Density Polyethylene Pipe (HDPE): Coat gasket and joint with soap-based lubricant immediately prior to closing the joint.

D. Corrugated Metal Pipe (CMP) and Corrugated Metal Arch Pipe (CMAP): Lap coupling bands to form a tightly closed joint upon installation.

E. Connections between Dissimilar Pipes:

1. Use manufactured adapters or couplings approved by the Engineer.

2. Where adapters or couplings are not available, the Engineer may authorize use of a concrete collar as shown in Figure 4020.211.

3.06 APRONS

A. Install pipe aprons where specified in the contract documents. Use the same installation methods as used on the pipe to which the apron is being attached. Dewater area as necessary to prevent installing the apron in water or on saturated soil or bedding. Do not allow water to rise around the apron prior to backfilling the area.

B. Install apron footings where specified in the contract documents. Construct according to Section 6010 and the contract documents. Dewater area as necessary to prevent installing the apron footing in water or on saturated soil or bedding. Do not allow water to rise around the apron footing prior to backfilling the area.

3.06 APRONS (Continued)

C. Anchor the last three concrete pipe sections and the apron together with two pipe connections per joint. Comply with Iowa DOT Standard Road Plan DR-121.

D. Attach corrugated metal aprons to the pipe with a manufacturer's approved bolt, weld, or clamp to fasten directly to the pipe.

E. Install apron guard where specified in the contract documents. Construct according to Figure 4030.224 or 4030.225. Repair any damage to the galvanized coating that occurs due to storage, handling, or installation.

3.07 TOLERANCES

The following tolerances apply to utilities installed by open trench construction. For trenchless construction, comply with Section 3020.

A. Do not allow horizontal and vertical alignment to vary from design line and grade at any structure by more than 1% of the inside diameter of the pipe or 1/4 inch, whichever is larger.

B. Do not allow the horizontal alignment of the pipe to vary from design line at any point along the pipe by more than 1% of the inside diameter of the pipe.

C. Low spots holding water exceeding the following depths for each pipe size will be considered unacceptable and must be removed and reinstalled to proper grade.

Pipe Diameter	Maximum Low Spot Depth
8"	1/2"
10"	1/2"
12"	3/4"
15"	3/4"
18" and Larger	5% of Pipe Diameter*

* Measured to the nearest 1/2"

3.08 CONFLICTS

A. Horizontal Separation of Gravity Storm Sewers from Water Mains: Separate storm sewers and water mains by at least 10 feet measured edge to edge unless it is impossible to do so. When not possible to maintain a 10 feet horizontal separation, maintain a minimum separation of 3 feet and utilize one of the following within 10 feet measured edge to edge:

1. Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.

2. Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.

3. Construct storm sewer pipe of water main materials.

4. Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

B. Separation of Storm Sewer Force Mains from Water Mains: Separate storm sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

1. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of Section 5010, 2.01 and

2. The sewer force main is laid at least 4 linear feet from the water main.

3.08 CONFLICTS (Continued)

C. Vertical Separation of Storm Sewers and Water Main Crossovers:

1. Vertically separate storm sewers from water mains by at least 18 inches measured between the outside edges of the water main and the storm sewer. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

2. When impossible to maintain an 18 inch vertical separation when the water main crosses over the storm sewer, maintain a minimum vertical separation of 6 inches and utilize one of the following within 10 feet measured edge-to-edge centered on the crossing:
   a. Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
   b. Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
   c. Construct storm sewer pipe of water main materials.
   d. Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

3.09 STORM SEWER ABANDONMENT

A. Plug:

1. Prior to placing the sewer plug, the Engineer will verify the sewer line is not in use.

2. Construct sewer plug by completely filling the end of the pipe with concrete. Force concrete into the end of the pipe for a distance of 16 inches, or one-half the pipe diameter, whichever is greater.

B. Fill:

1. Prior to filling the sewer, the Engineer will verify the sewer line is not in use.

2. If specified in the contract documents, fill the line to be abandoned with flowable mortar, foamed cellular concrete, or CLSM (comply with Section 3010) by gravity flow or pumping.

3. Batching, mixing, and placing may be started when temperature is 34°F and rising. Cease mixing and placing when temperature is 38°F or less and falling.

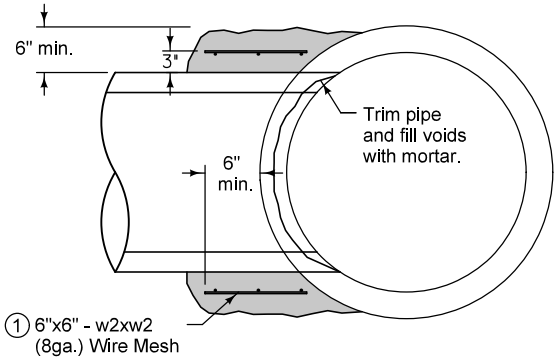
3.10 CONNECTION TO EXISTING MANHOLE OR INTAKE

Comply with Section 6010, 3.05.

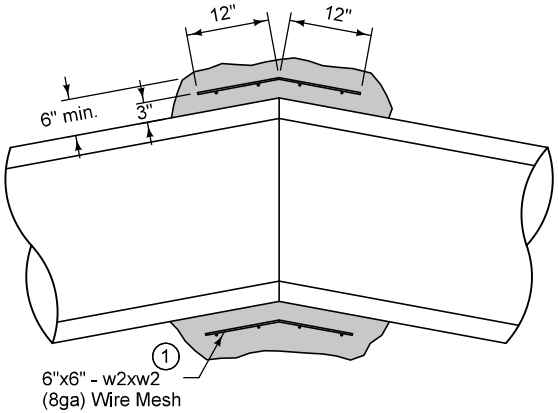
3.11 CLEANING, INSPECTION, AND TESTING

Clean, inspect, and test according to Section 4060.

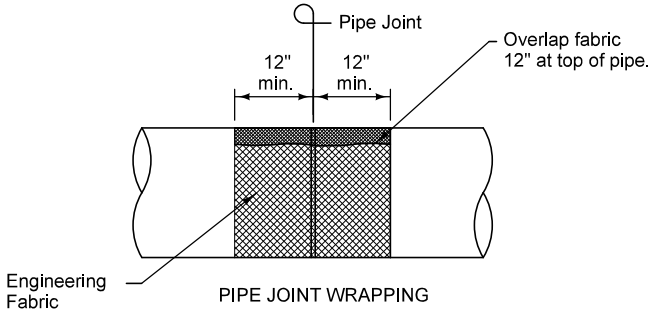
END OF SECTION



TYPE PC-1 CONCONCRETE COLLAR CONNECTION

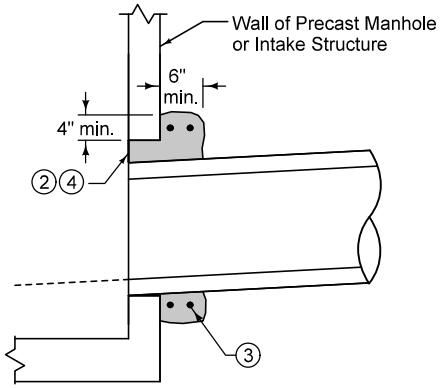


TYPE PC-2 CONCRETE COLLAR CONNECTION

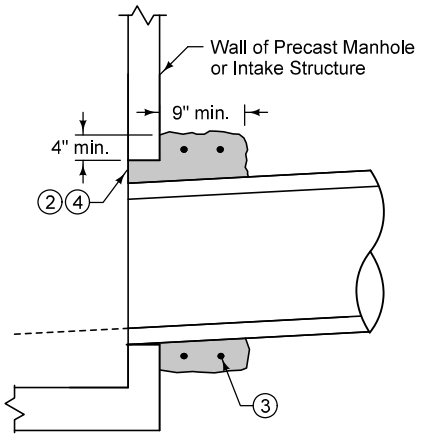


PIPE JOINT WRAPPING

PIPE TO PIPE CONNECTION



CONCRETE COLLAR FOR PIPES 12" AND SMALLER



CONCRETE COLLAR FOR PIPES GREATER THAN 12"

PIPE TO STRUCTURE CONNECTION

1. Lap ends of wire mesh a minimum of 6 inches.
2. Concrete collar is required when annular space between the outside of the pipe and the wall of the structure is 2 inches or greater.
3. Provide two #4 hoop bars in concrete collar. Lap bars a minimum of 6 inches.
4. Trowel concrete flush with inside wall of structure.

SUDAS | IOWADOT | REVISION 2 04-17-18

FIGURE 4020.211 | STANDARD ROAD PLAN | SW-211 | SHEET 1 of 1

REVISIONS: Removed 'Invert' callout on Pipe to Structure View. Redrawn and replaced old Iowa DOT and SUDAS logos with new logos.

Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

STORM SEWER PIPE CONNECTIONS

FIGURE 4020.211 | SHEET 1 OF 1

PIPE CULVERTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe Culverts

B. Pipe Aprons and Beveled Ends

C. Footings for Concrete Pipe Aprons

D. Pipe Apron Guards

1.02 DESCRIPTION OF WORK

Construct pipe culverts, beveled ends, pipe aprons, and associated appurtenances.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Pipe Culverts:

1. Trenched:

a. Measurement: Each type and size of pipe installed in a trench will be measured in linear feet from end of pipe to end of pipe along the centerline of pipe, exclusive of aprons. Lengths of elbows and tees will be included in length of pipe measured.

b. Payment: Payment will be made at the unit price of each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; connectors; testing; and inspection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the casing pipe.

b. Payment: Payment will be made at the unit price for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing and compacting backfill material; pipe connections; testing; and inspection.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Pipe Aprons:

1. **Measurement:** Each type and size of pipe apron will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of pipe apron.

3. **Includes:** Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing the apron; furnishing, placing, and compacting bedding and backfill material; connectors; and other appurtenances.

C. Footings for Concrete Pipe Aprons:

1. **Measurement:** Each type and size of footing installed on a concrete pipe apron will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of footing.

3. **Includes:** Unit price includes, but is not limited to, excavation; dewatering; reinforcing steel; concrete; furnishing, placing and compacting bedding and backfill material.

D. Pipe Apron Guards:

1. **Measurement:** Each type and size of pipe apron guard will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of pipe apron guard.

3. **Includes:** Unit price includes, but is not limited to, furnishing and installing the apron guard and repairing any damage to the apron from the installation process.

PART 2 - PRODUCTS

2.01 PIPE CULVERTS

A. Roadway Pipe Culverts: All storm sewer pipe materials specified for use in right-of-way in Section 4020 may be used within right-of-way as a roadway pipe culvert.

B. Entrance Pipe Culverts: The following pipe culvert types described in Section 4020 may be used within right-of-way as entrance pipe culverts:

1. Reinforced Concrete Pipe (RCP).
2. Reinforced Concrete Arch Pipe (RCAP).
3. Reinforced Concrete Elliptical Pipe (RCEP).
4. Reinforced Concrete Low Head Pressure Pipe (RCPP).
5. Corrugated Metal Pipe (CMP).
6. Spiral Rib Pipe.
7. Coated Corrugated Metal Pipe.
8. Corrugated Metal Arch Pipe.

C. Structural Plate Culverts: Structural plate culverts may be used in the right-of-way as roadway or entrance pipe culverts.

1. Use a galvanized steel structural plate complying with AASHTO M 167.
2. Use bolts and nuts complying with ASTM A 449 and galvanized per ASTM A 153, Class C.
3. Assemble the structure according to the manufacturer's recommendations. Tighten the bolts using an applied torque of between 100 and 300 foot-pounds.
4. Install the structure according to the contract documents, the manufacturer′s recommendations, and AASHTO Standard Specifications for Highway Bridges, Division II, Section 26.
5. Conform the gage of the structure to Iowa DOT Standard Road Plan DR-104 or as specified in the contract documents.

D. Aluminum Structural Plate Culverts: Aluminum structural plate culverts may be used in the right-of-way as roadway or entrance pipe culverts.

1. Comply with AASHTO M 219.
2. Use a corrugation profile of 9 inches by 2 1/2 inches.
3. Use aluminum complying with ASTM B 209.
4. Use a minimum thickness of 0.100 inch. Gage of structure complying with manufacturer's requirements.
5. Use bolts and nuts meeting ASTM A 307 or ASTM A 449 and galvanize per ASTM A 153.

2.01 PIPE CULVERTS (Continued)

6. Assemble the structure according to the manufacturer's recommendations. Tighten the bolts using an applied torque of between 100 and 300 foot-pounds.

7. Install the structure according to the contract documents, the manufacturer's recommendations, and AASHTO Standard Specifications for Highway Bridges, Division II, Section 26.

8. Meet or exceed the AASHTO Standard Specifications for Highway Bridges, Division I, Section 12.8 for HS 20 loading.

2.02 PIPE APRONS

Comply with the requirements of Section 4020, 2.01 and Section 4030, 2.01 for the pipe material of which the apron is constructed. Supply concrete pipe aprons according to Figure 4030.222 and Figure 4030.223. Supply CMP pipe aprons according to Figure 4030.225.

2.03 APRON FOOTINGS

Comply with the requirements of Figure 4030.221 and Section 6010 for reinforcing steel and structural concrete used in apron footings.

2.04 APRON GUARD

Use smooth or deformed steel bars, ASTM A 615, Grade 40 or merchant quality, in the construction of the apron guard. Hot dip galvanize the apron guard according to ASTM A 123.

PART 3 - EXECUTION

3.01 PIPE CULVERT INSTALLATION

A. Trenched:

1. Install pipe in a trench per Section 4020.

2. For culvert pipe installed in embankment, pipe may be installed at the Contractor's option per the contract documents and the following Iowa DOT Specifications sections:
   a. Reinforced Concrete Pipe (circular, arched, and elliptical): Section 2416.
   b. Corrugated Metal and Corrugated Plastic Pipe: Section 2417.
   c. Structural Plate Culverts: Section 2420.

B. Trenchless: For trenchless installations, comply with Section 3020.

3.02 APRONS

A. Install pipe aprons where specified in the contract documents. Use the same installation methods as used on the pipe to which the apron is being attached. Dewater area as necessary to prevent installing the apron in water or on saturated soil or bedding. Do not allow water to rise around the apron prior to backfilling the area.

B. Install apron footings where specified. Construct per Section 6010 and the contract documents. Dewater area as necessary to prevent installing the apron footing in water or on saturated soil or bedding. Do not allow water to rise around the apron footing prior to backfilling the area.

C. Anchor the last three concrete pipe sections and the apron together with two pipe connections per joint. Comply with Iowa DOT Standard Road Plan DR-121.

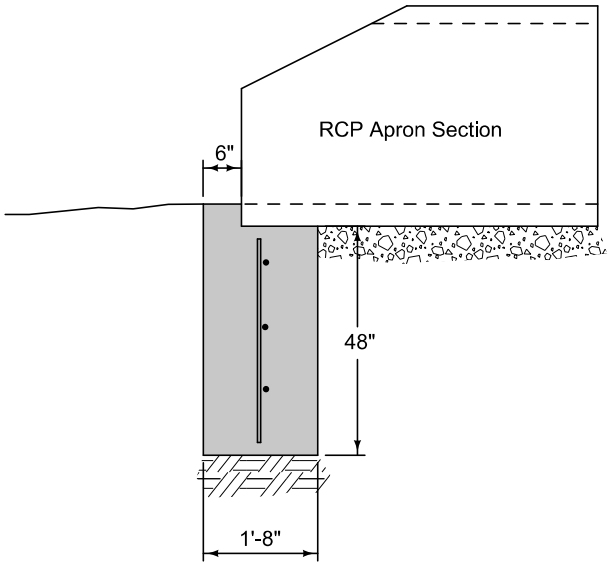
D. Attach corrugated metal aprons to the culvert pipe with a manufacturer's approved bolt, weld, or clamp to fasten directly to the culvert.

E. Install apron guard where specified. Construct according to Figure 4030.224 or 4030.225. Repair any damage to the galvanized coating that occurs due to storage, handling, or installation.

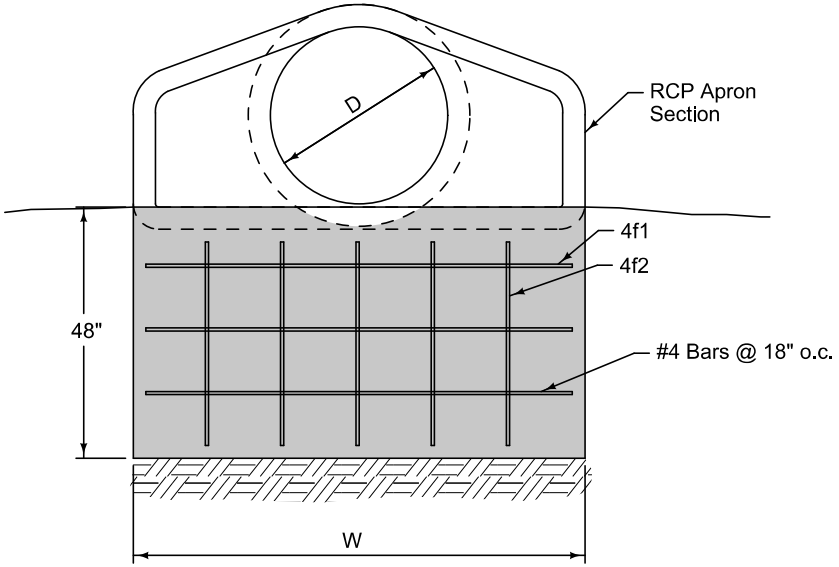
3.03 CLEANING, INSPECTION, AND TESTING

Clean, inspect, and test culverts per Section 4060.

END OF SECTION



TYPICAL SECTION



ELEVATION

REINFORCING BAR LIST

D	W	Mark	Size	Length	Count
12"	2'-4"	4f1	4	2'-0"	3
		4f2	4	3'-8"	2
15"	2'-10 ½"	4f1	4	2'-6 ½"	3
		4f2	4	3'-8"	2
18"	3'-5"	4f1	4	3'-1"	3
		4f2	4	3'-8"	3
24"	4'-6"	4f1	4	4'-2"	3
		4f2	4	3'-8"	3
30"	5'-7"	4f1	4	5'-3"	3
		4f2	4	3'-8"	4
36"	6'-8"	4f1	4	6'-4"	3
		4f2	4	3'-8"	5
42"	7'-3"	4f1	4	6'-11"	3
		4f2	4	3'-8"	5

D	W	Mark	Size	Length	Count
48"	7'-10"	4f1	4	7'-6"	3
		4f2	4	3'-8"	6
54"	8'-5"	4f1	4	8'-1"	3
		4f2	4	3'-8"	6
60"	8'-11"	4f1	4	8'-7"	3
		4f2	4	3'-8"	6
66"	8'-11"	4f1	4	8'-7"	3
		4f2	4	3'-8"	6
72"	10'-0"	4f1	4	9'-8"	3
		4f2	4	3'-8"	7
78"	10'-7"	4f1	4	10'-3"	3
		4f2	4	3'-8"	7
84"	11'-1"	4f1	4	10'-9"	3
		4f2	4	3'-8"	8

FIGURE 4030.221 | SHEET 1 OF 1

SUDAS

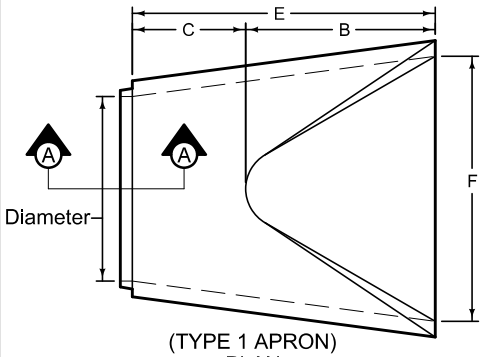
REVISION	
1	10-21-14

4030.221

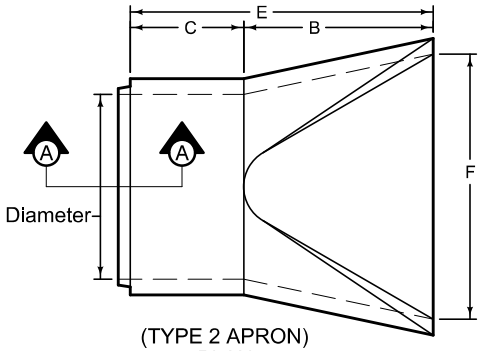
SHEET 1 of 1

SUDAS Standard Specifications

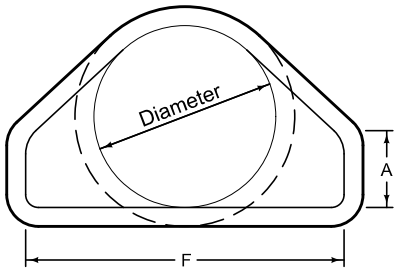
RCP APRON SECTION FOOTING



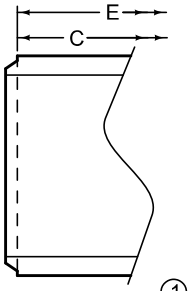
(TYPE 1 APRON)
PLAN



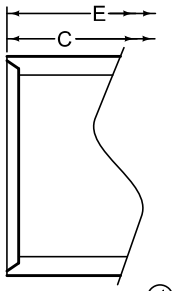
(TYPE 2 APRON)
PLAN



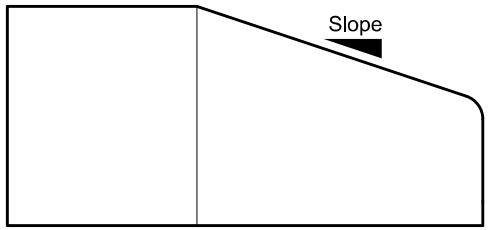
(TYPE 1 AND TYPE 2 APRONS)
END VIEW



SECTION A-A ①
TONGUE END DETAIL



SECTION A-A ①
GROOVE END DETAIL



SIDE VIEW

Dimension 'E' shown is the minimum and is considered the design length. Adjust for any difference between the actual length of concrete apron installed and the length indicated below for the length of concrete culvert pipe furnished.

① Tongue end used on inlet end section. Groove end used on outlet end section.

TYPE 1 APRONS						
DIAM.	SLOPE	A	B	MINIMUM		F
				C	E	
12"	2.4:1	4"	2'-0"	4'-⅞"	6'-⅞"	2'-0"
15"	2.4:1	6"	2'-3"	3'-10"	6'-1"	2'-6"
18"	2.3:1	9"	2'-3"	3'-10"	6'-1"	3'-0"
21"	2.4:1	9"	3'-0 "	3'-1½"	6'-1½"	3'-5"
24"	2.5:1	9½"	3'-7½"	2'-6"	6'-1½"	4'-0"
27"	2.5:1	10½"	4'-1 "	2'-0"	6'-1½"	4'-4"
30"	2.5:1	12"	4'-6"	1'-7¾"	6'-1¾"	5'-0"
36"	2.5:1	15"	5'-3"	2'-9"	8'-0"	6'-0"
42"	2.5:1	21"	5'-3"	2'-9"	8'-0"	6'-6"
48"	2.5:1	24"	6'-0"	2'-0"	8'-0"	7'-0"
54"	1.8:1	27"	5'-0"	3'-0"	8'-0"	7'-6"
60"	1.6:1	29½"	5'-0"	3'-0"	8'-0"	8'-0"
66"	1.7:1	30"	6'-0"	2'-3"	8'-3"	8'-0"
72"	1.6:1	30"	6'-6"	1'-9"	8'-3"	9'-0"
78"	1.8:1	36"	7'-6"	1'-9"	9'-3"	9'-6"
84"	1.3:1	29½"	6'-9"	2'-6½"	9'-3½"	10'-0"

TYPE 2 APRONS						
DIAM.	SLOPE	A	B	MINIMUM		F
				C	E	
12"	2.4:1	4"	2'-0"	4'-⅞"	6'-⅞"	2'-0"
15"	2.4:1	6"	2'-3"	3'-10"	6'-1"	2'-6"
18"	2.3:1	9"	2'-3"	3'-10"	6'-1"	3'-0"
21"	2.4:1	9"	3'-0"	3'-1½"	6'-1½"	3'-5"
24"	2.5:1	9½"	3'-7½"	2'-6"	6'-1½"	4'-0"
27"	2.5:1	10½"	4'-1 "	2'-0"	6'-1½"	4'-4"
30"	2.5:1	12"	4'-6"	1'-7¾"	6'-1¾"	5'-0"
36"	2.5:1	15"	5'-3"	2'-9"	8'-0"	6'-0"
42"	2.5:1	21"	5'-3"	2'-9"	8'-0"	6'-6"
48"	2.5:1	24"	6'-0"	2'-0"	8'-0"	7'-0"
54"	1.9:1	24½"	5'-5"	2'-7"	8'-0"	7'-6"
60"	1.4:1	24½"	5'-0"	3'-0"	8'-0"	8'-0"
66"	1.7:1	30"	6'-0"	2'-3"	8'-3"	8'-0"
72"	1.4:1	24"	6'-6"	1'-9"	8'-3"	9'-0"
78"	1.8:1	36"	7'-6"	1'-9"	9'-3"	9'-6"
84"	1.5:1	23½"	7'-6½"	1'-9"	9'-3½"	10'-0"

FIGURE 4030.222 | SHEET 1 OF 1

SUDAS

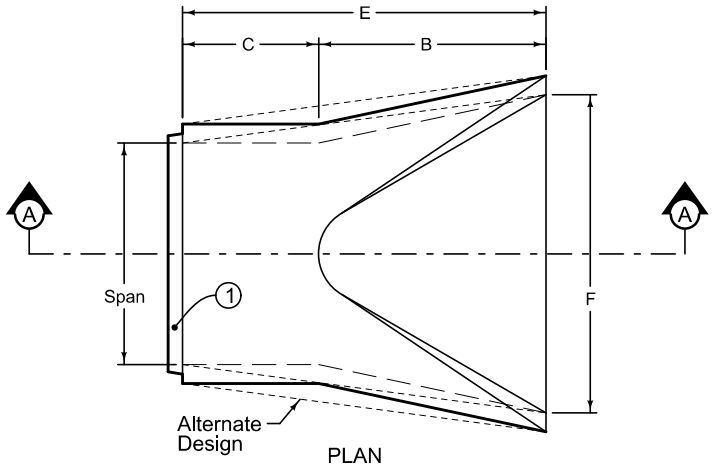
REVISION
New 10-18-16

4030.222

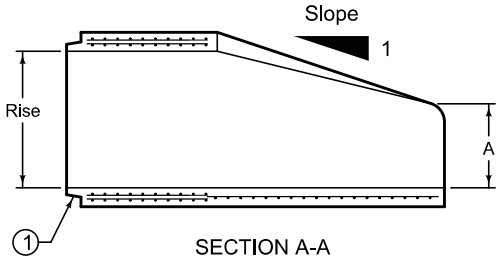
SHEET 1 of 1

SUDAS Standard Specifications

CIRCULAR CONCRETE APRONS



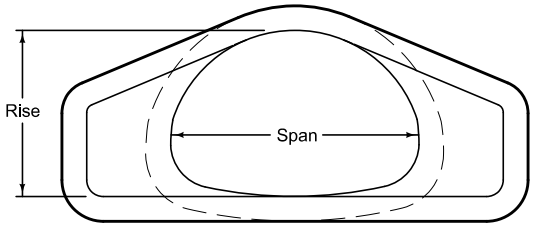
PLAN



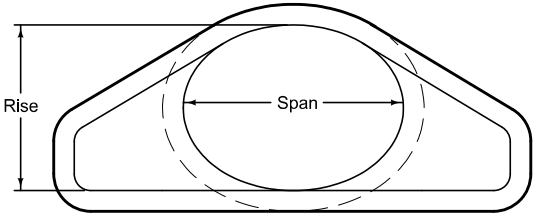
SECTION A-A

Dimension 'E' shown is the minimum and is considered the design length. Adjust for any difference between the actual length of concrete apron installed and the length indicated below for the length of concrete culvert pipe furnished.

(1) Tongue end used on inlet end section. Groove end used on outlet end section.



END (ARCH)



END (ELLIPTICAL)

EQUIVALENT DIAMETER Inches	SLOPE	APPROXIMATE DIMENSIONS Inches				
		A	B	C	E	F
18	3:1	7	27	45	72	36
24	3:1	$8\frac{1}{2}$	39	33	72	48
30	3:1	$9\frac{1}{2}$	50	46	96	60
36	3:1	$11\frac{1}{8}$	60	36	96	72
42	3:1	$15\frac{13}{16}$	60	36	96	78
48	3:1	21	60	36	96	84
54	3:1	$25\frac{1}{2}$	60	36	96	90
60	3:1	31	60	36	96	96
72	2:1	31	60	39	99	120
84	2:1	$21\frac{1}{2}$	83	19	102	144

ARCH PIPE

EQUIVALENT DIAMETER Inches	SLOPE	APPROXIMATE DIMENSIONS Inches				
		A	B	C	E	F
18	3:1	$7\frac{1}{2}$	27	45	72	36
24	3:1	$8\frac{1}{2}$	39	33	72	48
30	3:1	$9\frac{1}{2}$	54	18	72	60
36	2.5 to 1	$11\frac{1}{8}$	60	24	84	72
42	2.5 to 1	$15\frac{3}{4}$	60	36	96	78
48	2.5 to 1	21	60	36	96	84
54	2.5 to 1	$25\frac{1}{2}$	60	36	96	90
60	2.5 to 1	30	60	36	96	96
72	2.5 to 1	36	63	33	96	108
90	1.6 to 1	$36\frac{1}{2}$	58	38	96	113

ELLIPTICAL PIPE

FIGURE 4030.223 | SHEET 1 OF 1

SUDAS

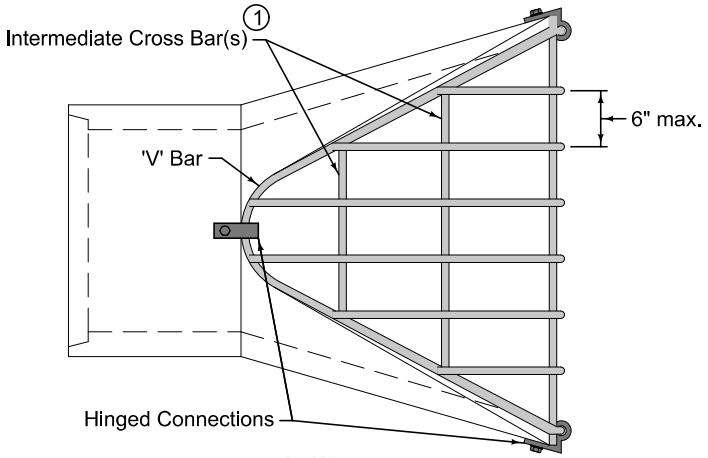
REVISION
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4030.223

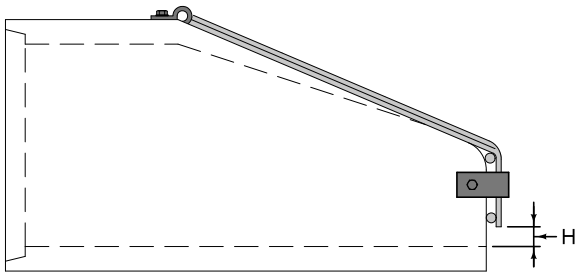
SHEET 1 of 1

SUDAS Standard Specifications

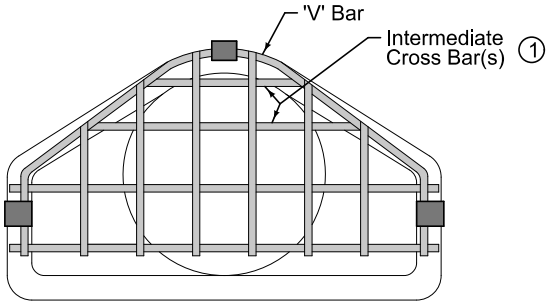
ARCH AND ELLIPTICAL CONCRETE PIPE APRONS



PLAN



PROFILE



FRONT

Provide guard dimensions to fit with type of apron provided. Ensure 'V' Bar completely rests on apron.

① All guards must include at least one intermediate cross bar. If pipe diameter, or equivalent diameter, is 60 inches or greater, use two intermediate cross bars equally spaced.

ROUND		ARCH		ELLIPTICAL	
PIPE SIZE	H	EQUIVALENT DIAMETER	H	EQUIVALENT DIAMETER	H
12"	$2\frac{1}{2}$"	18" to 24"	4"	18"	3"
15"	3"	30" to 36"	5"	24"	4"
18" - 24"	4"	42" to 54"	6"	30" to 36"	5"
27" - 36"	5"	60" to 72"	7"	42" to 54"	6"
42" - 54"	6"			60"	7"
60" - 72"	7"				
78" - 90"	8"				

BAR SIZES				
	PIPE SIZE (DIA. or EQUIV.)	HOLE DIA. REQ'D.	BOLT DIA.	BAR SIZE
ROUND	12" - 24"	$\frac{3}{4}$"	$\frac{5}{8}$"	$\frac{3}{4}$"
	27" - 48"	$\frac{7}{8}$"	$\frac{3}{4}$"	1"
	54" - 90"	$1\frac{1}{8}$"	1"	$1\frac{1}{4}$"
ARCH	up to 24" eq.	$\frac{3}{4}$"	$\frac{5}{8}$"	$\frac{3}{4}$"
	30" to 48"	$\frac{7}{8}$"	$\frac{3}{4}$"	1"
	54" to 72"	$1\frac{1}{8}$"	1"	$1\frac{1}{4}$"
ELLIPTICAL	up to 24" eq.	$\frac{3}{4}$"	$\frac{5}{8}$"	$\frac{3}{4}$"
	30" to 48"	$\frac{7}{8}$"	$\frac{3}{4}$"	1"
	54" to 60"	$1\frac{1}{8}$"	1"	$1\frac{1}{4}$"
BOLT LENGTH = PIPE WALL THICKNESS + $2\frac{1}{2}$"				

SUDAS

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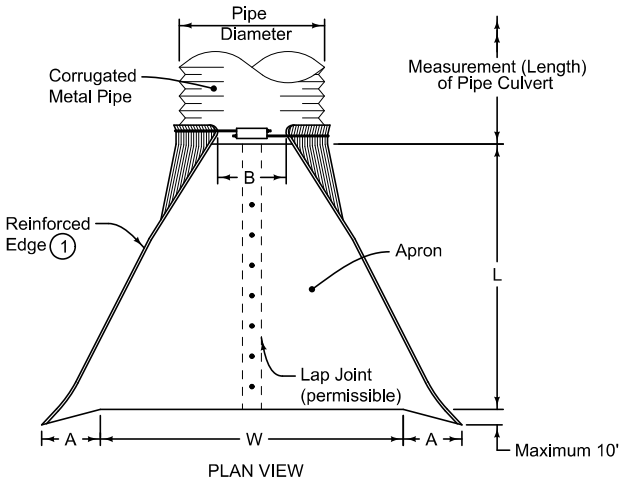
4030.224

SHEET 1 of 1

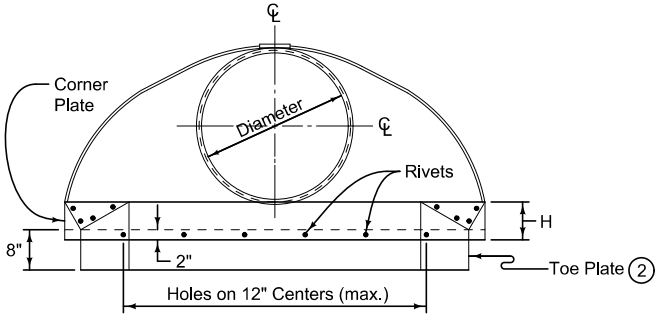
SUDAS Standard Specifications

CONCRETE PIPE APRON GUARD

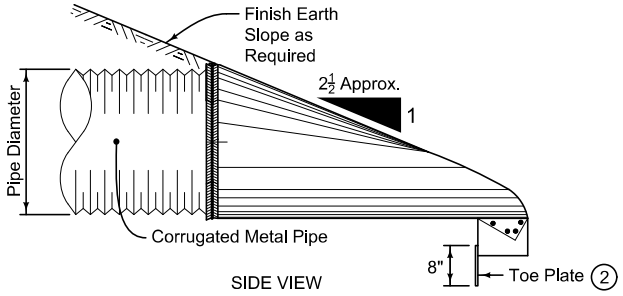
FIGURE 4030.224 | SHEET 1 OF 1



PLAN VIEW

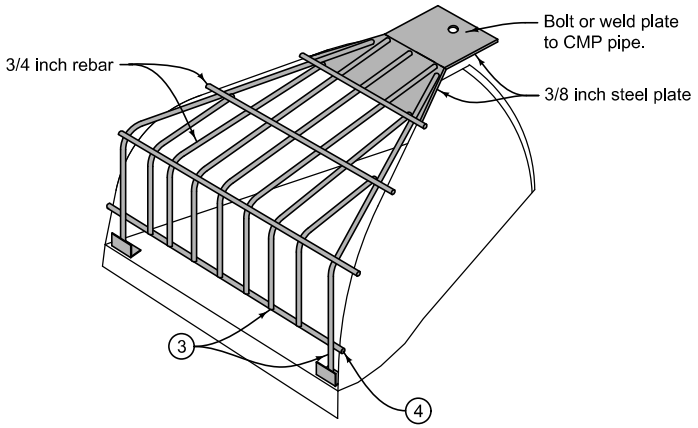


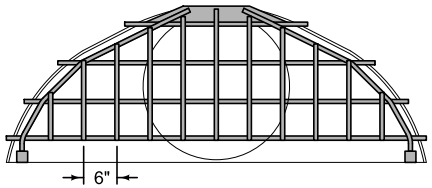
END VIEW



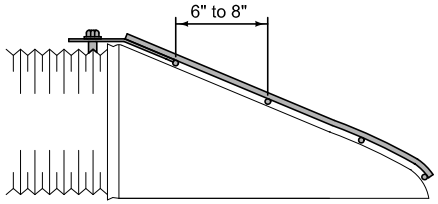
SIDE VIEW

METAL PIPE APRON





END VIEW



SIDE VIEW

METAL APRONS GUARD

1. On sizes 60 inches and larger, supplement the reinforced edge with a galvanized stiffener angle attached with bolts.
2. Install a galvanized toe plate (of the same gage metal as apron) on all aprons 24 inch diameter and larger.
3. Hold inside bars up 3 inches off bottom of apron. Extend outside bars to bottom of apron and attach to 2 inch by 2 inch by 1/4 inch steel angle.
4. When specified, extend bottom cross bar through apron.

DIMENSIONS					
PIPE DIAM.	A (±1")	B MAX.	H (±1")	L (±1½")	W (±2")
6"	4½"	1"	3"	8¾"	12"
8"	5⅞"	3"	4"	14¼"	16"
10"	7½"	6"	6"	21"	24"
12"	4¾"	6"	6"	21"	24"
15"	6"	8"	6"	26"	30"
18"	7"	9"	6"	31"	36"
21"	8¼"	11"	6"	36"	42"
24"	9½"	12"	6"	42"	48"
30"	12"	15"	7½"	52½"	60"
36"	14"	18"	9"	63"	72"
42"	16"	21"	10½"	73½"	84"
48"	18"	27"	12"	84"	90"
54"	18"	30"	12"	84"	102"
60"	18"	33"	12"	87"	114"
66"	18"	36"	12"	87"	120"
72"	18"	39"	12"	87"	126"
78"	18"	42"	12"	87"	132"
84"	18"	45"	12"	87"	138"
90"	24"	37"	11"	87"	144"
96"	25"	35"	12"	87"	150"

SUDAS

REVISION
New 10-18-16

4030.225

SHEET 1 of 1

SUDAS Standard Specifications

METAL PIPE APRONS AND APRON GUARDS

FIGURE 4030.225

SHEET 1 OF 1

SUBDRAINS AND FOOTING DRAIN COLLECTORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Subdrains

B. Subdrain Cleanouts and Outlets

C. Footing Drain Collectors

D. Storm Sewer Service and Connections

1.02 DESCRIPTION OF WORK

A. Construct subdrains, subdrain cleanouts and outlets, and footing drain collectors.

B. Construct storm sewer service and connections.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Subdrains:

1. **Measurement:** Each type and size of pipe installed will be measured in linear feet from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. Lengths of elbows and tees will be included in length of pipe measured.

2. **Payment:** Payment will be made at the unit price of each type and size of pipe.

3. **Includes:** Unit price includes, but is not limited to, trench excavation, furnishing and placing bedding and backfill material, engineering fabric (when specified), connectors, and elbows and tees.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Footing Drain Collectors:

1. **Measurement:** Each type and size of pipe will be measured in linear feet along centerline of pipe from end of pipe to end of pipe.

2. **Payment:** Payment will be made at the unit price for each type and size of pipe.

3. **Includes:** Unit price includes, but is not limited to, trench excavation, pipe, wyes, tap, fittings, and furnishing and placing bedding and backfill material.

C. Subdrain or Footing Drain Cleanouts:

1. **Subdrain Cleanouts:**
   a. **Measurement:** Each type and size of subdrain cleanout will be counted.
   b. **Payment:** Payment for each cleanout will be made at the unit price for each type and size of subdrain cleanout.
   c. **Includes:** Unit price includes, but is not limited to, trench excavation; furnishing cleanout and lid; and furnishing, placing, and compacting bedding and backfill material.

2. **Footing Drain Cleanouts:**
   a. **Measurement:** Each type and size of footing drain cleanout will be counted.
   b. **Payment:** Payment for each cleanout will be made at the unit price for each type and size of footing drain cleanout.
   c. **Includes:** Unit price includes, but is not limited to, trench excavation; furnishing cleanout and lid; and furnishing, placing, and compacting bedding and backfill material.

D. Subdrain or Footing Drain Outlets and Connections:

1. **Subdrain Outlets and Connections:**
   a. **Measurement:** Each type and size of outlet or connection to a structure will be counted.
   b. **Payment:** Payment for each outlet or connection to a structure will be made at the unit price for each type and size installed.
   c. **Includes:** Unit price includes, but is not limited to, pipe, non-shrink grout, coupling bands, and rodent guards for pipes 6 inches or smaller.

2. **Footing Drain Outlets and Connections:**
   a. **Measurement:** Each type and size of outlet or connection to a structure will be counted.
   b. **Payment:** Payment for each outlet or connection to a structure will be made at the unit price for each type and size installed.
   c. **Includes:** Unit price includes, but is not limited to, pipe, non-shrink grout, coupling bands, and rodent guards for pipes 6 inches or smaller.

E. Storm Sewer Service Stub: The storm sewer service stub is the portion of the storm sewer service from the footing drain collector or storm sewer to a point 10 feet outside of the right-of-way or as specified in the contract documents.

1. **Measurement:** Each type and size of pipe will be measured in linear feet along centerline of pipe from the centerline of storm sewer or footing drain collector to 10 feet outside of the right-of-way.

2. **Payment:** Payment will be made at the unit price per linear foot for each type and size of storm sewer service stub.

3. **Includes:** Unit price includes, but is not limited to, trench excavation, furnishing bedding material, placing bedding and backfill material, tap, fittings, and plugs.

PART 2 - PRODUCTS

2.01 FOOTING DRAIN COLLECTORS

A. Polyvinyl Chloride Pipe and Fittings (Solid Wall PVC):

1. Comply with ASTM D 3034, minimum thickness SDR 35, 46 psi minimum pipe stiffness.
2. Use PVC plastic conforming to ASTM D 1784, Cell Classification 12454.
3. Integral bell and spigot type rubber gasket joint complying with ASTM D 3212 and ASTM F 477.

B. Corrugated Polyvinyl Chloride Pipe and Fittings (Corrugated PVC):

1. Use corrugated exterior, smooth interior, PVC.
2. Comply with ASTM F 949, minimum pipe stiffness, 46 psi.
3. Use PVC plastic complying with ASTM D 1784, Cell Classification 12454.
4. Integral bell and spigot type rubber gasket joint complying with ASTM D 3212 and ASTM F 477.

C. High Density Polyethylene Pipe and Fittings (HDPE):

1. AASHTO M 252 or M 294, Type S corrugated exterior and smooth interior.
2. Integral bell and spigot joints with O-ring rubber gasket meeting ASTM F 477.

D. Reinforced Concrete Pipe (RCP): Comply with Section 4020, 2.01.

2.02 TYPE 1 SUBDRAINS (LONGITUDINAL SUBDRAIN)

A. Polyvinyl Chloride Pipe and Fittings (Solid Wall PVC):

1. Comply with Section 4040, 2.01, A.
2. Slot subdrain pipe according to ASTM F 949 or perforate with four rows of 1/4 inch to 3/8 inch diameter holes along the bottom of the pipe.

B. Corrugated Polyvinyl Chloride Pipe and Fittings (Corrugated PVC):

1. Comply with Section 4040, 2.01, B.
2. Slot subdrain pipe according to ASTM F 949.

C. High Density Polyethylene Pipe and Fittings (HDPE):

1. Comply with Section 4040, 2.01, C.
2. Slot or perforate according to AASHTO M 252, Type SP.

2.02 TYPE 1 SUBDRAINS (LONGITUDINAL SUBDRAIN) (Continued)

D. Corrugated Polyethylene Tubing and Fittings (Corrugated PE):

1. Comply with AASHTO M 252, Type C, corrugated interior and exterior.
2. Use only fittings supplied or recommended by pipe manufacturer for soil tight service.
3. Slot or perforate according to AASHTO M 252, Type CP.

2.03 TYPE 2 SUBDRAINS (COMBINATION SUBDRAIN/FOOTING DRAIN COLLECTOR)

A. Use materials complying with Section 4040, 2.01.

B. Perforate all pipe per the following requirements:

1. Solid Wall PVC Pipe: Comply with ASTM F 949 or perforate with four rows of 1/4 inch to 3/8 inch diameter holes along the bottom of the pipe.
2. Corrugated PVC Pipe: Comply with ASTM F 949.
3. HDPE Pipe: Comply with AASHTO M 252 or M 294, Type CP or Type SP.

2.04 POROUS BACKFILL MATERIAL

A. Crushed Stone or Processed Gravel: Comply with Iowa DOT Article 4109.02, Gradation No. 29 in the Aggregate Gradation Table and the quality requirements of Iowa DOT Section 4131.

B. Pea Gravel: Comply with Iowa DOT Article 4109.02, Gradation No. 20 or No. 21 in the Aggregate Gradation Table and the quality requirements of Iowa DOT Section 4131.

2.05 SUBDRAIN OUTLETS

A. Corrugated Metal Pipe (CMP):

1. Comply with AASHTO M 36, Type 1.
2. Zinc coating complying with AASHTO M 218.
3. Use a corrugated steel circular section with annular or helical corrugation.
4. Minimum thickness of 0.052 inch.

B. Corrugated HDPE:

1. Comply with Section 4040, 2.01.
2. Pipe to be double-walled.

C. PVC: Comply with Section 4040, 2.01.

D. Coupling Bands: Match annular or helical corrugations on coupling bands to pipe ends.

E. Rodent Guard: Mild steel meeting ASTM A 36 with hot-dip galvanized coating applied following welding and fabrication. Comply with Iowa DOT Materials I.M. 443.01 and Figure 4040.233. Required for 4 inch or 6 inch subdrains.

2.06 SUBDRAIN OR FOOTING DRAIN CLEANOUTS

A. Type A-1 or A-2 Cleanouts:

1. Use solid wall PVC riser pipe and fittings of the same diameter (maximum 8 inch) as the adjacent subdrain or footing drain pipe. Comply with Figure 4040.232.

2. Use a light duty (HS-20 loading) cast iron casting for Type A-1 cleanouts. When a PVC cap is used on top of the cleanout, drive a 1 foot length of reinforcing steel into the ground immediately adjacent to the cleanout to allow future location.

B. Type B Cleanouts: Comply with Figure 4040.232. Use 24 inch diameter riser for subdrain 8 inches or smaller. Use 30 inch diameter riser for 10 inch and 12 inch subdrains.

1. Reinforced Concrete: Use Class III RCP complying with Section 4020, 2.01.

2. Polyvinyl Chloride:
a. Comply with ASTM D 1784, Cell Classification 12454 for PVC plastic.
b. Conform to ASTM D 3212 for joints.
c. Comply with ASTM F 477 for flexible elastomeric.

3. Concrete: Comply with Section 6010 for structural concrete for base and invert shaping.

4. Castings: Use a light duty (HS-20 loading) cast iron casting complying with Section 6010, 2.10 or a ductile iron casting meeting ASTM A 536.

2.07 ENGINEERING FABRIC

Use fabric complying with Iowa DOT Article 4196.01.

2.08 STORM SEWER SERVICE STUBS

Use materials complying with Section 4040, 2.01.

PART 3 - EXECUTION

3.01 SUBDRAINS

A. Install Type 1 or Type 2 subdrain where specified in the contract documents. Comply with Figure 4040.231.

1. Excavate trench and provide pipe bedding and backfill as shown on the figures. Install engineering fabric if specified in the contract documents.

2. Begin subdrain installation at the outlet and continue upgrade.

3. Lay subdrain pipe to the proper line and grade. Place pipe with the perforations down.

4. If concrete pipe is specified for Type 2 subdrains, wrap exterior of each joint with engineering fabric and do not use joint sealant.

5. Place porous backfill material over installed pipe in layers no more than 6 inches thick. Thoroughly tamp each layer with mechanical tampers.

6. Restore pavement subbase material, shoulder material, or ground above subdrain trench as applicable.

B. Provide cleanouts where specified in the contract documents. Comply with Figure 4040.232.

C. Provide outlets where specified in the contract documents.

1. Comply with Figure 4040.233 for outlets to structures.

2. Install a rodent guard on all subdrain outlet pipes 6 inches and smaller.

3.02 FOOTING DRAIN COLLECTORS

A. Install footing drain collectors according to Section 3010.

B. If specified, install engineering fabric.

C. Provide cleanouts and connections where specified in the contract documents.

1. Connect footing drain sewer collectors to storm sewer manhole or intake.

2. Provide fabricated or preformed wye or tee service fitting for each platted lot or building.

D. Provide manholes, where specified, according to Section 6010.

3.03 FOOTING DRAIN SERVICE STUBS

A. Provide footing drain service stubs at locations specified in the contract documents.

B. Install wye or tee for each service connection.

1. For new storm sewer and footing drain collector construction, except RCP sewers, install wye or tee fittings according to the manufacturer's requirements.

2. For existing storm sewers, existing footing drain collectors, and all RCP sewers, saw or drill a neat hole in main and install preformed saddle wyes or tees according to the manufacturer's requirements.

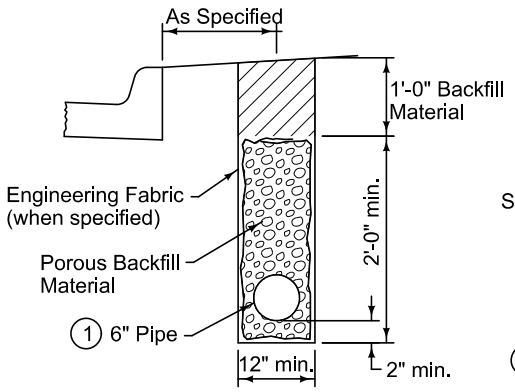
3.03 FOOTING DRAIN SERVICE STUBS (Continued)

C. Install footing drain service stub to a location 10 feet beyond the right-of-way line or as specified in the contract documents.

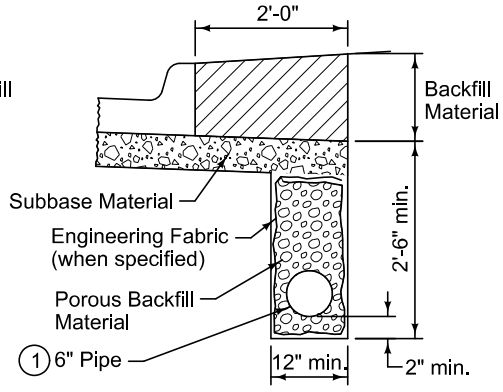
1. For undeveloped properties, place a watertight stopper or plug in the end of the storm sewer service.

2. For reconnection of existing service pipe to new sewer service pipe, use a manufactured flexible connection.

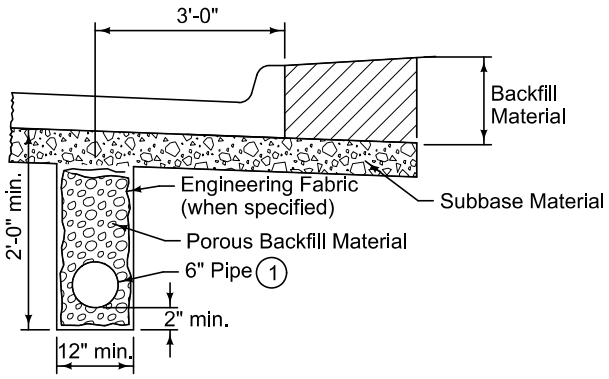
END OF SECTION



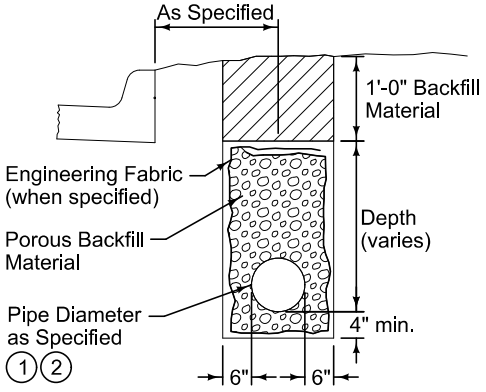
CASE A
TYPE 1



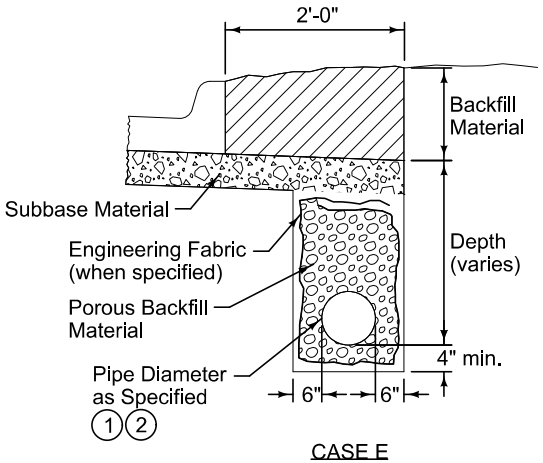
CASE B
TYPE 1



CASE C
TYPE 1



CASE D
TYPE 2



CASE E
TYPE 2

Type 1 installation is for longitudinal subdrain only. Type 2 installation is for combination subdrain/footing drain collectors.

1. Place perforations down for all installations.
2. When concrete pipe is specified, wrap pipe joints with engineering fabric. Do not apply joint sealant. Comply with Figure 4020.211

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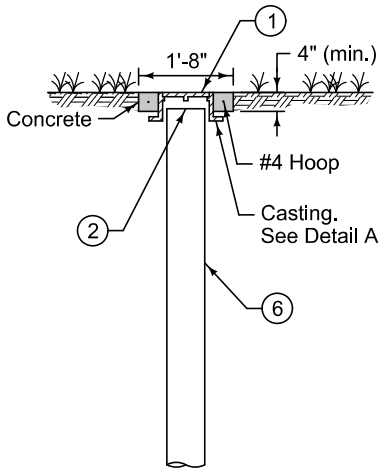
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SHEET 1 of 1

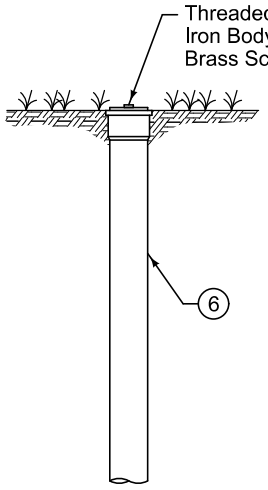
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SUBDRAINS

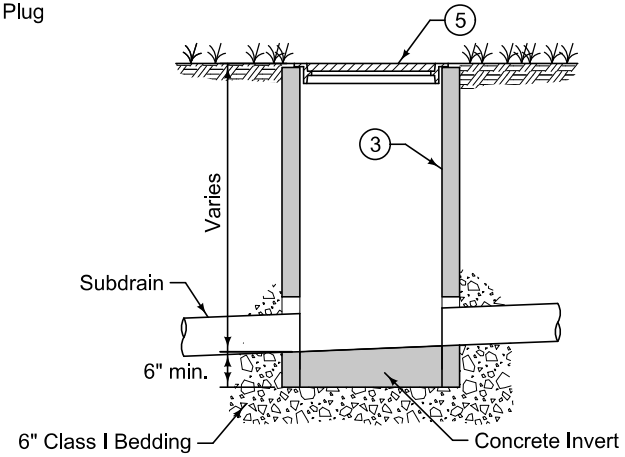
FIGURE 4040.231 | SHEET 1 OF 1



TYPE A-1 CLEANOUT



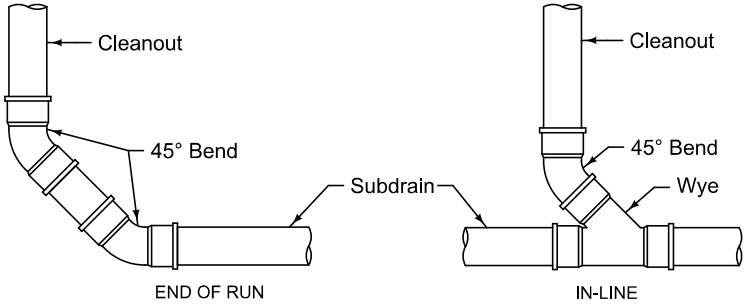
TYPE A-2 CLEANOUT



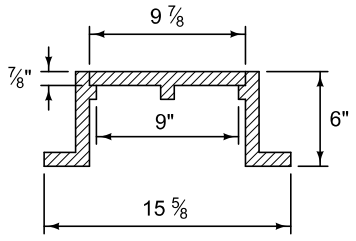
TYPE B CLEANOUT

Use in non-traffic areas.

1. Light duty casting. Label lid with "Storm" or "Storm C.O."
2. Do not allow casting to bear on top of riser pipe; provide 2 inch clearance, minimum.
3. A manufactured cleanout may be used in lieu of a Type B cleanout, if approved by the Engineer.
4. Design is intended for use in conjunction with 8 inch PVC riser pipe. Other sized caps may be used with smaller pipe, as approved by the Engineer.
5. Provide Type G casting, as required to fit pipe size.
6. PVC riser pipe; match diameter of subdrain (8 inches maximum).



TYPE A CLEANOUT CONNECTIONS



DETAIL A (1)(4)
(Dimensions are nominal)

FIGURE 4040.232 | SHEET 1 OF 1

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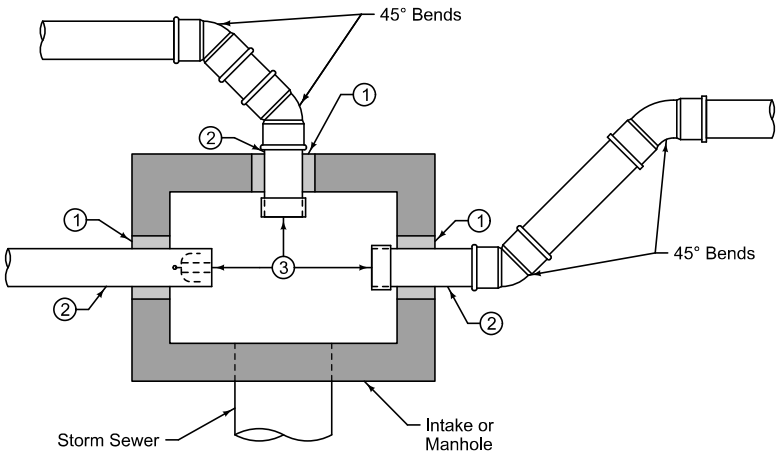
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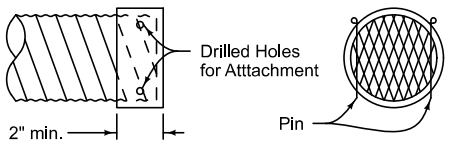
SUDAS Standard Specifications

SUBDRAIN CLEANOUTS

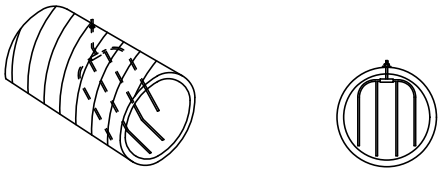


PLAN VIEW

OUTLET INTO STRUCTURE

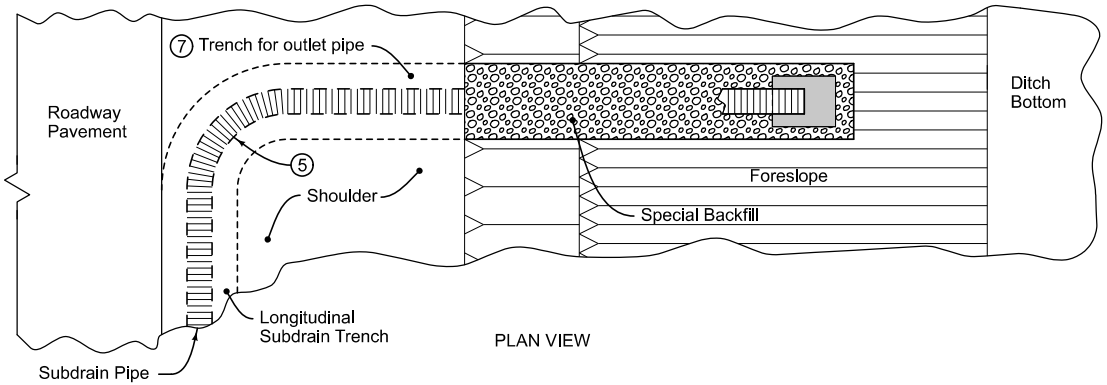


REMOVABLE GRATE

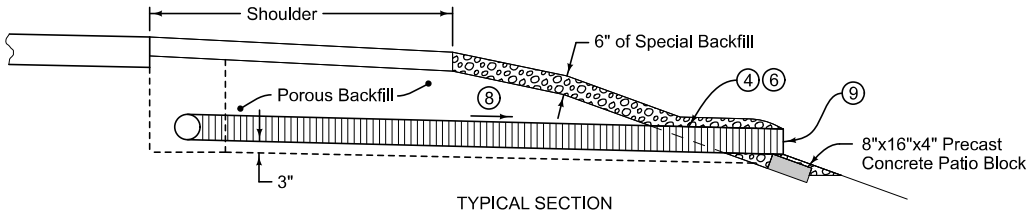


REMOVABLE FORK (9)

RODENT GUARD DETAILS



PLAN VIEW



TYPICAL SECTION

SUBDRAIN OUTLET TO DITCH

Transverse and backslope subdrains require only single outlets. Install double outlet pipes on all longitudinal subdrain systems, except at the beginning and end of the system. At these locations, install a single outlet pipe.

1. Fill annular space with non-shrink grout.
2. Outlets through intake walls to be CMP; corrugated, double-walled HDPE; or PVC.
3. Extend outlet pipe into structure as required to install removable rodent guard.
4. Construct subdrain outlet to ditch with the same type and size of pipe as used for the subdrain.
5. Provide a minimum 1 foot radius for all bends or use two 45° fittings
6. If a CMP outlet is specified in the contract documents, construct the final 10 to 12 feet of the subdrain outlet to ditch with CMP 2 inches larger than the subdrain pipe. Connect pipes with a manufactured coupler or concrete collar.
7. Provide a minimum trench width of 12 inches for a single outlet and 24 inches for a double outlet.
8. Provide a 6 inch minimum drop in elevation between longitudinal subdrain and outlet.
9. For subdrain outlet to ditch, only use fork type rodent guard.

FIGURE 4040.233

SHEET 1 OF 1

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SHEET 1 of 1

SUDAS Standard Specifications

SUBDRAIN OUTLETS

PIPE CLEANING AND REHABILITATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe Cleaning

B. Cured-in-place Pipe (CIPP) Main Lining

C. Cured-in-place Pipe (CIPP) Point Repair

D. Cured-in-place Pipe (CIPP) Service Repair

E. Pressure Testing and Grouting of Sewer Joints

F. Spot Repairs by Pipe Replacement

1.02 DESCRIPTION OF WORK

A. Pipe Cleaning:

1. Mainline pipe cleaning (not associated with a rehabilitation or pre-inspection) is light sewer cleaning with a hydraulic flusher and includes cleaning the sewer and associated manholes, including drop connections and benches, to remove all deposits settled (DS).

2. Pre-rehabilitation cleaning and inspection is light sewer cleaning with a hydraulic flusher. Does not include root cutting or removal of deposits or protruding service connections.

3. Additional sewer cleaning is heavy sewer cleaning including an unlimited number of passes with high velocity hydro cleaning equipment / hydraulic spinner nozzle, cutting roots, removing deposits of attached encrustation (DAE), and removing deposits of attached grease (DAGS). Does not include lateral cuts.

B. CIPP lining for mainline, service (lateral) repair, and point repair.

C. Pressure testing and grouting of sewer joints.

D. Pipe spot repairs.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. CIPP Rehabilitation:

1. Thickness Design: Submit design calculations for CIPP wall thickness based upon ASTM F 1216, prepared and signed by a licensed Professional Engineer in the State of Iowa.

2. Resin: Certificate of compliance with ASTM F 1216 or D 5813.

3. Tube: Certificate of compliance with ASTM F 1216 or F 2019. If glass fiber reinforcement is used, CIPP strain corrosion testing according to ASTM D 3681.

4. Wet Out and Curing: Complete description of the manufacturer's recommended wet out procedure and curing method for the type of lining proposed.

1.03 SUBMITTALS (Continued)

5. Safety Procedures: Submit documentation of National Institute of Occupational Safety and Health (NIOSH) testing, health hazard evaluation, and recommended safety procedures for CIPP workers and public. The safety plan is to include emission stacks a minimum of 6 feet tall and a method to establish a safe perimeter around manholes/emission stacks a minimum of 15 feet in diameter. Based on active air monitoring, workers must wear suitable Personal Protection Equipment (PPE) when initially opening and entering the transport truck or storage unit holding the liner.

B. Grouting Sewer Joints and Service Connections:

1. Grout: Description of chemical grout materials to be used.

2. Additives: Description of additives to be used including strengthening agents, shrinkage reducers, dye, viscosity modifiers, gel time modifier, freeze/thaw inhibiter, or others.

3. Root Inhibitor: Description of chemical root deterrent.

4. Procedures: Manufacturer's published recommendations for storing, mixing, testing, and handling chemical grouts.

C. Installer Information: When requested by the Contracting Authority, submit the following prior to the preconstruction meeting.

1. Installer name.

2. Completed project list for last five years including for each project and year completed, client name/address/contact person/phone number, footages installed by pipe diameter, and number of lateral reinstatements.

3. Detailed installation procedures, including estimated times for each task, lateral reinstatement methods, number of required excavations, and other items unique to each product.

4. Video of installation process, if available.

5. Evidence of properly trained personnel.

6. Related ASTM standards or any nationally recognized standards for product installation.

7. Available equipment list.

8. Detailed procedures for repairing the product in the event of future damage or failure and for tapping future service connections, including and required specialized equipment or training.

9. Videos of two rehabilitated sewer sections showing before and after conditions.

10. Additional information may be required. The submittal of prequalification information in no way implies that the product, manufacturer, or installer will be deemed to be qualified. The Contracting Authority, in its sole discretion, will determine whether a product, manufacturer, or installer does or does not qualify as an approved equal.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Provide, as a minimum, the following information for evaluation.

A. Product Information:

1. Product name.
2. Year product first available in the United States.
3. Total footage or number of line segments installed in the United States.
4. Results of all available product testing, including but not limited to leakage, physical properties, pipe stiffness, chemical resistance, strain-corrosion, external loading, flow characteristics, infiltration/inflow reductions, structural capacity, and external hydrostatic loading capacity.
5. Samples of before and after product.
6. Design method.
7. Typical lining thickness for pipe sizes included in the project.

B. Manufacturer Information:

1. Manufacturer name.
2. Years of experience manufacturing the product.
3. Country of manufacture of all product components.
4. Quality control procedures for product manufacture, including inspection requirements, testing procedures, and allowable tolerance levels.
5. Related ASTM standards, or other nationally recognized standards for product manufacturing.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. Prior to start of work, notify all affected parties 24 hours in advance as to the length of time their service will be blocked.

B. Unless otherwise specified, the Jurisdiction will provide water at no cost for cleaning and installation of cured-in-place pipe. Utilize an approved double check backflow assembly or open gap.

1.07 SPECIAL REQUIREMENTS (Continued)

C. Establish a Public Information and Notification Program for contacting each home or business connected to the affected sanitary sewer, informing them of the work to be done and when the sewer will be off-line. The following specific steps are part of the Public Information and Notification Program.

1. Provide written notice to be delivered to each affected home or business describing work, schedule, how the work affects them, and a local telephone number of the Contractor they can call to discuss the project or their problems.

2. Personally contact each home or business on the day lateral verifications using closed circuit video inspection are to be performed. The homeowner or business will be asked to run water down their drain to verify each lateral. If the homeowner is unavailable, attempt other arrangements (cleanouts) to drain water through the lateral to verify each connection.

3. Provide written notice and personally contact the home or business the day prior to beginning inversion of the section of sewer to which they are connected.

4. Personally contact all homes or businesses that cannot be reconnected within the time stated in the written notice.

5. Furnish and service portable toilets for use by the home or business occupants if so required by any affected served business or homeowner.

1.08 MEASUREMENT AND PAYMENT

A. Pipe Cleaning and Inspection:

1. Mainline Cleaning:
- **a. Measurement:** Measurement will be made for each diameter range of sewer main cleaned. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.
- **b. Payment:** Payment will be made at the unit price per linear foot for each diameter of cleaning.
- **c. Includes:** Unit price includes, but is not limited to, sewer cleaning, debris removal and transport, post CCTV inspection for Engineer review, and logging of active service taps (if specified). Unit price also includes disposal and associated costs for all debris removed from sewer.

2. Pre-Rehabilitation Cleaning and Inspection:
- **a. Measurement:** Measurement will be made for each diameter range of sewer main cleaned and inspected prior to rehabilitation. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.
- **b. Payment:** Payment will be made at the unit price per linear foot for each diameter of pre-lining cleaning and inspection.
- **c. Includes:** Unit price includes, but is not limited to, pre-cleaning CCTV inspection, light sewer cleaning, debris removal and transport, post cleaning CCTV inspection for Engineer review, and identification and logging of active service taps. Unit price also includes disposal and associated costs for all debris removed from sewer.

3. Additional Sewer Cleaning:
- **a. Measurement:** Measurement will be made on an hourly basis for additional sewer cleaning for each diameter range. Hours will start with the initial cleaning work following the Engineer's approval to proceed and will extend until mechanical cleaning ceases. Time for removal, transporting, and disposal of debris is not included. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.

1.08 MEASUREMENT AND PAYMENT (Continued)

b. Payment: Payment will be made at the unit price per hour for additional sewer cleaning.

c. Includes: Unit price includes, but is not limited to, heavy sewer cleaning; root cutting; deposit cutting; and post cleaning CCTV inspection for Engineer review.

4. Debris Removal, Transportation, and Disposal:

a. Measurement: Measurement will be made on a per ton basis for decanted and pressed debris removed as a part of additional pipe cleaning.

b. Payment: Payment will be made at the unit price per ton for additional pipe cleaning based on tickets from an approved landfill site.

c. Includes: Unit price includes, but is not limited to, removing, decanting, transporting, disposing, and paying associated costs for all debris removed from sewer as a part of additional cleaning.

B. Remove Protruding Service Connections:

1. Measurement: Each protruding service connection removed will be counted. Quantity will be based on number of protruding service connections identified in the pre-rehabilitation CCTV inspection and removed from the post-rehabilitation CCTV inspection.

2. Payment: Payment will be made at the unit price for each protruding service connection removed.

3. Includes: Unit price includes, but is not limited to, removal of protruding service connections and debris removal.

C. CIPP Lining:

1. CIPP Main Lining:

a. Measurement: Each size of main pipe lining will be measured in linear feet along the centerline of the pipe lining from center of manhole to center of manhole.

b. Payment: Payment will be made at the unit price per linear foot for each size of pipe lining.

c. Includes: Unit price includes, but is not limited to, furnishing and installing the liner and appurtenances, CCTV inspection immediately prior to lining, bypass pumping unless otherwise specified, sliding foil, post-lining CCTV inspection, and all costs associated with the public information and notification program.

2. Building Sanitary Sewer Service Reinstatement:

a. Measurement: Each active sanitary sewer service reinstated, including those reinstated by excavation, will be counted.

b. Payment: Payment will be made at the unit price for each active sewer service reinstated.

c. Includes: Unit price includes, but is not limited to, reinstating sanitary sewer service connections, removal of debris, and coordination with service owners.

3. CIPP End Seal:

a. Measurement: Each size of CIPP end seal installed will be counted.

b. Payment: Payment will be made at the unit price for each CIPP end seal installed.

c. Includes: Unit price includes, but is not limited to, end seal and installation.

1.08 MEASUREMENT AND PAYMENT (Continued)

D. CIPP Point Repair:

1. **Measurement:** Each diameter of CIPP point repair will be counted. Repairs in excess of 10 feet in length will be counted as multiple repairs.

2. **Payment:** Payment will be made at the unit price for each diameter of CIPP point repair.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing point repair liner, bypass pumping unless otherwise specified, sewer cleaning, removal of obstructions, debris removal, pipe preparation, and pre and post repair CCTV inspection.

E. CIPP Service Repair:

1. **CIPP Service Pipe, Connection:**
   a. **Measurement:** Each size combination of main and service connection diameters repaired will be counted.
   b. **Payment:** Payment will be made at the unit price for each size combination of CIPP service pipe, connection.
   c. **Includes:** Unit price includes, but is not limited to, furnishing and placing service connection liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.

2. **CIPP Service Repair, Partial Pipe:**
   a. **Measurement:** Each size combination of main and service diameters and specified service length lined will be counted.
   b. **Payment:** Payment will be made at the unit price for each size combination of CIPP service repair, partial pipe.
   c. **Includes:** Unit price includes, but is not limited to, furnishing and installing service repair liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.

F. Pressure Testing and Grouting of Sewer Joints and Service Connections:

1. **Pressure Testing of Mainline Sewer Joints:**
   a. **Measurement:** Each mainline sewer joint tested will be counted. Separate measurement will be made for each diameter of sewer main. Visually leaking joints, whether tested or not, will be counted if they are grouted.
   b. **Payment:** Payment will be made at the unit price for each sewer joint tested.
   c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, control testing, and documentation.

2. **Injection Grouting of Mainline Sewer Joints:**
   a. **Measurement:** Each mainline sewer joint grouted will be counted. Separate measurement will be made for each diameter of sewer main.
   b. **Payment:** Payment will be made at the unit price for each sewer joint grouted.
   c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, material testing, pressure testing after grouting, re-grouting of failed joints, and documentation. Unit price does not include the quantity of chemical grout used.

3. **Pressure Testing of Service Connections:**
   a. **Measurement:** Each sewer service connection tested will be counted. Separate measurement will be made for service connections on each diameter of sewer main.
   b. **Payment:** Payment will be made at the unit price for each service connection tested.
   c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, and documentation.

1.08 MEASUREMENT AND PAYMENT (Continued)

4. **Injection Grouting of Service Connections:**
   a. **Measurement:** Each service connection grouted will be counted. Separate measurement will be made for service connections on each diameter of sewer main.
   b. **Payment:** Payment will be made at the unit price for each service connection grouted.
   c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, material testing, pressure testing after grouting, and documentation. Unit price does not include the quantity of chemical grout used.

5. **Chemical Grout:**
   a. **Measurement:** Each gallon of chemical grout used for sealing mainline sewer joints and service connections will be counted.
   b. **Payment:** Payment will be made at the unit price for each gallon of chemical grout used.
   c. **Includes:** Unit price includes, but is not limited to, grout additives; root inhibitor; and supplying, mixing, and measurement of chemical grout.

G. Bypass Pumping

1. **Measurement:** Lump sum item, no measurement will be made.

2. **Payment:** Payment will be made at the lump sum price for bypass pumping.

3. **Includes:** Lump sum price includes, but is not limited to, development and submittal of the bypassing plan, all staffing, equipment, and appurtenances necessary to accomplish the approved bypassing plan, including reserve equipment.

H. Spot Repairs by Pipe Replacement: Both of the following methods will be used for measurement and payment of spot repairs by pipe replacement.

1. **Spot Repairs by Count:**
   a. **Measurement:** Each spot repair location will be counted.
   b. **Payment:** Payment will be made at the unit price for each spot repair.
   c. **Includes:** Unit price includes, but is not limited to, uncovering and removing existing pipe and furnishing and placing bedding and backfill material for replacement pipe.

   and;

2. **Spot Repairs by Linear Foot:**
   a. **Measurement:** Each spot repair will be measured in linear feet along the centerline of the replacement pipe.
   b. **Payment:** Payment will be made at the unit price per linear foot of spot repair.
   c. **Includes:** Unit price includes, but is not limited to, furnishing and installing replacement pipe and connections.

I. Pavement Removal and Replacement: Comply with Section 7040.

J. Sod: Comply with Section 9020.

K. Seeding: Comply with Section 9010.

PART 2 - PRODUCTS

2.01 CIPP MAIN LINING

A. Fabric Tube and Resin: Comply with ASTM F 1216 for heat cure or ASTM F 2019 and D 5813 for UV light cure.

B. CIPP Lining Dimensions:

1. Use nominal internal diameter and length such that CIPP forms to internal circumference and length of original pipe.

2. Field verify diameter and length.

3. Use one continuous length without joints.

C. Structural Requirements:

1. Design the CIPP liner according to ASTM F 1216.

2. Unless otherwise specified in the contract documents, assume fully deteriorated conditions and the following properties for design at each location:

Table 4050.01: CIPP Main Lining Design Values

Design Criteria	Value
Factor of safety, N	2.0
Soil modulus, E'_s	1,000 psi
Soil density, ω	120 lb/ft^3
Live load, W_s	H20
Ovality reduction factor, C	As specified for each location
Height of soil above pipe, H	As specified for each location
Height of water above top of pipe, H_w	1/2 depth of cover
Long term flexural strength, σ_L	Use value for 50 year design

3. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.

4. Design for internal pressure or vacuum is not required.

D. CIPP Lubricant: Provide a non-toxic, oil based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

E. CIPP End Seal:

1. Hydrophilic Gasket Sleeve: Provide a seamlessly molded gasket and retaining ring system complying with ASTM F 3240.

2. Expansion Band System:
a. Provide a one-piece rubber gasket and a pair of stainless-steel expansion bands in a system manufactured specifically for CIPP end seal applications.
b. Provide bands with positive locking mechanism permanently securing the bands in their expanded position after tightening.
c. Comply with material requirements of ASTM C 923 for rubber gasket and stainless steel.

2.02 CIPP POINT REPAIR

A. General: Utilize a repair system that complies with the following requirements.

1. Meet or exceed the material requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.

2. Provides a full wrap section sized to create a circular liner equal to the inner diameter of the pipe. Ensure one end of the CIPP point repair sheet overlaps the second end by a minimum of 10% to allow for variation in pipe diameter.

3. Sufficient strength to bridge missing pipe segments and ability to stretch to fit irregular pipe sizes.

4. Uniform thickness and 10% extra resin.

5. Utilizes a thermoset resin system comprised of a base resin and hardener that cure at ambient temperatures.

6. Has a shrinkage value of less than 0.5% when measured according to ISO 2577 or ASTM D 6289.

7. Designed against corrosion and typical chemicals found in domestic sewage.

B. Liner Length: Minimum length as specified in the contract documents. Lengths beyond 10 feet may be completed with multiple liners.

C. Structural Requirements: Design the CIPP point repair according to the structural requirements for CIPP main lining described herein. Assume an ovality of 2% unless otherwise specified in the contract documents.

2.03 CIPP SERVICE REPAIR

A. General: Utilize a repair system that provides the following.

1. Full circumferential CIPP liner inside the main pipe and a tube that extends continuously from the sewer main into the service for the distance specified in the contract documents.

2. Installation of system from within the sewer main without the need for excavation or access through a clean out.

3. The ability to seal a combination of tees and wyes of varying angles.

4. The ability to seal the connection of the service to the mainline in a continuous, tight fitting, watertight pipe within a pipe that eliminates infiltration and root intrusion between the liner and host pipe.

B. Liner Length:

1. CIPP Service Connection Repair: Provide service liner with a length of 12 to 24 inches to seal the connection between the main line and the wye or tee.

2. Partial Service Pipe: Provide service liner with a length between 12 and 24 inches, as specified in the contract documents, to seal the connection from the main line to the first service pipe joint.

3. Main Pipe Liner Length: Provide main pipe liner with a length of 18 inches minimum.

2.03 CIPP SERVICE REPAIR (Continued)

C. Fabric Tube:

1. Provide a fabric tube consisting of one or more layers of absorbent non-woven felt fabric, felt/fiberglass, or fiberglass complying with the requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.

2. Provide nominal fabric tube wall thickness to the nearest 0.5 mm increment as required by the thickness design. Ensure the wet-out fabric tube has a uniform thickness that, when compressed at installation pressures, meets or exceeds the design thickness after cure.

3. Coat inside (after installation) of fabric tube with an impermeable, flexible membrane that will contain the resin and facilitate vacuum impregnation.

4. Mark the fabric tube with the name of the lining system manufacturer and manufacturing lot or production footage. Ensure print is visible during final CCTV inspection.

D. Resin:

1. Provide a chemical-resistant thermoset (heat or UV light) resin and catalyst system or epoxy resin and catalyst / hardener system that, when cured within the fabric tube, complies with requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.

2. Method of cure may be by heat source, UV light, or ambient temperature.

3. Provide resin to tube ratio as recommended by the manufacturer.

E. Structural Requirements:

1. Design the cured-in-place service liner according to ASTM F 1216 utilizing the following assumptions, unless otherwise specified in the contract documents:

Table 4050.02: CIPP Service Design Values

Design Criteria	Value
Factor of safety	2.0
Soil modulus	1,000 psi
Soil density	120 pcf
Live load	H20
Depth of cover	As specified for each location
Groundwater	1/2 depth of cover
Ovality	2%

2. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.

2.03 CIPP SERVICE REPAIR (Continued)

3. Comply with the following minimum structural properties:

Table 4050.03: Minimum Structural Properties for CIPP Service

Property	Test Method	Minimum Value
Flexural modulus of elasticity	ASTM D 790	250,000 psi
Flexural strength	ASTM D 790	4,500 psi

4. Do not consider the bond to the existing pipe in determining the structural performance of the lining system.

2.04 CHEMICAL GROUT

A. Grout: Provide a chemical grout (chemical sealing material) complying with ASTM F 2304 or ASTM F 2454.

B. Additives: Strengthening agents, shrinkage reducers, dyes, viscosity modifiers, gel time modifiers, and freeze/thaw inhibiters, are allowed at the Contractor's discretion. Provide additives compatible with the chemical grout and complying with chemical grout manufacturer's requirements.

C. Root Inhibitor: When specified in the contract documents, provide a root deterrent chemical to control root regrowth. Ensure root inhibitor is compatible with chemical grout and additives and complies with grout manufacturer's requirements.

2.05 SEWER DYE

Provide tracer dye complying with NSF/ANSI 60.

2.06 PIPE REPAIR COUPLINGS FOR SPOT REPAIRS BY PIPE REPLACEMENT

A. Style: Full circle, fully lined, bolted.

B. Length: As recommended by the manufacturer for pipe diameter; 12 inches, minimum.

C. Materials and Manufacturer:

1. Shells, armors, side bars, lugs, Turner lifting bars; complying with ASTM A 240, Type 304 stainless steel.

2. MIG welds, fully passivated.

3. Rubber gasket complying with ASTM D 2000, AA415 with full coverage and a grid pattern.

4. Stainless steel armor bonded to gasket to bridge lug area.

D. Nuts and Bolts: 1/2 inch or 5/8 inch diameter, complying with ASTM A 240, Type 304 stainless steel, and Teflon coated threads.

2.07 SEWER MAIN PIPE (FOR SPOT REPAIRS)

A. Comply with Section 4010.

B. Use materials for pipe replacement as specified in the contract documents or approved by the Engineer.

PART 3 - EXECUTION

3.01 SEWER CLEANING AND INSPECTION

A. General:

1. Provide equipment specifically designed and constructed for sewer cleaning and inspection.

2. Use sewer cleaning equipment manufacturer's recommended size tools for various pipe sizes.

3. Utilize equipment recommended by the manufacturer to protect the manhole and pipe during cleaning and inspection operations.

4. Perform all cleaning and removal operations under CCTV observation to monitor the progress of the work and to monitor the sewer line for damage. Continue until the condition of the host pipe meets the requirements of the liner manufacturer.

5. Flush all debris to downstream manhole. Screen, collect, and remove debris from sewer.

6. Dispose of all sanitary sewer debris and material at a location directed by the Owner. If specified in the contract documents, pay for all disposal fees.

B. Pre-Cleaning Inspection:

1. Complete CCTV inspection of sewer prior to initiating cleaning.

2. Inspect each pipe segment between manholes or access points in a single, continuous run where possible.

3. If line is impassable due to debris or obstructions, reverse setup and inspect from opposite manhole or access point.

C. Sewer Pipe Cleaning:

1. Perform light cleaning with hydraulic flusher or high velocity cleaning equipment to remove loose debris.

2. Complete up to three passes in an attempt to remove all debris from line.

3. If the light cleaning fails to leave the sewer line in a condition ready for lining, contact Engineer for authorization to proceed with additional sewer cleaning.

D. Additional Sewer Cleaning:

1. Notify Engineer prior to performing heavy cleaning as required to remove obstructions, grease, rock, sticks, deposits attached grease (DAGS), deposits attached encrustation (DAE), and roots, so the sewer is ready for lining. This item does not include cutting/grinding protruding service lines.

2. Utilize bucket machines with Teflon or equivalent covers, rotating nozzles, saws or cutters, or high velocity hydro-cleaning equipment.

3. Keep all the debris removed during additional cleaning separate from debris removed during light cleaning. Prior to removal, decant and press debris onsite. Discharge decanted water into a sanitary sewer prior to obtaining the tonnage of the material removed from the sewer..

3.01 SEWER CLEANING AND INSPECTION (Continued)

4. Notify Engineer prior to use of mechanical/hydraulic spinner nozzle, chain flail, or other devices that may damage pipe or service connections.

5. If deposits and obstructions cannot be removed by tools normally used in the sewer cleaning industry, notify the Engineer immediately

6. Maintain a log of time spent performing additional pipe cleaning on each line segment.

E. Remove Protruding Service Connection:

1. Grind or cut services that protrude more than 1/2 inch into the sewer main as approved by the Engineer.

2. Utilize a remote grinding/cutting device specifically designed to remove concrete, vitrified clay, PVC, and other types of pipe materials.

3. Notify the Engineer if ductile iron, steel, cast iron, or other non-typical service materials are encountered to review the ability and risks of removing the protruding services.

4. Grind or cut protruding service flush to the main sewer pipe without scouring or damaging the main sewer or service connection.

5. Notify the Engineer immediately if the sewer main or service pipe are not structurally sound.

F. Post-Cleaning CCTV Inspection: Complete inspection according to Section 4060 and the following.

1. Complete CCTV inspection of sewer upon completion of all sewer cleaning, obstruction removal, and protruding service removal activities.

2. Identify active and inactive service connections by the following:
   a. Observe each service connection and identify active connections by active sewage flow or evidence of recent sewage flow.
   b. If the status of the connection is inconclusive, run water down adjacent services to verify the location of each service.
   c. Dye test connections if necessary to verify active status.
   b. Accurately measure and log the location and clockwise position of all active service connections.

G. Groundwater: If significant groundwater infiltration is present, which could result in resin loss, resin contamination, reduction in CIPP thickness, or inadequate curing, notify the Engineer prior to installing CIPP liner.

H. Inspection Reporting:

1. Provide a copy of the pre-cleaning and post-cleaning video inspections. Include on-screen continuous footage, pipe diameter, direction of viewing, manhole number, and street location reference in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.

2. Provide a written report of the inspections. Include true to scale drawings of all sewer defects and observation locations. Reference the time stamp on each line item entry on the written report.

3.02 BYPASSING SEWAGE

A. Submit a bypassing plan to the Engineer for review.

B. When sewer line flows exceed the values in Table 4050.04, or the depth recommended by the manufacturer of the sewer rehabilitation practice being implemented, reduce flows to acceptable levels.

1. Plug the line at a point upstream of pipe to be rehabilitated if bypassing is required.

2. Pump flow to a downstream point or adjacent system as directed by the Engineer.
   a. Provide pump and bypass lines of adequate capacity to handle all flows.
   b. Provide adequate reserve pumps on-site for emergency use and for storm flows.

C. Rehabilitation and inspection work may be completed without bypassing in certain situations including low flow conditions, adequate upstream storage, use of a flow-through packer, or other situations approved by the Engineer. If proposed work will be completed without bypassing, have equipment and plan of action available to implement bypass pumping in the event the work is delayed or sewage levels in the upstream line are in danger of causing backups.

Table 4050.04: Maximum Depth of Flow During Inspection, Testing, and Rehabilitation

Main Diameter	CCTV Inspection	Joint Testing/Sealing
6” to 10”	20% of pipe diameter	25% of pipe diameter
12” to 24”	25% of pipe diameter	30% of pipe diameter
27” and up	30% of pipe diameter	35% of pipe diameter

3.03 CIPP MAIN LINING

A. General:

1. Clean, prepare, and inspect the repair point according to Section 4050, 3.01

2. Install liner according to the manufacturer′s published recommendations, ASTM F 1216, and ASTM F 2019.

B. Resin Impregnation:

1. Vacuum impregnate tube with resin (wet-out) at manufacturer’s plant under quality controlled conditions or on-site in mobile wet-out unit.

2. Fill all voids in the tube material, adding 5% to 10% excess resin to allow for migration of resin into the voids and cracks.

C. Insertion:

1. General:
   a. Perform pre-lining video inspection immediately prior to insertion of the wet-out tube.
   b. Insert the wet-out tube through an existing manhole or approved access.
   c. Ensure the tube is continuous between manholes with no joints. A single tube may span several manhole reaches as allowed by the equipment, properties of the CIPP, and time limits imposed by sewage flows to the host pipe.
   d. Insertion of CIPP indicates acceptance of the host pipe conditions and the suitability of the liner inserted into the host pipe. Repair any failure of CIPP liner due to inadequate cleaning, groundwater infiltration, or defects in the liner system at no additional cost to the Contracting Authority.

3.03 CIPP MAIN LINING (Continued)

2. Inverted Heat-Cured Liner:

a. Prior to installation of the liner, place a temperature sensor on the bottom of the host pipe to monitor the temperature of the outside of the liner during the curing process. Place sensor at the termination point or location most distant from the heat source.
b. Insert the wet-out tube into the inversion device or standpipe with the impermeable plastic liner on the outside of the tube.
c. Turn back the end of the liner to form a cuff and secure the cuff to the inversion device or standpipe.
d. Apply air pressure or hydrostatic head as required to invert the tube into the host pipe with the impermeable liner on the inside of the pipe.
e. Apply lubricant directly to the tube or pour lubricant into the standpipe during the inversion process to reduce friction.
f. Maintain and adjust pressure as necessary to invert the tube from the point of insertion to the point of termination and to hold the tube tight against the wall, producing dimples at service connections.

3. Pull-In UV Light Cured Liner:

a. If CIPP manufacturer recommends the use of a sliding foil for the existing pipe conditions, provide sliding foil which covers the lower third to lower half of the pipe circumference. Pull sliding foil into place.
b. Fold the wet-out liner in half and pull into place through an existing manhole. Monitor pulling speed and tension to avoid exceeding the manufacturer's recommendations.
c. Pull 1 to 2 feet of excess liner into the termination manhole.
d. If the product is sensitive to elongation, measure the overall elongation of the tube after pull-in. Ensure the elongation of the tube is less than 2% of the overall length of the segment specified by the manufacturer.
e. Expand the resin-impregnated tube as necessary to hold the tube tight against the wall, producing dimples at service connections.
f. Perform CCTV inspection of the inflated liner prior to initiating cure. Confirm alignment and fit prior to initiating cure. Make corrections as necessary to provide a finished liner free of wrinkles and defects.

D. Curing:

1. Heat Cured:

a. Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete. Increase pressures to compensate for external ground water, if present.
b. Cure liner using circulating heated water or steam. Ensure the temperature is sufficient to affect a cure in all sections of the pipe.
c. Monitor and log the temperature from the sensor placed between the impregnated tube and the host pipe.
d. Initial cure will occur during heat up and is achieved when exposed portions of the new pipe appear to be hard and sound and the temperature sensor indicates the liner has reached the temperature necessary to effect a cure in the resin.
e. After initial cure is reached, raise the temperature to post-cure temperatures and hold for a period of time as recommended by the resin manufacturer.
f. Cool the new pipe to a temperature of 100°F for water cure and 113°F for steam cure before relieving the internal pressure within the section.

2. UV Light Cured:

a. Automatically record the time, rate of travel of the ultraviolet assembly, pressures, and amount of lamps in operation for each CIPP segment as documentation of correct curing of the fabric tube.
b. Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete.

3.03 CIPP MAIN LINING (Continued)

c. Draw the multi-lamp ultraviolet curing assembly through the pipe at a consistent, predetermined, speed that allows for cross-linking/polymerization of the CIPP resin.
d. Adjust air pressure during curing as necessary to hold liner tight to the wall. Maintain pressure by adjustment of the outlet valve.
e. Remove the temporary internal calibration hose installed by the manufacturer after curing is complete.

E. CIPP End Seal Installation:

1. Hydrophilic Gasket Sleeve: Install sleeve according to ASTM F 3240, sleeve manufacturer's published recommendations, and the following:
a. Do not install sleeve in host pipe more than 24 hours prior to CIPP lining.
b. Clean the first 6 inches of the main pipe to remove debris and visible grease deposits.
c. Install metal retaining clip at the leading edge of the sleeve. The metal clip may be held in place with adhesive tape if desired.
d. Install the sleeve in the main pipe so the leading edge is no more than 6 inches inside the end of the main pipe as measured from the manhole wall.
e. If the main pipe has a diameter of 18 inches or larger, utilize anchor screws to hold the sleeve in place.

2. Expansion Band System: Install system according to manufacturer's published recommendations and the following:
a. After installation of the CIPP liner, trim the end of the liner squarely a distance of 2 to 6 inches from the inside face of the manhole.
b. Clean the exposed face of the main pipe to remove debris and loose resin.
c. Slide the rubber gasket into the pipe, centering it over the end of the liner. Ensure one expansion band will seat against the liner and the other will seat against the main pipe.
d. Expand the expansion bands using a hydraulic expansion tool approved by the band manufacturer.

F. Service Reinstatement:

1. Do not leave sanitary service blocked for more than 24 hours.

2. Reinstate active service lines from within the main with a CCTV camera and remote cutting tool. Do not reinstate inactive service connections.

3. Machine the opening to full size of the service connection opening area. Ensure the bottom of the liner opening and service line are flush.

4. Ensure the opening does not have pipe fragments or CIPP fragments that may obstruct flow or snag debris.

5. In the event that service reinstatement results in a liner opening greater than 100% of the service connection opening, or damage to the service connection occurs, install a CIPP service repair to cover the over-cut service connection at no additional cost to the Contracting Authority.

6. If service connection cannot be reinstated remotely and requires excavation complete according to the local plumbing code at no additional cost to Contracting Authority.

3.03 CIPP MAIN LINING (Continued)

G. Inspection: Complete inspection according to Section 4060 and the following.

1. Perform CCTV video inspection of completed CIPP lining, including observance of reinstated service connections. Provide copy of video inspection to Jurisdiction.

2. Ensure the tube is free of dry spots, lifts (spots cured away from the sewer), and delaminations. Remove and replace deficient sections.

3. If the CIPP does not fit tight against the original pipe at its termination point, seal the space between the pipes by filling with a resin mixture or hydrophilic seal compatible with the CIPP.

3.04 CIPP POINT REPAIR

A. Preparation: Clean, prepare, and inspect the repair point according to Section 4050, 3.01.

B. Bypass Pumping: Develop a plan for flow diversion or stoppage. Review with Engineer prior to initiating repair.

C. Installation:

1. Bypass mainline flow according to the submitted bypass plan.

2. Install CIPP point repair according to system manufacturer's published recommendations.

3. Wet-out the liner with the entire volume of resin recommended by the manufacturer.

4. Load the wet-out liner onto the packer and secure in place. Ensure the ends of the packer extend beyond the ends of the liner.

5. Pull the packer into position within the pipe. Verify position with CCTV observation.

6. Apply air pressure to the packer to expand the CIPP point repair liner against the host pipe.

7. Maintain consistent pressure for the duration of the curing period.

D. Inspection: Complete inspection according to Section 4060 and the following.

1. Perform CCTV video inspection of completed CIPP point repair. Provide copy of video inspection to Jurisdiction.

2. Ensure the tube is free of foreign inclusions, dry spots, pinholes, wrinkles greater than 2% of the pipe diameter, and delamination. Remove and replace deficient sections.

3.05 CIPP SERVICE REPAIR

A. Preparation:

1. Prior to installation of the system, clean and prepare the interior of the host and service pipe in according to the manufacturer's written instructions.

2. Remove all debris and obstructions.

3.05 CIPP SERVICE REPAIR (Continued)

3. Perform a post cleaning CCTV inspection in preparation for installation of the lining system.

4. If any obstructions, joint misalignments, broken or collapsed pipe, or other conditions are identified that will prohibit proper installation of the system, notify the Engineer immediately.

B. Installation:

1. Install CIPP service repair according to system manufacturer's published recommendations and to the length specified in the contract documents.

2. Bypass main line flow according to the submitted bypass plan. Coordinate installation with service owner to prevent service line flows.

3. Wet-out the entire liner, including lateral and mainline portions, using vacuum impregnation.

4. Load the lining system inside or on a pressure apparatus and move into position in the mainline pipe at the service connection.

5. Align and verify the position of liner and service line via CCTV prior to initiating installation.

6. Apply air pressure to invert or expand the resin impregnated CIPP into the lateral pipe and push the main-line portion of the system against the main pipe. Maintain pressure until the curing process is complete.

7. Apply heat or UV light as required by the manufacturer to property cure the liner.

8. If liner is heat cured, follow manufacturer's recommendations for cool-down before relieving pressure.

9. If liner is ambient cured, maintain pressure according to the manufacturer's recommendations before relieving pressure.

10. Remove frayed ends of the system.

C. Inspection and Documentation: Complete inspection according to Section 4060 and the following.

1. Provide Jurisdiction with video documentation of pre-installation conditions and post-installation conditions showing the repair.

2. Ensure the finished CIPP service repair is free of any leakage and visual defects including foreign inclusions, dry spots, lifts, pinholes, major wrinkles, and delamination. Repair any defects that could affect the structural integrity of the system or allow leaks.

3. Maintain a written log of installation conditions according to system manufacturer's recommendations. At a minimum, include time of wet out, time and location of insertion, time of inflation, bladder pressure requirements, required cure time, actual cure time, and cool down duration.

4. Submit documentation of results for CIPP liner material to Jurisdiction.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS

A. General:

1. Clean, prepare, and inspect the repair point according to Section 4050, 3.01

2. Complete sewer joint and service connection testing and grouting according to the grout supplier and equipment manufacturer′s published recommendations, ASTM F 2304, and ASTM F 2454.

B. Equipment:

1. Joint Testing Device: Provide a joint testing device (packer), with means for introducing air under pressure into the void area created by the expanded ends of the packer against the host pipe and a means of continuously measuring, viewing, and recording the static pressure of the test medium and grout within the void area only. Provide packer constructed in a manner to allow a limited amount of sewage to flow through at all times.

2. Service Connection Testing Device: Provide a service connection testing device with inflatable mainline end elements and a service line grouting plug that creates a void area extending beyond the main connection. Use a service line grouting plug sized to match the diameter of the service being grouted with an effective sealing length of at least 18 inches, unless otherwise specified in the contract documents.

3. Pumping Equipment:
   a. Provide positive displacement metering grout pump and hose delivery system capable of supplying a mixed volume of grout at a minimum of 3 gallons per minute and 30 gallons of uninterrupted flow within 10 minutes.
   b. Ensure pump system has sufficient discharge pressure (in excess of system pressure losses and groundwater) to deliver grout volume to fill void space within the gel set time of the chemical grout.

4. Grout Tanks: When using non-soluble additives, ensure grout tanks have mechanical mixing devices to keep additives in suspension.

5. Measuring Equipment: Provide means of measuring and recording the volume of mixed grout pumped for each grouted joint or service connection.

C. Control Tests:

1. Prior to beginning testing and grouting, perform a demonstration test in an above ground 8 inch nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. For service line testing, provide an 8 inch test cylinder with 6 inch service tee to receive the lateral bladder.

2. Equip the test cylinder with a pressure gauge to monitor internal pressure and a release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions.
   a. With the void release valve closed, inflate the packer and air test the void at 7 to 10 psi. Ensure the observed void pressure at the test cylinder pressure gauge is within $\pm$ 1/2 psi of the test monitoring equipment.
   b. Crack open the release valve to simulate a small leak. Ensure the pressure drop of the cylinder gauge is within $\pm$ 1/2 psi of the test monitoring equipment.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

2. After entering each pipeline segment, but prior to commencement of joint testing, position the packer on a section of sound and clean sewer between two consecutive pipe joints and perform a pressure test. Pressurize packer to between 7 and 10 psi and hold for a period of 15 seconds with a pressure drop of less than 1.0 psi. Deflate packer and ensure that void pressure monitoring equipment drops $\pm$ 1/2 psi of initial reading.

3. If any of the control tests are unsuccessful, clean equipment of excess grout or make necessary repairs and retest.

D. Sewer Main Joint Pressure Testing:

1. Test joints at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).

2. Position the packer within the pipe so the packer straddles the pipe joint to be tested. Verify location via CCTV monitoring.

3. Expand the packer ends to isolate the joint from the remainder of the pipe and to create a void area between the pipe joint and testing device.

4. Pump air into void space until the pressure reaches the required test pressure.

5. Stop the flow of air into the void space and observe the void pressure for 15 seconds.

6. If the pressure is maintained with a drop of less than 1 psi, the joint will be considered as having passed the test.

7. If the pressure drops more than 1 psi during the test period, the joint will be considered as having failed and sealing will be required.

8. Deflate packer and verify the void pressure monitor drops to within $\pm$ 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

E. Service Line Pressure Testing:

1. Test service lines at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).

2. Position the testing device within the line segment to straddle the service connection. Verify location via CCTV.

3. Align the service bladder with the service connection.

4. Apply air pressure to invert or inflate the bladder from the mainline assembly into the service pipe.

5. Expand the packer ends to isolate the section of the service connection to be tested.

6. Introduce air into the void area until a pressure equal to or up to 10% greater than the required test pressure is observed.

7. Stop the flow of air into the void space and observe the void pressure for 15 seconds.

8. If the pressure is maintained, with a pressure drop of less than 2 psi, the connection will be considered as having passed the test.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

9. If the pressure drops more than 2 psi during the test period, the connection will be considered as having failed and sealing will be required.

10. Deflate packer and bladder and verify the void pressure monitor drops to within ± 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

F. Sewer Main Joint Sealing by Injection Grouting: Perform joint sealing according to ASTM F 2304, equipment manufacturer, grout supplier, and the following:

1. Position packer over the faulty joint and expand packer ends, isolating the joint with a tight seal.

2. Pump two-part chemical sealant material into the ratio specified by the grout supplier.

3. Continue to pump grout, in stages if necessary, until "refusal" is achieved.
   a. Refusal indicates the grout has flowed throughout the void, into the surrounding soil, forming a cohesive seal stopping further flow of grout.
   b. Under pumping conditions, void pressure will slowly rise as grout is forced into the surrounding soil and begins to set. When void pressure spikes an additional 8 psi or more in a short pumping period of 1 to 5 seconds, the point of refusal is achieved.
   c. If a quantity of grout equal to 1/2 gallon per inch diameter of pipe size is pumped without reaching the point of refusal, staging may be required. Staging is accomplished by repetitive cycles of pumping and curing until refusal is achieved. Notify Engineer for approval before staging is attempted.
   d. If joint cannot be sealed by staging, abandon sealing operations at that joint and notify Engineer.

4. Upon reaching refusal, stop grout pumps and allow grout to cure for 30 to 40 seconds.

5. Deflate packer to break away the ring of gel formed in the void and move at least one packer length away from the joint in either direction.

6. Ensure pressure gauge reads zero pressure ± 1/2 psi. If gauge does not return to zero clean equipment.

7. Reposition packer over joint and retest at a pressure equal to the initial test pressure.

8. If joint fails pressure test, repeat grouting and pressure testing procedure until the joint is sealed or Engineer determines grout consumption is too high and continued attempts to seal joint are abandoned.

9. Remove residual sealing materials that extend into the pipe or restrict the flow. Ensure sealed joint surfaces are left flush with existing pipe surface. Remove residual grout material from manhole; do not allow grout to be flushed down the sewer.

G. Service Connection Sealing by Injection Grouting: Perform service sealing according to ASTM F 2454, equipment manufacturer, grout supplier, and the following requirements.

1. Pump two-part chemical sealant material at the ratio specified by the grout supplier.

2. Continue to pump grout, in stages if necessary, until refusal is achieved.
   a. Under initial pumping conditions, the void pressure will slowly rise to a range of approximately 2 to 4 psi.
   b. Continue pumping until there is a sudden increase to over 8 psi in a few seconds, indicating refusal.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

c. If a quantity of grout equal to 1 gallon per foot of service line bladder plus 3 gallons is pumped without reaching the point of refusal, staging may be required.
d. Stage grouting by pumping additional grout equivalent to 1 gallon plus 0.25 gallons per foot of bladder, waiting 1 full minute and retesting. Do not exceed two stages unless approved by Engineer

3. Upon reaching refusal, stop grout pumps and allow grout to cure for 1 full minute.

4. Deflate service packer, re-inflate, and repeat service line pressure testing.

5. If the service connection test fails, repeat injection grouting and pressure testing procedures until service is sealed or Engineer determines grout consumption is too high and continued attempts to seal service are abandoned.

6. Confirm flow after sealing of each service. If a grout blockage exists, immediately clear the service of the blockage.

7. A thin film of residual grout inside the service, which does not significantly impede flow, is a normal result of sealing and is not considered a blockage.

H. Inspection and Reporting: Comply with ASTM F 2304 Section 12.9 as noted below.

1. Inspection: Complete inspection according to Section 4060 and the following.
a. Perform CCTV observation and recording of initial pressure testing, sealing operations (if required), and final pressure testing (if required) for each joint or service.
b. Perform final CCTV video inspection of sewer main rehabilitated by injection grouting after all grouting work is completed. Provide copy of video to the Jurisdiction.

2. Reporting: Upon completion of each pipe segment, submit a report showing the following information for each joint and service connection tested, grouted or both.
a. Identification of sewer pipe section tested.
b. Type of pipe material, diameter, and depth of pipe to surface at manholes.
c. Length of pipe sections between joints.
d. Test pressure used before and after sealing and duration of test.
e. Location of each joint or service connection tested and any joints or service connections not tested with and explanation for not testing.
f. Pass/fail results for each joint or service connection tested.
g. Volume of grout material used on each joint or service connection.
h. Grout mix record of the batches mixed including amount of grout and catalyst, additives, temperature of the grout solution in the tanks, and gel set time used.

3.07 SPOT REPAIRS BY PIPE REPLACEMENT

A. Excavate trench according to Section 3010.

B. Remove existing pipe to the extent required and disconnect affected sewer services.

C. Install replacement pipe of the same nominal size as the existing pipe.

1. Use the materials as specified in the contract documents that comply with Section 4010.

2. Place bedding material according to Section 3010.

3.07 SPOT REPAIRS BY PIPE REPLACEMENT (Continued)

D. Install pipe repair coupling.

1. Cut pipes to length required allowing no more than a 1/2 inch gap between butted pipe ends at coupling location. Cut pipes perpendicular to centerline.

2. Clean the outside surface of the existing and replacement pipes as required to provide a positive seal with the pipe repair coupling.

3. Wrap coupling around pipes, centered on butt joint, and tighten bolts according to manufacturer's recommendations.

E. Reconnect sewer services.

F. Place backfill in trench according to Section 3010.

3.08 CLEANUP AND CLOSEOUT

A. Verify that the services are reconnected and fully operable, with at least 90% of original capacity.

B. Submit initial and final recordings in a digital format and on a device approved by the Engineer.

C. Remove all equipment and debris.

END OF SECTION

CLEANING, INSPECTION, AND TESTING OF SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cleaning, Inspecting, and Testing Sanitary Sewers

B. Cleaning, Inspecting, and Testing Storm Sewers

C. Cleaning and Inspecting Pipe Culverts

D. Cleaning and Inspecting Rehabilitated Pipes

1.02 DESCRIPTION OF WORK

A. Clean, inspect, and test sanitary sewer gravity mains, sanitary sewer force mains, and sanitary sewer service stubs.

B. Clean, inspect, and test storm sewers.

C. Clean and inspect pipe culverts.

D. Clean, inspect, and test rehabilitated pipe.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Notify Engineer at least 24 hours prior to performing testing.

B. The Engineer must be present to review testing procedures and to record results.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

Cleaning, inspecting, and testing sanitary sewers, storm sewers, pipe culverts, and rehabilitated pipes (including video inspection) are incidental to other project costs and will not be paid for separately.

PART 2 - PRODUCTS

2.01 TESTING EQUIPMENT

A. General: Comply with applicable sections of ASTM, NASSCO Specifications, and other applicable industry standards and codes.

B. Video Inspection:

1. Camera:
   a. High-resolution color with adjustable iris focus.
   b. Pan and tilt capabilities.
   c. Integral lighting suitable to provide proper illumination and a clear video image of the entire periphery of the pipe.
   d. Capable of operating in 100% humidity conditions.
   e. Produce a high quality video image.

2. Provide closed-circuit video inspection equipment capable of displaying on-screen footage of distance measured to within 1% of actual distance.

3. Record the inspection in color in the recording media specified by the Engineer. Forward the recording to the Engineer.

PART 3 - EXECUTION

3.01 CLEANING

A. Clean all sanitary sewers, storm sewers, and pipe culverts prior to testing by flushing with high pressure water and removing debris by vacuum extraction, and by removing sheeting, bracing, shoring, forms, soil sediment, concrete, or other debris.

B. Do not discharge soil sediment or debris to drainage channels, existing storm sewers, or existing sanitary sewers.

3.02 VIDEO INSPECTION

A. General:

1. Unless otherwise specified in the contract documents, conduct video inspection of all new and rehabilitated sanitary and storm sewers after all backfill and compaction operations are completed, but prior to paving.

2. Notify the Engineer the day prior to inspection so the Engineer may be present during the inspection.

3. Complete inspections under the supervision of a competent employee who has completed NASSCO's Pipeline Assessment Certification Program (PACP).

4. Notify the Engineer of the extent of noncompliance with the low spot depth tolerances in Section 4010 for sanitary sewers and Section 4020 for storm sewers.

5. Re-inspect sewers after any corrective action has been completed.

B. Inspection Procedure:

1. Prior to video inspection, run sufficient water through the pipe to saturate potential low spots so they may be detected during inspection.

2. Inspect each pipe segment between manholes or access points in a single, continuous run. Progress through the entire project in a uniform direction.

3. Pan camera around the circumference of each joint per NASSCO requirements.

4. Inspect all lateral connections and other observations at right angles utilizing the pan and tilt capabilities of the camera.

5. Center the video camera in the pipe during the inspection.

6. Do not exceed 30 feet of inspection per minute.

C. Inspection Reporting:

1. Provide a copy of the video inspection including on-screen continuous footage, pipe diameter, direction of viewing, and manhole and street location references in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.

2. Provide a written report of the inspection. In the report, include true-to-scale drawings of all sewer defects and observation locations. Reference the time stamp on each line item entry on the written report.

3.02 VIDEO INSPECTION (Continued)

D. Inspection Acceptance: The Engineer may reject videos failing to meet specifications. Any reinspection will be conducted at the Contractor's expense.

1. Videos can be rejected if the speed or comprehensiveness of the pan and tilt provided in the video does not allow full inspection of a lateral connection and joints.

2. Full observation of the new or rehabilitated pipe is required in the video provided after the inspection. If the amount of water, debris within the pipe, equipment present in the pipe, or other circumstances during the inspection results in a video not allowing the full observation of new or rehabilitated sewer pipe, the inspection can be rejected.

3.03 SANITARY SEWER LEAKAGE TESTING

Perform one or more of the following tests on new sanitary sewer gravity mains and sanitary sewer service stubs. Conduct tests only if service lines to any private properties are plugged and not active. Test sanitary sewer manholes separately as specified in Section 6030.

A. Sanitary Sewer Infiltration Testing:

1. Use only where ground water is more than 2 feet above top of pipe at highest point in section being tested.

2. Provide documented verification of ground water elevations for no less than 24 hours before measurement of infiltration.

3. Measure infiltration in sanitary sewer with a V-notch weir in a downstream manhole.

4. The maximum allowable infiltration for new sanitary sewers, including manholes, is 200 gallons per inch of diameter per mile of pipe per day.

B. Sanitary Sewer Exfiltration Testing:

1. General: Use an exfiltration test when ground water level is less than 2 feet above top of pipe at highest point in section being tested. Sectionalize the test section so the internal pressure in the pipe does not exceed 5 feet of water.

2. Test Procedures:

a. Install a watertight plug in the inlet of the upstream and downstream manhole of sewer section being tested.
b. Fill the sewer and upstream manhole with potable water until the water elevation in the upstream manhole is 2 feet higher than outside top of pipe in section being tested or 2 feet above existing ground water level, whichever is highest elevation.
c. Allow the water level to stabilize for 30 minutes, then refill the upstream manhole with water to the original level and begin the test.
d. Measure the amount of water lost in the upstream manhole in 1 hour. Use that amount to determine exfiltration in a 24 hour period.

3. Exfiltration Rate: The following table may be used to determine exfiltration in gallons per 24 hours by measuring the loss that occurs in 1 hour. The table is applicable only for 48 inch diameter manholes.

The maximum allowable exfiltration for new sanitary sewer, including manholes, is 200 gallons per inch of diameter per mile of pipe per day.

3.03 SANITARY SEWER LEAKAGE TESTING (Continued)

Table 4060.01: Loss in Gallons per 24 Hours for Drop in Water Level per Hour in 48 Inch Diameter Manhole (table may be interpolated to the nearest 1/4" drop)

Drop	0"	1"	2"	3"	4"	5"	6"	7"	8"	9"
	0	188	376	564	752	940	1128	1316	1504	1692

For manholes larger than 48 inch diameter use the following formula:

$G = 0.0816(H)(D^2)$

Where:
G = loss in gallons.
D = diameter of manhole in inches.
H = water level drop in manhole in inches.

C. Sanitary Sewer Low Pressure Air Testing:

1. General:

a. A low pressure air test may be used in lieu of an exfiltration test except as noted.
b. Air test is not recommended when ground water elevation is 2 feet or greater above the top of the pipe, and cannot be used when ground water is greater than 6 feet above the top of the pipe.
c. Use extreme care and follow safety precautions during testing operations. No one is allowed in manholes during testing.

2. Test Procedures:

a. Clean entire line of all debris. Flush or wet line to produce consistent results.
b. Plug all inlets and outlets to resist the test pressure. Special attention must be given to stoppers and laterals.
c. Determine the test duration for the section being tested from the following table. This table ignores pipe length and uses the factor 0.472 x d, with “d” being in inches. Pressure holding time is based on average holding pressure of 3.0 psi or drop from 3.5 psi to 2.5 psi.

Table 4060.02: Test Duration

Size Pipe (inches)	Test Period Duration (minutes)
8	4.0
10	5.0
12	6.0
15	7.0
18	8.5
21	10.0
24	11.5
27	13.0
30	14.0
36	17.0
42	20.0
48	23.0
54	25.5
60	28.5

3.03 SANITARY SEWER LEAKAGE TESTING (Continued)

d. Add air to the line segment being tested until the internal air pressure of the sewer line is raised to approximately 4.0 psi greater than the average back pressure of any ground water that may be over the top of the pipe. Pressure in the sewer should not exceed 5.0 psi. Allow at least 2 minutes for air pressure to stabilize.
e. When pressure has stabilized and is at or above the starting test pressure of 3.5 psi, commence the test. Record the drop in pressure for the test period. The test may be discontinued when the prescribed test time has been completed, even though 1.0 psi drop has not occurred.
f. If the ground water level at the time of testing is above the pipe invert, add 0.43 psi of air per foot of water above the invert to the test air pressure range of 2.5 psi to 3.5 psi stated above.
g. If the pressure drop exceeds 1.0 psi during the test period, the test will be considered to have failed. Repair and retest the line.

D. Sanitary Sewer Vacuum Testing: Comply with ASTM C 1244.

1. General:
a. Vacuum testing may be used in lieu of other specified test methods.
b. Use extreme care and follow safety precautions during testing operations. Keep personnel out of and away from manholes during testing.
c. Where practical, clean the pipe prior to testing and wet the pipe surface. Isolate the test segment as necessary, including closing service connections.

2. Test Procedures:
a. Determine the test time for the size of pipe being tested using the following table.

Table 4060.03: Minimum Test Time

Nominal Pipe Size (inches)	Time (Minutes/100 feet of pipe)
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

b. Test time is the time required for vacuum to drop from 3.5 to 2.5 psi.
c. Use a vacuum pump with the capacity to evacuate the sewer test section in time equal or less than that shown in Table 4060.03 for the size of pipe being tested.
d. Evacuate air until the internal air pressure of the sewer line is lowered by approximately 4.0 psi. Allow the air pressure to stabilize.
e. When the air pressure is stabilized near the starting test vacuum of 3.5 psi, commence the test by allowing gage pressure to drop to 3.5 psi, then commence time recording. Record the drop in vacuum for the test period.
f. If the drop in vacuum is 1.0 psi or less during the test period, the test will be considered successfully passed.
g. If the drop in vacuum is greater than 1.0 psi during the test period, inspect, evaluate, repair, and retest.

3.04 DEFLECTION TESTING

A. Perform deflection tests on all flexible sanitary sewer mains, excluding ductile iron pipe. Also perform deflection tests on all flexible storm sewer or culvert pipe 12 inches in diameter or greater.

B. Perform deflection tests after backfill has been in place at least 30 calendar days and before paving activity takes place, or as per appropriate sections of these specifications.

C. Pull 9 arm deflection mandrel, complying with applicable ASTM Standards, through sewer by hand.

D. Ensure pipe deflection does not exceed 5% of average inside diameter as established by ASTM Standards.

E. Remove and replace pipe exceeding deflection limits.

F. Handle and divert existing flows during deflection testing.

3.05 FORCE MAIN TESTING

A. Provide test pumps, test plugs, pipe, and gages. Make necessary piping connections.

B. Fill the force main with potable water and flush before testing to remove entrapped air. Other water sources may be used if approved by the Engineer.

C. Insert taps as required to remove air. Plug taps after the completion of tests.

D. Use a test pressure of 1.5 times the working pressure at the lowest point along the test section, but not less than 50 psi.

E. Pressurize the test section and allow it to stabilize prior to beginning the leakage test.

F. Maintain pressure to within 5 psi of the test pressure by pumping in potable water as required.

G. Leakage is the quantity of water that must be supplied into the test section to maintain pressure within 5 psi of the specified test pressure during a 2 hour test period.

H. The maximum allowable leakage is determined by the following formula:

$$L = \frac{(S)(D)(P)^{0.5}}{148{,}000}$$

Where:
L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal pipe diameter, in inches
P = average test pressure, in pounds per square inch

The following table assumes an average test pressure (P) of 50 psi and length of pipe (S) of 1,000 feet.

Table 4060.04: Maximum Allowable Leakage Rate

Pipe Diameter (inches)	Allowable Leakage Rate (gallons/hour/1,000 feet of pipe)
4	0.19
6	0.29
8	0.38
10	0.48
12	0.57
14	0.67
16	0.76

I. Examine exposed pipe and fittings during testing. Repair all visible leaks.

J. If the test indicates leakage greater than allowed, locate, repair, or replace damaged or defective pipe, and repeat tests until the requirements are met.

END OF SECTION

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DIVISION 5
Water Mains
and Appurtenances

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PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe

B. Fittings

C. Special Fittings

D. Pipeline Accessories

1.02 DESCRIPTION OF WORK

Construct water mains and building service pipes.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Submit product information sheet for joint restraint system to be used.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Remove pipe and fittings contaminated with mud and surface water from the site; do not use in construction unless thoroughly cleaned, inspected, and approved by the Engineer.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Water Main:

1. Trenched:

a. Measurement: Each type and size of pipe installed in an open trench will be measured in linear feet along the centerline of the pipe, including the length through the fittings.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; tracer system; testing; disinfection; and polyethylene wrap for ductile iron pipe and for fittings.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Trenchless:
- **a. Measurement:** Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.
- **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; tracer system; testing; and disinfection.

B. Water Main with Casing Pipe:

1. Trenched:
- **a. Measurement:** Each type and size of pipe with a casing pipe installed in an open trench, will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.
- **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of carrier pipe.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

2. Trenchless:
- **a. Measurement:** Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe.
- **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of carrier pipe.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

C. Fittings: One of the following methods will be specified for measurement and payment of water main fittings.

1. Fittings by Count:
- **a. Measurement:** Each type and size of fitting installed as specified in the contract documents or as required for proper installation of the water main will be counted.
- **b. Payment:** Payment will be made at the unit price for each type and size of fitting.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and installing fittings, restrained joints, anchor blocks, and thrust blocks.

2. Fittings by Weight:
- **a. Measurement:** Each type and size of fitting installed as specified in the contract documents or as required for proper installation of the water main will be counted. Determine the total weight of fittings counted, in pounds, based on the standard fitting weights published in AWWA C153 for ductile iron compact fittings.
- **b. Payment:** Payment will be made at the unit price per pound for each type and size of fitting.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and installing fittings, restrained joints, anchor blocks, and thrust blocks.

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Water Service Stubs by Each:

1. **Measurement:** Each type and size of water service stub from the water main to the stop box will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of water service stub.

3. **Includes:** Unit price includes, but is not limited to, water service corporation; service pipe; curb stop; stop box; trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; and installation of tracer wire system for non-metallic service pipe.

E. Water Service Stubs by Length:

1. **Water Service Pipe:**
   a. **Measurement:** Each type and size of water service pipe will be measured in linear feet along the centerline of the pipe.
   b. **Payment:** Payment will be made at the unit price per linear foot of each type and size of water service pipe.
   c. **Includes:** Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; and installation of tracer wire system for non-metallic service pipe.

2. **Water Service Corporation:**
   a. **Measurement:** Each type and size of water service corporation will be counted.
   b. **Payment:** Payment will be made at the unit price for each type and size of water service corporation.
   c. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary); furnishing and installing the water service corporation; and furnishing, placing, and compacting bedding and backfill material.

3. **Water Service Curb Stop and Box:**
   a. **Measurement:** Each type and size of water service curb stop and box will be counted.
   b. **Payment:** Payment will be made at the unit price for each type and size of water service curb stop and box.
   c. **Includes:** Unit price includes, but is not limited to trench excavation (if necessary); furnishing and installing the curb stop and box; and furnishing, placing, and compacting bedding and backfill material.

F. Water Main Abandonment, Cap:

1. **Measurement:** Each size and location of water main to be abandoned will be counted.

2. **Payment:** Payment will be made at the unit price for each size and location of water main abandoned.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary); closing valves; removing valve boxes; installing thrust blocks; cutting pipe; installing MJ caps; and furnishing, placing, and compacting backfill material.

1.08 MEASUREMENT AND PAYMENT (Continued)

G. Water Main Abandonment, Fill and Plug:

1. **Measurement:** Each size and location of water main to be abandoned by filling and plugging will be measured in linear feet.

2. **Payment:** Payment will be made at the unit price per linear foot of water main filled and plugged.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary); closing valves; removing valve boxes; installing thrust blocks; cutting and removing the specified section of pipe; furnishing and pumping flowable material to fill the pipe to be abandoned; installing MJ caps; and furnishing, placing, and compacting backfill material.

H. Water Main Removal:

1. **Measurement:** Each size and location of water main to be removed will be measured in linear feet from end to end.

2. **Payment:** Payment will be made at the unit price per linear foot for each pipe removed.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary); closing valves; installing thrust blocks; cutting pipe; installing MJ caps; removal and disposal of all valves and pipe specified for removal; furnishing, placing, and compacting backfill material.

PART 2 - PRODUCTS

2.01 WATER MAIN

A. Polyvinyl Chloride (PVC) Pipe: Comply with AWWA C900 with ductile iron pipe equivalent outside diameters.

1. **Minimum Wall Thickness:**
   - **a. 4 inch through 24 inch sizes:** DR 18.
   - **b. Sizes over 24 inch:** As specified in the contract documents.

2. **Joint Type:** Use push-on joint type, except as otherwise specified in the contract documents or as authorized by the Engineer.
   - **a. Push-on:** According to AWWA C900.
   - **b. Integral Restrained Joint:** AWWA C900 pipe with restraining system manufactured integrally into pipe end.
   - **c. Mechanical Restrained Joint:** Ductile iron mechanical device designed for joint restraint of AWWA C900 pipe complying with the requirements of ASTM F 1674.

3. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. Spigot insertion depth gauge.
   - d. National Sanitation Foundation (NSF) seal.

B. Ductile Iron Pipe (DIP):

1. **Minimum Thickness Class:**
   - **a. 4 inch through 24 inch sizes:** Special thickness Class 52 according to AWWA C151.
   - **b. Sizes over 24 inches:** As specified in the contract documents.

2. **Cement-mortar Lined:** According to AWWA C104 with seal coat.

3. **External Coating:** Seal coat according to AWWA C151.

4. **Joint Type:** Use push-on type, unless otherwise specified in the contract documents or as authorized by the Engineer.
   - **a. Push-on:** According to AWWA C111.
   - **b. Mechanical:** According to AWWA C111.
   - **c. Restrained, Buried:** Pipe manufacturer′s standard field removable system.
   - **d. Restrained, in Structures:** Restraining gland, flanged or grooved/shouldered.
   - **e. Flanged:** According to AWWA C111.
   - **f. Grooved/Shouldered:** According to AWWA C606.
   - **g. Gaskets:** According to AWWA C111.

5. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. Spigot insertion depth gauge.

2.02 BOLTS FOR WATER MAIN AND FITTINGS

Use corrosion resistant bolts.

A. Tee-bolts and Hexagonal Nuts for Mechanical Joints:

1. High-strength, low-alloy steel manufactured according to AWWA C111.

2. Provide ceramic-filled, baked-on, fluorocarbon resin coating for bolts and nuts.

3. Include factory-applied lubricant that produces low coefficient of friction for ease of installation.

B. Other Bolts and Nuts:

1. Stainless steel.

2. Ductile iron.

3. Zinc, zinc chromate, or cadmium plated.

2.03 FITTINGS

A. For DIP and PVC Pipe: Comply with AWWA C110 (ductile iron or gray iron) or AWWA C153 (ductile iron).

1. Joint Type:
   a. For pipe sizes 16 inches and less, use mechanical joint complying with AWWA C111.
   b. For pipe sizes greater than 16 inches, use restrained mechanical joint system. Provide follower gland using breakaway torque bolts to engage thrust restraint.
      1) Minimum pressure rating same as connecting pipe. For fittings between dissimilar pipes, the minimum pressure rating is the lesser of the two pipes.
      2) Suitable for buried service.
      3) Joint restraint system to be field installable, field removable, and re-installable.
   c. Use of alternate restraint systems must be approved by the Engineer.

2. Lined: Cement mortar lined according to AWWA C104 with seal coat or protective fusion bonded coatings per AWWA C116.

3. Wall Thickness: Comply with AWWA C153.

4. Gaskets: Comply with AWWA C111.

B. Flange Adapter:

1. Body: Ductile iron complying with ASTM A 536.

2. End Rings (Follower Rings): Ductile iron complying with ASTM A 536.

3. Gaskets: New rubber compounded for water service and resistant to permanent set.

4. Bolts and Nuts: High strength, low alloy corrosion resistant steel or carbon steel bolts complying with ASTM A 307.

2.03 FITTINGS (Continued)

C. Pipe Coupling:

1. Center Sleeve (Center Ring): Steel pipe or tubing complying with ASTM A 53 or ASTM A 512, or formed carbon steel with a minimum yield of 30,000 psi.

2. End Ring (Follower Ring): Ductile iron complying with ASTM A 536, or steel meeting or exceeding the requirements of ASTM A 576, grade 1010-1020.

3. Gaskets: New rubber compounded for water service and resistant to permanent set.

4. Bolts and Nuts: High strength, low alloy corrosion resistant steel.

2.04 CONCRETE THRUST BLOCKS

A. Use Iowa DOT Class C concrete.

B. Comply with the contract documents for dimensions and installation of thrust blocks. Comply with Figure 5010.101.

C. Use for all pipe sizes 16 inches in diameter or smaller or when specified.

2.05 PIPELINE ACCESSORIES

A. Polyethylene Wrap:

1. Comply with AWWA C105.

2. Provide tubes or sheets with 8 mil minimum thickness.

B. Tracer System: Comply with Figure 5010.102.

1. Tracer Wire:
- **a. Open Cut:**
  - **1) Solid Single Copper Conductor:**
    - **a) Size:** #12 AWG
    - **b) Insulation Material:** Linear low-density polyethylene (LLDPE) insulation suitable for direct burial applications
    - **c) Insulation Thickness:** 0.030 inches, minimum
    - **d) Breaking Strength:** 150 pounds, minimum
    - **e) Operating Voltage:** Rated for 30 volts
  - **2) Bimetallic Copper Clad Steel Conductor:**
    - **a) Size:** #14 AWG
    - **b) Rating:** Direct burial
    - **c) Operating Voltage:** Rated for 30 volts
    - **d) Conductivity:** 21%
    - **e) Copper Cladding:** 3% of conductor diameter, minimum
    - **f) Insulation Material:** High density, high molecular weight polyethylene
    - **g) Insulation Thickness:** 0.030 inches, minimum
    - **h) Breaking Strength:** 175 pounds, minimum
- **b. Directional Drilling/Boring:**
  - **1) Bimetallic Copper Clad Steel Conductor:**
    - **a) Size:** #12 AWG
    - **b) Rating:** Direct burial
    - **c) Operating Voltage:** Rated for 30 volts
    - **d) Conductivity:** 21%

2.05 PIPELINE ACCESSORIES (Continued)

e) Copper Cladding: 3% of conductor diameter, minimum
f) Insulation Material: High density, high molecular weight polyethylene
g) Insulation Thickness: 0.045 inches, minimum
h) Breaking Strength: 1,100 pounds, minimum

2. Ground Rod: 3/8 inch diameter, 60 inch steel rod uniformly coated with metallically bonded electrolytic copper.

3. Ground-rod Clamp: High-strength, corrosion-resistant copper alloy.

4. Splice Kit: Inline resin splice kit with split bolt (1 kV and 5 kV) for use with single conductor and unshielded cable splices in direct bury and submersible applications.

5. Tracer Wire Station: Comply with the contract documents.

2.06 SPECIAL GASKETS

A. For soils contaminated with gasoline, use neoprene or nitrile gaskets.

B. For soils contaminated with volatile organic compounds, use nitrile or fluorocarbon gaskets.

C. For other soil contaminants, contact the Engineer for the required gasket.

2.07 WATER SERVICE PIPE AND APPURTENANCES

A. Controlling Standards: Local plumbing and fire codes.

B. Materials (as allowed by Jurisdiction or specified in contract documents)**:**

1. Copper Pipe:
a. Comply with ASTM B 88.
b. Wall Thickness: Type K.

2. DIP: As specified in Section 5010, 2.01. Polyethylene wrap is required.

3. PVC Pipe: ASTM D 1785, Schedule 80 or ASTM D 2241, SDR 21. Provide solvent weld joints for all pipes.

4. Brass Pipe: Red, seamless, according to ASTM B 43.

5. Polyethylene Pipe: Class 200, according to AWWA C901.

C. Corporations, Stops, and Stop Boxes: Contact the Jurisdiction for requirements.

2.08 NON-SHRINK GROUT

Comply with Iowa DOT Materials I.M. 491.13.

2.09 CASING PIPE

Comply with Section 3020.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

A. General:

1. Do not use deformed, defective, gouged, or otherwise damaged pipes or fittings.
2. Keep trench free of water. Clean pipe interior prior to placement in the trench.
3. Install pipe with fittings and valves to the lines and grades specified in the contract documents.
4. Clean joint surfaces thoroughly and apply lubricant approved for use with potable water and recommended by the manufacturer.
5. Push pipe joint to the indication line on the spigot end of the pipe before making any joint deflections.
6. Limit joint deflections to one degree less than pipe manufacturer's recommended maximum limit.
7. Tighten bolts in a joint evenly around the pipe.
8. Install concrete thrust blocks on all fittings 16 inches in diameter or smaller (comply with Figure 5010.101). For fittings larger than 16 inches, install restrained joints, and when specified in the contract documents, also install concrete thrust blocks.
9. Keep exposed pipe ends closed with rodent-proof end gates at all times when pipe installation is not occurring.
10. Close the ends of the installed pipe with watertight plugs during nights and non-working days.
11. Do not allow any water from the new pipeline to enter the existing distribution system piping until testing and disinfection are successfully completed.

B. Trenched:

1. Excavate trench and place pipe bedding and backfill material as specified in Section 3010.
2. Provide uniform bearing along the full length of the pipe barrel. Provide bell holes.

C. Trenchless: Comply with Section 3020.

3.02 ADDITIONAL REQUIREMENTS FOR DIP INSTALLATION

A. Utilize full-length gauged pipe for field cuts. Alternatively, use a MJ gland or other approved method to field-gauge pipe selected for cutting to verify the outside diameter is within allowable tolerances.

B. Cut the pipe perpendicular to the pipe barrel. Do not damage the cement lining. Bevel cut, file, or grind the ends for push-on joints according to the manufacturer's recommendations.

C. Encase all pipe, valves, and fittings with polyethylene wrap according to Section 5010, 3.05.

D. Install pipe according to AWWA C600, except as modified herein.

3.03 ADDITIONAL REQUIREMENTS FOR PVC PIPE INSTALLATION

A. Cut the pipe perpendicular to the pipe barrel. Deburr and bevel cut spigot end of the pipe barrel to match factory bevel. Re-mark the insertion line.

B. When connecting to shallow-depth bells, such as on some cast iron fittings or valves, cut the spigot end square to remove factory bevel. Deburr the end and form a partial bevel on the end.

C. Install pipe according to AWWA C605, except as modified herein.

3.04 POLYETHYLENE ENCASEMENT INSTALLATION

A. Apply polyethylene encasement to buried ductile iron pipe and to buried fittings, fire hydrants, and appurtenances. The polyethylene encasement is used to prevent contact between the pipe and the bedding material, but need not be airtight or watertight.

B. Install polyethylene encasement according to AWWA C105, using tubes or flat sheets, and pipe manufacturer's recommendations.

C. Do not expose the polyethylene encasement to sunlight for long periods before installation.

D. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before encasing the pipe. Take care to prevent soil or bedding material from becoming trapped between the pipe and polyethylene.

E. Lift polyethylene-encased pipe with a fabric-type sling or padded cable.

F. Secure and repair encasement material using polyethylene tape, or replace as necessary.

3.05 TRACER SYSTEM INSTALLATION

A. Install with all buried water main piping. Comply with Figure 5010.102 for tracer wire installation.

B. Begin and terminate the system at all connections to existing mains.

C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 2 inch wide, 10 mil thickness polyethylene pressure sensitive tape.

D. Install splices only as authorized by the Engineer. Allow the Engineer to inspect all below-grade splices of tracer wire prior to placing the backfill material.

E. Install ground rods adjacent to connections to existing piping and at locations specified in the contract documents or as directed by the Engineer.

F. Bring two wires to the surface at each fire hydrant location and terminate with a tracer wire station (comply with Figure 5010.102).

G. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair discontinuities.

3.06 CONFLICTS

A. Horizontal Separation of Gravity Sewers from Water Mains:

1. Sanitary and Combined Sewers:

a. Separate gravity sanitary and combined sewer mains from water mains by a horizontal distance of at least 10 feet unless:
   1) The top of a sewer main is at least 18 inches below the bottom of the water main, and
   2) The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

b. Maintain the maximum feasible separation distance in all cases. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, provide a linear separation of at least 2 feet and one of the following:
   1) Construct sanitary and combined sewers of water main materials meeting the requirements of Section 5010, 2.01.
   2) Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

2. Storm Sewers: Separate storm sewers and water mains by at least 10 feet measured edge-to-edge unless it is impossible to do so. When impossible to maintain a 10 feet horizontal separation, maintain a minimum separation of 3 feet and utilize one of the following within 10 feet measured edge-to-edge:

a. Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
b. Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
c. Construct storm sewer pipe of water main materials.
d. Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

B. Horizontal Separation of Water Mains from Sanitary and Combined Sewer Manholes: Ensure water pipes do not pass through or come in contact with any part of a sanitary or combined sewer manhole. Maintain a minimum horizontal separation of 3 feet.

C. Horizontal Separation of Sewer Force Mains from Water Mains: Separate sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

1. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of Section 5010, 2.01 and

2. The sewer force main is laid at least 4 linear feet from the water main.

D. Vertical Separation of Sewers and Water Main Crossovers:

1. Sanitary and Combined Sewers:

a. Vertically separate sanitary and combined sewers crossing under water mains by at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, do not place the sewer closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

3.06 CONFLICTS (Continued)

b. Where the sanitary sewer crosses over or less than 18 inches below a water main, utilize one of the following within 10 feet measured edge-to-edge horizontally, centered on the crossing:
   1) Construct sanitary and combined sewers of water main material meeting the requirements of Section 5010, 2.01.
   2) Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

2. Storm Sewers:

a. Vertically separate storm sewers from water mains by at least 18 inches measured between the outside edges of the water main and the storm sewer. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported. Use a low permeability soil for backfill material within 10 feet of the point of crossing.
b. When impossible to maintain an 18 inch vertical separation when the water main crosses over the storm sewer, maintain a minimum vertical separation of 6 inches and utilize one of the following within 10 feet measured edge-to-edge centered on the crossing:
   1) Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
   2) Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
   3) Construct storm sewer pipe of water main materials.
   4) Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

E. Surface Water Crossings: Comply with the Recommended Standards for Water Works, 2012 Edition.

1. Above-water Crossings: Ensure the pipe is adequately supported and anchored; protected from vandalism, damage, and freezing; and accessible for repair or replacement.

2. Underwater Crossings: Provide a minimum cover of 5 feet over the pipe unless otherwise specified in the contract documents. When crossing water courses that are greater than 15 feet in width, provide the following.

a. pipe with flexible, restrained, or welded watertight joints,
b. valves at both ends of water crossings so the section can be isolated for testing or repair; ensure the valves are easily accessible and not subject to flooding, and
c. permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve closest to the supply source.

3.07 TRANSITIONS IN PIPING SYSTEMS

Where the specified material of a piping system entering or exiting a structure changes, make the change at the outside of the structure wall, beyond any wall pipe or wall fitting required, unless otherwise specified.

3.08 STRUCTURE PENETRATIONS

A. Wall Pipes:

1. Install where pipes penetrate and terminate at a wall or floor surface of a concrete structure, or where the pipe protrudes through the concrete wall or floor and the protrusion is otherwise unsupported.

2. Provide a waterstop flange near the center of the embedment length. The waterstop is to be cast integrally with the wall pipe, or fully welded to it around the pipe circumference.

B. Wall Sleeves:

1. Install where a pipe passes through a structure wall.

2. Sleeves in concrete walls are to be supplied with a waterstop collar, fully welded, and cast-in-place in the concrete.

3.09 WATER SERVICE STUB

A. Install water service pipe, corporations, stops, and stop boxes according to local Jurisdiction requirements.

B. Install 1 inch and smaller corporation valves tapped at 45 degrees above horizontal at a minimum distance of 18 inches from pipe bell or other corporation. Install 1 1/2 inch and 2 inch corporation valves tapped horizontal a minimum distance of 24 inches from pipe bell or other corporation.

C. Construct trench and place backfill material according to Section 3010.

3.10 WATER MAIN ABANDONMENT

Verify with the Engineer that all services are no longer using the main to be abandoned.

A. For Each Pipe to be Abandoned by Capping:

1. Close valves and remove valve boxes as specified in the contract documents.

2. Construct thrust blocks on each end of the active pipes according to Figure 5010.101.

3. Cut pipe to be abandoned a minimum of 5 feet from the closed valve on each end of the active pipes, leaving a minimum of 12 inches of pipe exposed beyond the thrust block.

4. Remove a minimum of 3 feet of the pipe to be abandoned.

5. Install a MJ cap using a retaining gland according to Figure 5010.101 on the end of each pipe to be abandoned and each active pipe.

B. For Each Pipe to be Abandoned by Filling:

1. Close valves and remove valve boxes as specified in the contract documents.

2. Construct thrust blocks on each end of the active pipes according to Figure 5010.101.

3. Cut pipe to be abandoned a minimum of 5 feet from the closed valve on each end of the active pipes, leaving a minimum of 12 inches of pipe exposed beyond the thrust block.

3.10 WATER MAIN ABANDONMENT (Continued)

4. Remove a minimum of 3 feet of the pipe to be abandoned.

5. Install a MJ cap using a retaining gland according to Figure 5010.101 on each pipe to be abandoned and each active pipe.

6. Fill the pipe to be abandoned by pumping with flowable mortar, foamed cellular concrete, or CLSM complying with Section 3010.

3.11 WATER MAIN REMOVAL

Verify with the Engineer that all services are no longer using the main and have been disconnected from the main to be removed.

A. Close valves as specified in the contract documents.

B. Construct thrust block on each end of the active pipes according to Figure 5010.101.

C. Cut pipe to be removed a minimum of 5 feet from the closed valve on each end of the active pipes leaving a minimum of 12 inches of pipe exposed beyond the thrust block.

D. Install a MJ cap using a retaining gland according to Figure 5010.101 at the end of each active pipe.

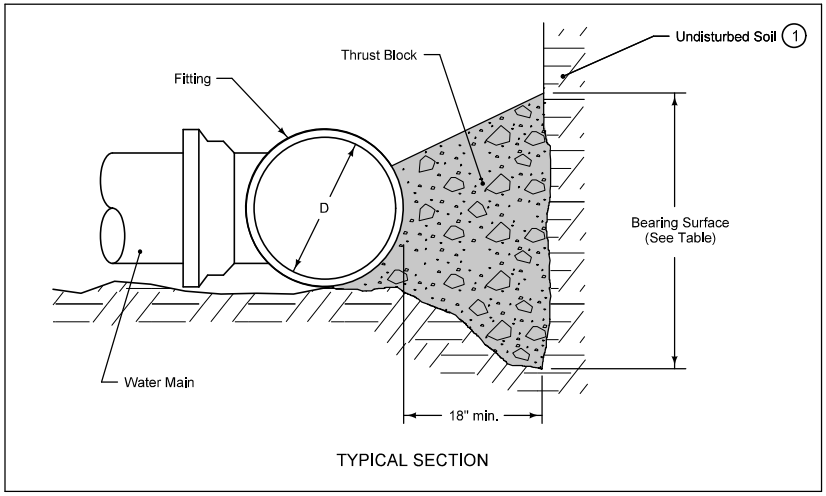
E. Remove and dispose of water main pipe. Furnish, place, and compact backfill material.

3.12 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

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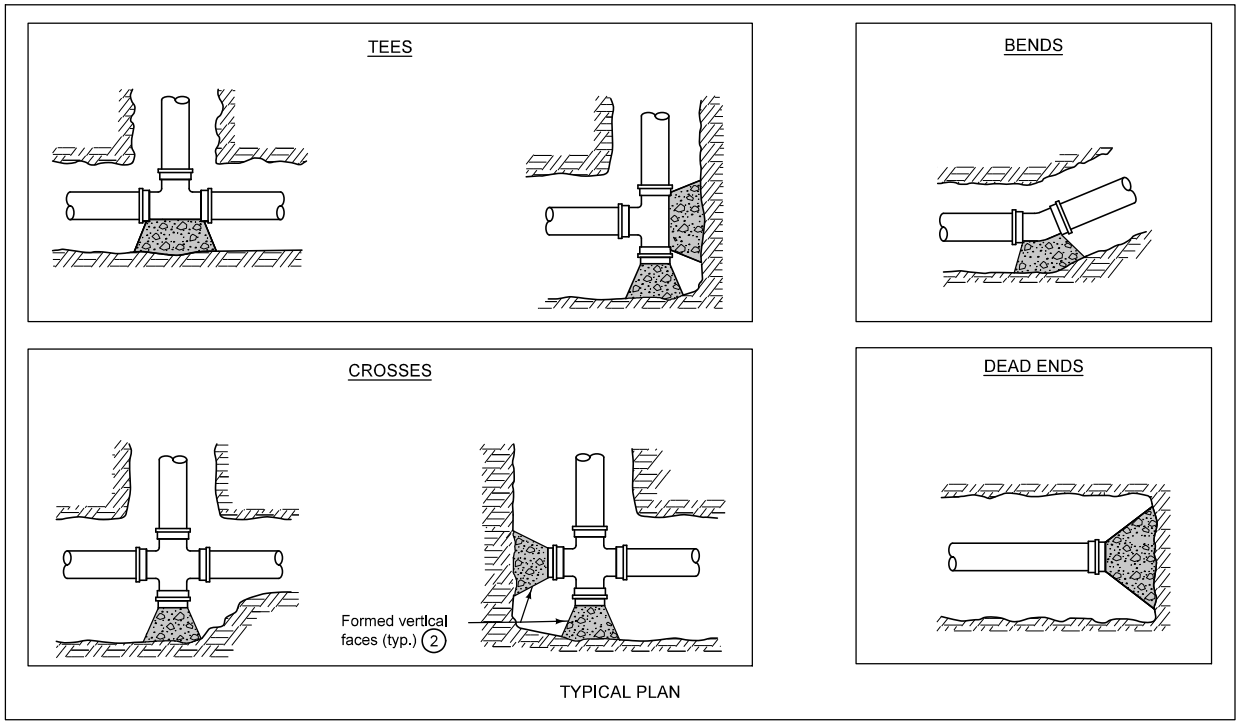


TYPICAL SECTION

Encase all fittings in polyethylene wrap. Do not allow concrete to directly contact joints or fitting bolts.

(1) Extend thrust blocks to undisturbed soil. Excavation into trench wall may be necessary.

(2) Form vertical surfaces of poured concrete thrust blocks except on bearing surface.



TYPICAL PLAN

Diameter of Pipe, D (inches)	MINIMUM BEARING SURFACE (sf)				
	Bends				Tees and Dead Ends
	$11\frac{1}{4}^{\circ}$	$22\frac{1}{2}^{\circ}$	45°	90°	
4	1	2	3	4	3
6	2	3	5	8	6
8	2	4	8	14	10
10	3	6	12	21	15
12	5	9	16	30	21
14	6	11	22	40	28
16	7	14	28	51	36
18	9	18	35	64	45
20	11	22	42	78	55
24	16	31	61	111	79
30	24	48	93	171	121
36	34	68	133	245	173

Minimum surface area based on water pressure of 150 psi and allowable soil pressure of 1,000 psf.

SUDAS

INTERIM

REVISION 2 01-01-26

FIGURE 5010.101 | **STANDARD ROAD PLAN** | **WM-101**

SHEET 1 of 2

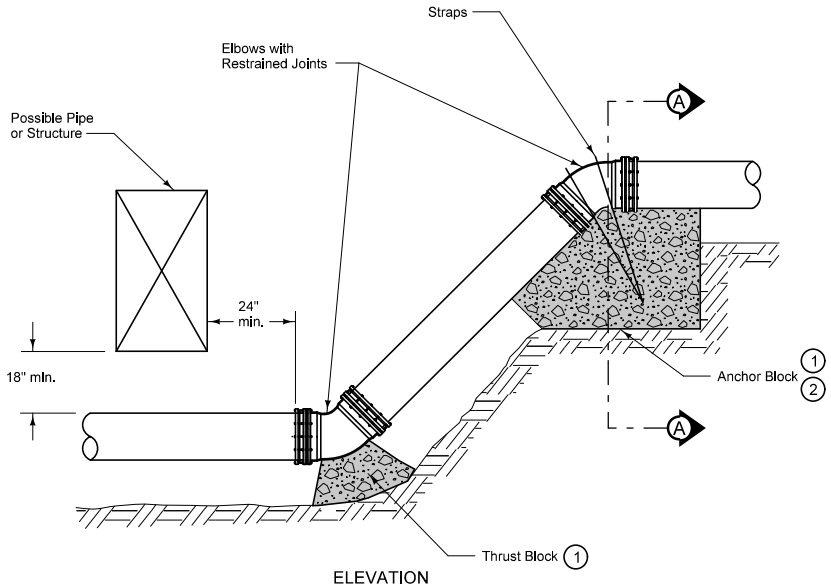
REVISIONS: Updated table and notes to match SUDAS.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

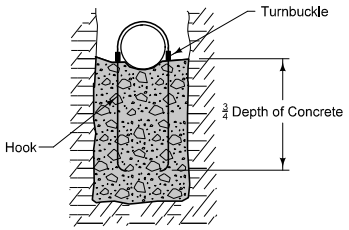
THRUST BLOCKS

FIGURE 5010.101 | SHEET 1 OF 2

CHANGES IN PIPE DEPTH



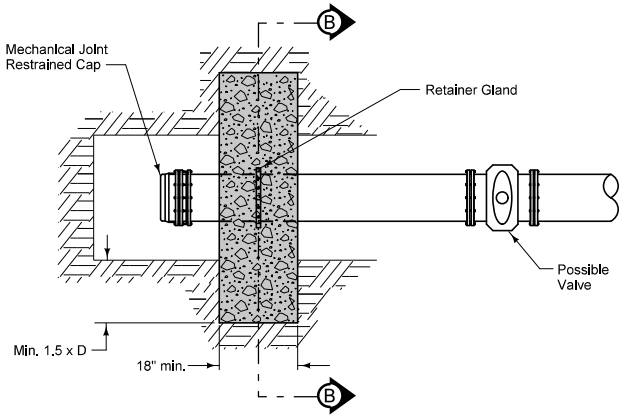
ELEVATION



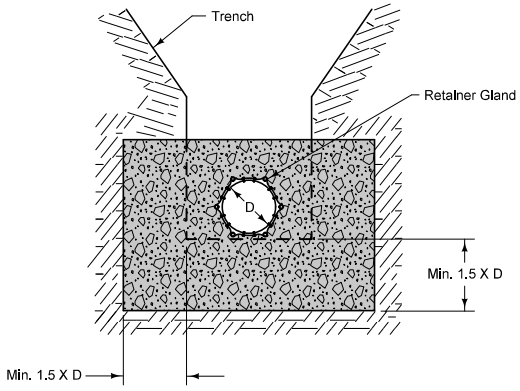
SECTION A-A

DEAD ENDS (ALTERNATE METHOD)

Use only when allowed by the Engineer, or when specified in the contract documents.



PLAN



SECTION B-B

Encase all fittings in polyethylene wrap. Do not allow concrete to directly contact joints or fitting bolts.

1. Fittings are shown with both restrained joints and thrust/anchor blocks. These methods can be used independently or in conjunction with each other. Install as specified.
2. Anchor block sizes and shapes are detailed on individual plan sheets.

SUDAS	INTERIM	REVISION 2 01-01-26
FIGURE 5010.101	STANDARD ROAD PLAN	WM-101
		SHEET 2 of 2

REVISIONS: Updated table and notes to match SUDAS.

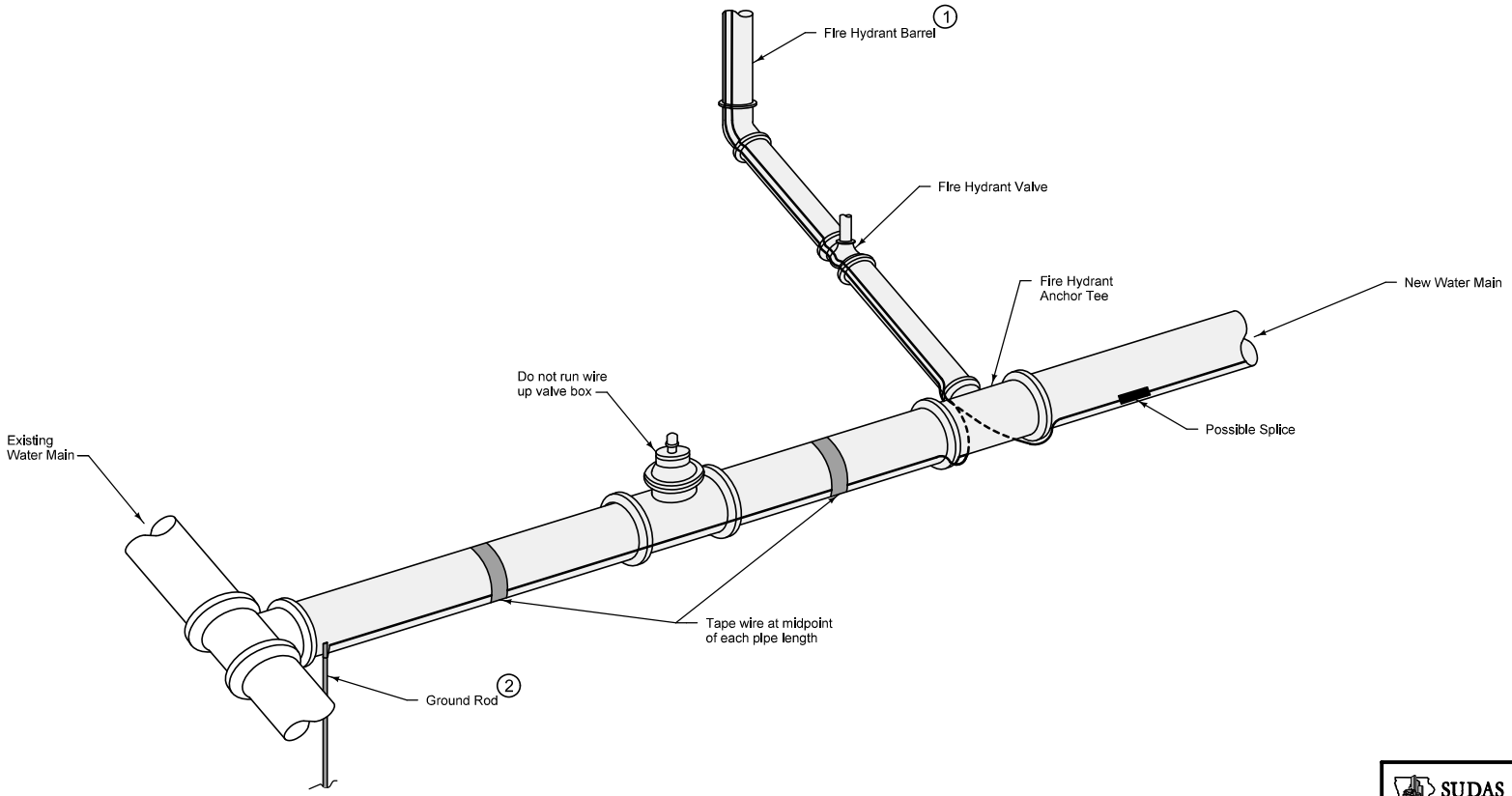
SUDAS DIRECTOR — DESIGN METHODS ENGINEER

THRUST BLOCKS

FIGURE 5010.101 | SHEET 2 OF 2

① Extend tracer wire up fire hydrant barrel to internal terminals of tracer wire station and back down. Refer to WM-201 for details of fire hydrant assembly.

② Clamp tracer wire to ground rod at system termination points.



TYPICAL INSTALLATION

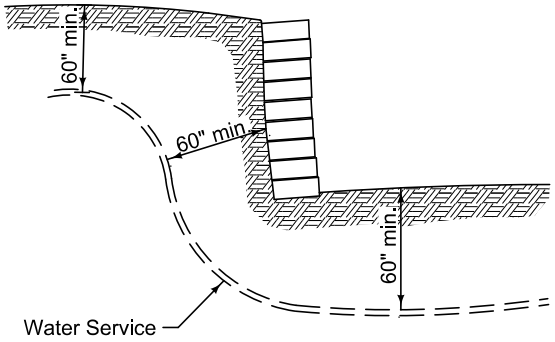
FIGURE 5010.102 SHEET 1OF 1

SUDAS	IOWADOT	REVISION 1 10-18-16
FIGURE 5010.102	STANDARD ROAD PLAN	WM-102 SHEET 1 of 1

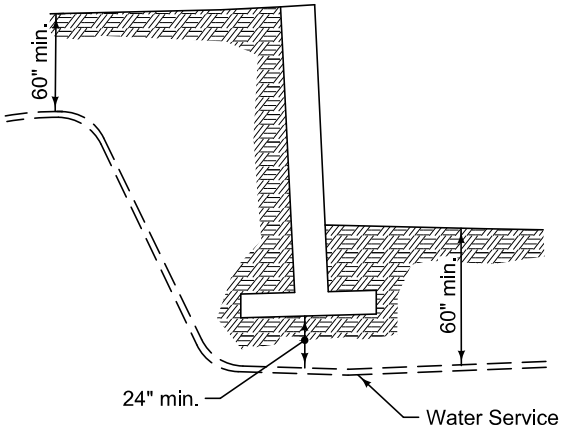
REVISIONS: Replaced Iowa DOT and SUDAS logos with new logos.

Paul D. Wigand SUDAS DIRECTOR — Brian Smith DESIGN METHODS ENGINEER

TRACER SYSTEM

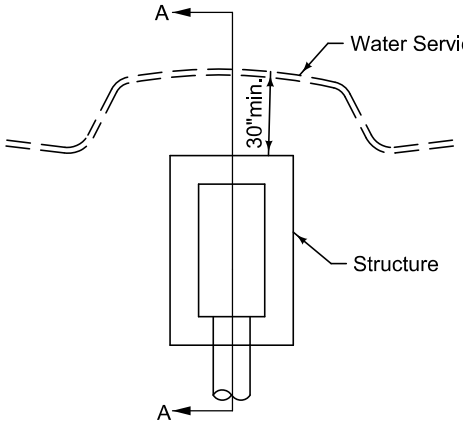


SECTION

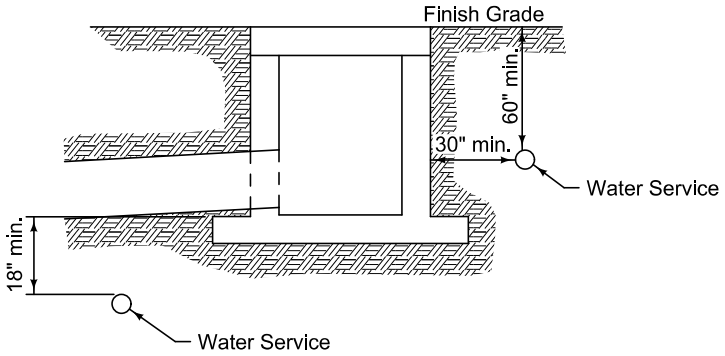


SECTION

This figure details minimum required clearances between structure and water service lines. Adjust location of water services as directed by the Engineer to maintain the clearances shown.



PLAN VIEW



SECTION

FIGURE 5010.901 | SHEET 1 OF 1

SUDAS

REVISION 1 10-21-14

5010.901

SHEET 1 of 1

SUDAS Standard Specifications

MINIMUM CLEARANCE BETWEEN WATER SERVICE AND STRUCTURE

FUSIBLE PVC AND HDPE PIPE

PART 1 - GENERAL

1.01 SECTION INCLUDES

Water Main Pipe

1.02 DESCRIPTION OF WORK

Construct water mains.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Pre-Construction:

1. Recommended Minimum Bending Radius
2. Recommended Maximum Safe Pull Force

B. Post-Construction:

Fusion joint report containing the following information:

1. Pipe size and thickness
2. Machine size
3. Fusion technician identification
4. Job identification
5. Fusion joint number
6. Fusion, heating, and drag pressure settings
7. Heat plate temperature
8. Time stamp
9. Heating and cool down time of fusion
10. Ambient temperature

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Load, off-load, store, and otherwise handle pipe according to the pipe supplier's recommendations. Handle and support pipe with woven fiber pipe slings or approved equal. Do not use handling devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe.

1.05 DELIVERY, STORAGE, AND HANDLING (Continued)

B. Exercise caution to avoid compression, damage, or deformation to the ends of the pipe during transportation to the site and while stored on site.

C. Notify the Engineer of any damaged pipe and remove from the site; do not use in construction unless allowed by the Engineer. Pipe considered as damaged includes the following:

1. Any length of pipe showing a crack.

2. Any length of pipe which has received a blow that may have caused an incident fracture, even though no such fracture is visible.

3. Any length of pipe with a scratch or gouge greater than 10% of the wall thickness.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Perform thermal fusion of pipe by a Fusion Technician fully qualified by the pipe supplier for the type(s) and size(s) of pipe being used. Ensure qualification is current as of the date of fusion performance on the project.

1.08 MEASUREMENT AND PAYMENT

A. Fusible Water Main:

1. Trenched:
- **a. Measurement:** Each type and size of fusible pipe installed in an open trench will be measured in linear feet along the centerline of the pipe, including the length through the fittings.
- **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
- **c. Includes:** Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, performing fusion jointing, placing bedding and backfill material, tracer system, testing, and disinfection.

2. Trenchless:
- **a. Measurement:** Each type and size of fusible pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.
- **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of fusible pipe.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and installing pipe; performing fusion jointing, trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; tracer system; testing; and disinfection.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Water Main with Casing Pipe:

1. Trenched:

a. Measurement: Each type and size of fusible pipe with a casing pipe installed in an open trench, will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both fusible carrier pipe and casing pipe, performing fusion jointing, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, casing spacers, furnishing and installing annular space fill material, tracer system, testing, and disinfection.

2. Trenchless:

a. Measurement: Each type and size of fusible pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of fusible carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both fusible carrier pipe and casing pipe; performing fusion jointing, trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

PART 2 - PRODUCTS

2.01 WATER MAIN

A. Fusible PVC Pipe: Comply with AWWA C900 with ductile iron pipe equivalent outside diameters.

1. **Minimum Wall Thickness:**
   - **a. 4 inch through 24 inch sizes:** DR 18.
   - **b. Sizes over 24 inch:** As specified in the contract documents.

2. **Pipe Manufacturing:**
   - a. Provide pipe extruded with plain ends square to the pipe, free of any bevel or chamfer, and without bells or gaskets of any kind.
   - b. Pipe for potable water use to be blue in color.

3. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. NSF International (NSF) seal

B. Fusible HDPE Pipe: Comply with AWWA C906 with ductile iron pipe equivalent outside diameters.

1. **Material Designation Code:** PE4710.

2. **Minimum Wall Thickness:** DR 9.
   - a. 4 inch through 24 inch sizes: DR 9.
   - b. Sizes over 24 inch: As specified in the contract documents.

3. **Pipe Manufacturing:**
   - a. Provide pipe extruded with plain ends square to the pipe, free of any bevel or chamfer, and without bells or gaskets of any kind.
   - b. Pipe for potable water use to be black in color with two blue stripes.

4. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. NSF International (NSF) seal.

PART 3 - EXECUTION

Comply with Section 5010, Part 3, as well as the following:

3.01 ADDITIONAL REQUIREMENTS FOR FUSIBLE PIPE INSTALLATION

A. General:

1. Thermally butt fuse pipe joints and install pipe complying with the contract documents and the pipe supplier's recommendations.

2. Assemble pipe lengths in the field with butt-fused joints. Whenever possible, fuse and stage pipe lengths in their entirety prior to installation.

3. Handle and install pipe in a manner that does not over-stress the pipe or exceed the recommended bending radius at any time.

4. Where pipe is installed by pulling in tension, do not exceed the safe pulling force at any time.

5. Once pipe installation has commenced, continue the operation without interruption until the entire length of the fused section of pipe is installed.

6. Repair sections of pipe damaged during installation by cutting out the damaged section, facing the two pipe pieces according to the tolerances set by the manufacturer, and then rejoining with standard butt-fused joints.

B. Equipment:

1. **Fusion Machine:** Use fusion machines in good condition, properly equipped and set up for the pipe size being fused, and approved by the pipe supplier for the fusion process. Fusion machines must incorporate the following elements:
   a. **Heat Plate:** Free of any debris, contamination, or deep gouges or scratches; sized appropriately and capable of maintaining a uniform and consistent heat profile and temperature for the pipe being fused.
   b. **Carriage:** Capable of smooth travel with no binding at operating loads.
   c. **Data Logging Device:** Device compatible with the fusion machine and capable of logging a time stamp with heat plate temperature and pressure during the fusion process.

2. **Pipe Rollers:** Provide pipe rollers of sufficient quantity, spacing, and size to assure adequate support and limit excessive sagging of the pipe during handling and installation operations.

3. **Weather Canopy:** Provide a weather protection canopy which allows full motion of the fusion machine during inclement or windy weather or during extreme temperatures.

4. **Infrared (IR) Pyrometer:** For checking pipe and heat plate temperatures.

5. **Facing Blades:** Use blades specifically designed for cutting the fusible pipe being used.

6. **Pipe Pull Heads:** Where applicable, pull pipe utilizing a pull head specifically designed for use with the type of fusible pipe being used. Provide pull head that employs a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.

3.01 ADDITIONAL REQUIREMENTS FOR FUSIBLE PIPE INSTALLATION (Continued)

C. Fusion Process: Prepare and fuse pipe according to the pipe supplier's recommendations as well as the following.

1. Joint Recording: Record and log each fusion joint with a data logging device connected to the fusion machine. Manually log required data not logged electronically and include in the fusion joint report.

2. Joint Finishing: After fusing, grind the external joint bead to a maximum height of 0.1 inch. If required by the contract documents, grind the internal joint bead to a maximum height of 0.1 inch or as specified.

D. Trenched Installation:

1. Do not drop or roll pipe into the trench or excavation.

2. If the length of the fused pipe is longer than what the available equipment can lower into the trench or excavation at one time, stage equipment so that lowering begins at one end of the installation and proceed along the trench or excavation so that the entire fused length is installed without exceeding the minimum bend radius of the fused pipe.

3. Pipe may also be installed by pulling it into the end of the trench via a sloped section that is constructed so as not to exceed the minimum bending radius of the pipe.

4. Bed and backfill fused pipe per the contract documents and all applicable standards.

E. Trenchless Installation:

1. Where applicable, grade the pipe entry area as necessary to provide support for the pipe so as not to exceed the minimum bending radius of the pipe and to allow free movement into the bore hole.

2. Use a swivel attachment between the reaming head and the pipe to minimize torsion stress on the pipe assembly.

F. Pipe Connections:

1. Allow initial lengths of installed pipe to come to thermal equilibrium with the soil temperature at burial depth, by waiting at least 24 hours after installation prior to making connections such as service lines and laterals.

2. Tap pipe only with standard tapping saddles or sleeves designed according to AWWA C605 for PVC and AWWA M55 for HDPE. Do not direct tap fusible pipe.

3. Observe pipe supplier's guidelines for maximum tap size per pipe diameter and follow pipe supplier recommendations for tapping PVC and HDPE.

5. Use tapping bits specifically made for the pipe type being used, such as slotted shell style cutters. Do not use hole saws intended for cutting wood, steel, ductile iron, or other materials.

3.02 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

VALVES, FIRE HYDRANTS, AND APPURTENANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Butterfly Valves

B. Gate Valves

C. Tapping Valve Assemblies

D. Fire Hydrant Assemblies

E. Flushing Devices (Blowoffs)

F. Valve Boxes

1.02 DESCRIPTION OF WORK

Install valves, fire hydrants, and appurtenances for water mains.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Remove valves, fire hydrants, and appurtenances contaminated with mud and surface water from the site. Do not use in construction unless thoroughly cleaned, inspected, and approved by the owner.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Valve (Butterfly or Gate):

1. **Measurement:** Each type and size of valve will be counted.

2. **Payment:** Payment will be at the unit price for each type and size of valve.

3. **Includes:** Unit price includes, but is not limited to, all components attached to the valve or required for its complete installation, including underground or above ground operator, square valve operating nut, valve box and cover, valve box extension, and valve stem extension.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Tapping Valve Assembly:

1. **Measurement:** Each size of tapping valve assembly will be counted.

2. **Payment:** Payment will be at the unit price for each tapping valve assembly.

3. **Includes:** Unit price includes, but is not limited to, tapping sleeve, tapping valve, the tap, valve box and cover, valve box extension, and valve stem extension.

C. Fire Hydrant Assembly:

1. **Measurement:** Each fire hydrant assembly will be counted.

2. **Payment:** Payment will be at the unit price for each fire hydrant assembly.

3. **Includes:** Unit price includes, but is not limited to, the fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchoring pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchoring pipe, fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve and appurtenances, except tapping valve assembly if used.

D. Alternate Fire Hydrant Assembly:

1. **Measurement:** Each alternate fire hydrant assembly will be counted.

2. **Payment:** Payment will be at the unit price for each alternate fire hydrant assembly.

3. **Includes:** Unit price includes, but is not limited to, the fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchoring pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchoring pipes, 90 degree bend; fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve and appurtenances, except tapping valve assembly if used.

E. Flushing Device (Blowoff):

1. **Measurement:** Each size of flushing device will be counted.

2. **Payment:** Payment will be at the unit price for each flushing device

3. **Includes:** Unit price includes, but is not limited to, trench excavation; furnishing, installing, and removing the flushing device (if designated by the Engineer); and furnishing, placing, and compacting bedding and backfill material.

F. Valve Box Adjustment, Minor: Measurement and payment for minor adjustment of an existing valve box by raising or lowering the adjustable valve box is incidental.

G. Valve Box Extension:

1. **Measurement:** Each existing valve box adjusted to finished grade by adding a valve box extension will be counted.

2. **Payment:** Payment will be at the unit price for each valve box extension.

3. **Includes:** Unit price includes, but is not limited to, furnishing and installing the valve box extension and replacing the valve box lid.

1.08 MEASUREMENT AND PAYMENT (Continued)

H. Valve Box Replacement:

1. **Measurement:** Each existing valve box replaced with a new valve box will be counted.

2. **Payment:** Payment will be at the unit price for each valve box replacement.

3. **Includes:** The unit price for each valve box replacement includes, but is not limited to, removal of existing valve box; excavation; furnishing and installing new valve box; backfill; compaction; and all other necessary appurtenances.

I. Fire Hydrant Adjustment:

1. **Measurement:** Each existing fire hydrant adjusted to finished grade by addition of an extension barrel section and stem will be counted.

2. **Payment:** Payment will be at the unit price for each adjustment of an existing fire hydrant.

3. **Includes:** The unit price for each adjustment of an existing fire hydrant includes, but is not limited to, removal and reinstallation of the existing fire hydrant; furnishing and installing the extension barrel section and stem; and all other necessary appurtenances.

J. Fire Hydrant Assembly Removal:

1. **Measurement:** Each fire hydrant assembly removed will be counted.

2. **Payment:** Payment will be made at the unit price for each fire hydrant assembly removed.

3. **Includes:** The unit price includes, but is not limited to, excavation, removal of the fire hydrant, hydrant valve, thrust block, delivery of the fire hydrant assembly to the Contracting Authority (if specified), capping of the pipe, backfill, compaction, and surface restoration to match the surrounding area.

K. Valve Removal:

1. **Measurement:** Each size of valve removed will be counted

2. **Payment:** Payment will be made at the unit price for each size of valve removed.

3. **Includes:** The unit price includes, but is not limited to, excavation, removal of each valve, replacing the removed valve with pipe and connections if required or capping the former valve connection, delivery of the valve to the Contracting Authority (if specified), backfill, compaction, and surface restoration to match the surrounding area.

L. Valve Box Removal:

1. **Measurement:** Each valve box removed will be counted

2. **Payment:** Payment will be made at the unit price for valve box removed.

3. **Includes:** The unit price includes, but is not limited to, excavation, removal of each valve box, delivery of the valve box to the Contracting Authority (if specified), backfill, compaction, and surface restoration to match the surrounding area.

PART 2 - PRODUCTS

2.01 VALVES

A. General:

1. **Valve Body:** Manufacturer's name and pressure rating cast on valve body.

2. **Direction of Opening:** The opening direction is counterclockwise as viewed from the top, unless otherwise specified in the contract documents or as directed by the Jurisdiction.

3. **Joints:**
   a. For buried installations, use mechanical joints per AWWA C111. Comply with Section 5010 for joint nuts and bolts.
   b. For installation within structures, flanged with dimensions and drillings according to AWWA C110 or ANSI B16.1 class 125.

B. Gate Valves:

1. **Standards:** Comply with AWWA C509 (gray iron or ductile iron) or AWWA C515 (ductile iron) and NSF 61.

2. **Stem Seals:** Double O-rings permanently lubricated between seals. Lubricant certified for use in potable water.

3. **External Bolts and Hex Nuts:** Stainless steel according to ASTM A 240, Type 304.

C. Butterfly Valves:

1. **Standards:** Comply with AWWA C504 class 150B (gray iron or ductile iron) and NSF 61.

2. **Stem:** Stainless steel according to ASTM A 240, Type 304, turned, ground, and polished.

3. **For Seat on Body Valves:**
   a. Disc: Ductile iron or gray iron with plasma applied nickel-chromium edge or stainless steel edge according to ASTM A 240, Type 316, and mechanically fixed stainless steel pins.
   b. Seat: Synthetic rubber compound mechanically retained to the body.

4. **For Seat on Disc Valves:**
   a. Disc: Ductile iron according to ASTM A 536 with synthetic rubber compound seat mechanically retained to the disc.
   b. Seat: Continuous Type 316 stainless steel seat.

5. **External Bolts and Hex Nuts:** Stainless steel according to ASTM A 240, Type 304.

D. Tapping Valve Assemblies:

1. **Tapping Valve:** Gate valve complying with AWWA C509 or AWWA C515.

2. **Sleeve:**
   a. Minimum 14 gauge.
   b. Stainless steel according to ASTM A 240, Type 304.
   c. Working pressure 150 psi.
   d. Must fully surround pipe.
   e. Flanged with dimensions and drillings according to AWWA C110 or ANSI B16.1 class 125.

2.01 VALVES (Continued)

3. **Minimum Sleeve Length:** Comply with the following table.

Table 5020.01: Minimum Sleeve Length

Outlet Flange Size	Minimum Sleeve Length
4”	15”
6”	15”
8”	20”
10”	25”
12”	25”
Over 12”	As approved by the Engineer

4. **Gasket:**
   a. To completely surround pipe.
   b. Minimum thickness 0.125 inch.
   c. Use nitrile rubber.

5. **Outlet Flange:**
   a. Stainless steel complying with ASTM A 240, Type 304.
   b. ANSI B16.1, 125 pound pattern.

6. **Hex Nuts and Bolts:** Stainless steel complying with ASTM A 240, Type 304.

7. **Tapping Valve Assemblies:** Use only where specified in the contract documents.

2.02 FIRE HYDRANT ASSEMBLY

A. Material: Comply with AWWA C502.

B. Manufacturers: As allowed by the Jurisdiction or as specified in the contract documents.

C. Features:

1. **Breakaway Items:** Stem coupling and flange.
2. **Inlet Nominal Size:** 6 inch diameter.
3. **Inlet Connection Type:** Mechanical joint.
4. **Hose Nozzles:** Two, each 2 1/2 inches in diameter.
5. **Direction of Opening:** Counterclockwise, unless otherwise specified.
6. **Items to be Specified:** The following items will be specified by the Jurisdiction or in the contract documents.
   a. Operating nut.
   b. Pumper nozzle.
   c. Nozzle threads.
   d. Main valve nominal opening size.

D. Painting:

1. Shop coating according to AWWA C502.

2. Above grade exterior coating type and color will be selected by the Engineer.

E. External Bolts and Hex Nuts: Stainless steel according to ASTM A 193, Grade B 8.

F. Gate Valve: Comply with Section 5020, 2.01.

G. Pipe and Fittings: Comply with Section 5010.

2.03 APPURTENANCES

A. Flushing Device (Blowoff): As specified in the contract documents.

B. Valve Box:

1. Applicability: For all buried valves.

2. Manufacturer: As allowed by the Jurisdiction or specified in the contract documents.

3. Type:
a. In paved areas, use a slide type.
b. In all other areas, use a screw extension type.

4. Material: Gray iron.

5. Cover: Gray iron, labeled "WATER"

6. Wall Thickness: 3/16 inch, minimum.

7. Inside Diameter: 5 inches, minimum.

8. Length: Adequate to bring top to finished grade, including valve box extensions, if necessary.

9. Factory Finish: Asphalt coating.

10. Valve Box Centering Ring: Include in installation.

C. Valve Stem Extension: For all buried valves, provide as necessary to raise 2 inch operating nut to within 3 feet of the finished grade. Stem diameter according to valve manufacturer's recommendations, but not less than 1 inch.

PART 3 - EXECUTION

3.01 GENERAL

A. Install according to the contract documents.

B. Apply polyethylene wrap to all iron pipe, valves, fire hydrants, and fittings.

C. Set tops of valve boxes to finished grade, unless otherwise directed by the Engineer.

D. Check the working order of all valves by opening and closing through entire range. Before opening the valves, check with the Jurisdiction on operating requirements.

E. Test and disinfect all valves, fire hydrants, and appurtenances as components of the completed water main according to Section 5030.

3.02 FLUSHING DEVICE (BLOWOFF)

Install and construct as specified in the contract documents.

3.03 FIRE HYDRANT

A. Install according to Figure 5020.201. Ensure a 3 foot clear space around the circumference of the fire hydrant. Place anchor tee and hydrant in the locations specified in the contract documents.

B. If the fire hydrant valve is positioned adjacent to the water main, attach it to an anchor tee.

C. If the fire hydrant valve is positioned away from the water main, restrain all joints between the valve and water main.

D. Fire Hydrant Depth Setting:

1. Use adjacent finished grade to determine setting depth.

2. Set bottom of breakaway flange between 2 and 5 inches above finished grade.

3. If finished grade is not to be completed during the current project, consult with the Engineer for proper setting depth.

E. Coordinate installation with tracer wire installation.

F. Orient fire hydrant nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb. Set hydrants having two hose nozzles 90 degrees apart with each nozzle facing the curb at an angle of 45 degrees or as directed by the Engineer.

3.04 ADJUSTMENT OF EXISTING VALVE BOX OR FIRE HYDRANT

A. Minor Valve Box Adjustment: For existing adjustable boxes that have sufficient adjustment range to bring to finished grade, raise or lower valve box to finished grade.

B. Valve Box Extension: For existing valve boxes that cannot be adjusted to finished grade, install valve box extensions as required.

C. Valve Box Replacement: For existing valve boxes that cannot be adjusted to finished grade, remove and replace the valve box.

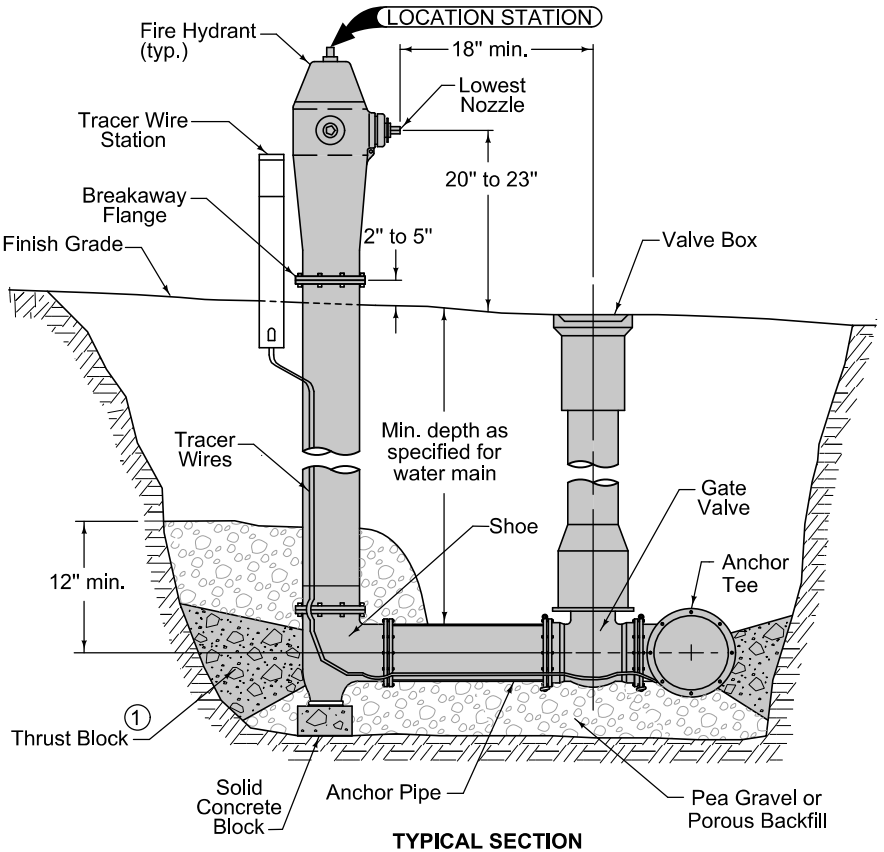
3.04 ADJUSTMENT OF EXISTING VALVE BOX OR FIRE HYDRANT (Continued)

D. Fire Hydrant Adjustment:

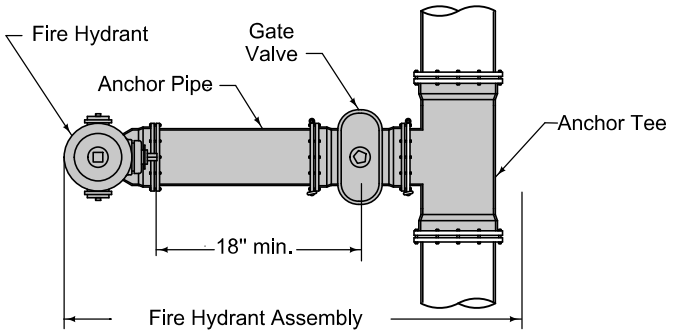
1. Add extension barrel sections and stems as necessary to set existing fire hydrant at finished grade.

2. Paint exterior of new barrel section to match existing fire hydrant unless otherwise specified.

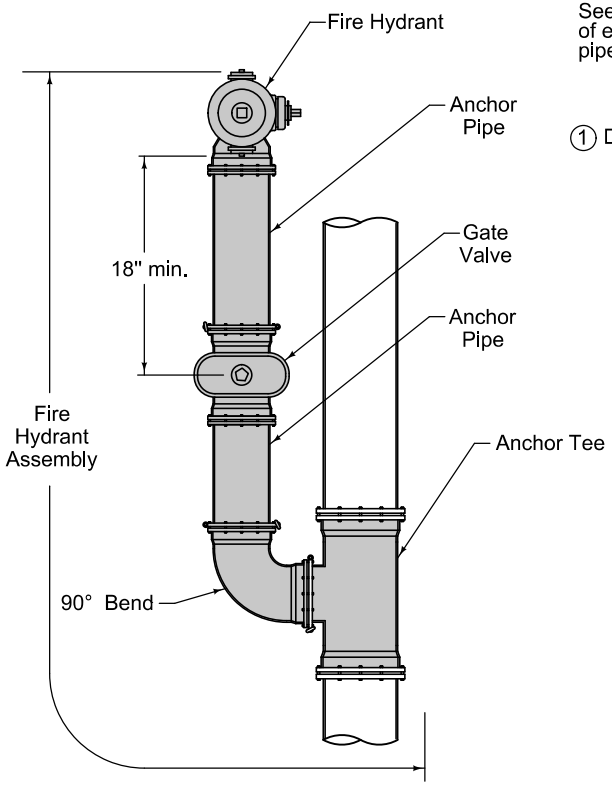
END OF SECTION



TYPICAL SECTION



TYPICAL PLAN



ALTERNATE PLAN

Use ductile iron pipe with restrained mechanical joints for fire hydrant assembly and anchor tee.

All shaded items are included in the Fire Hydrant Assembly bid item.

See the contract documents for the location of each hydrant and the length of ancoring pipe.

(1) Do not cover drain holes or tracer wire.

SUDAS	IOWADOT	REVISION 4 04-19-22
FIGURE 5020.201	STANDARD ROAD PLAN	WM-201 SHEET 1 of 1

REVISIONS: Added general note for location and length.

Paul D. Wigand, SUDAS DIRECTOR — Steven Nichols, DESIGN METHODS ENGINEER

FIRE HYDRANT ASSEMBLY

FIGURE 5020.201 SHEET 1OF 1

TESTING AND DISINFECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pressure and Leak Testing of Water System

B. Disinfection of Potable Water Systems

1.02 DESCRIPTION OF WORK

Test and disinfect water mains, valves, fire hydrants, and appurtenances.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Notify the Engineer two working days in advance of testing or disinfection operations to coordinate the operations.

B. The Engineer or his/her representative is required to be in attendance during testing or disinfection.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

Testing and disinfection of water systems is incidental to the construction of pipe and fittings.

PART 2 - PRODUCTS

2.01 DISINFECTION AGENT - CHLORINE

A. Liquid Chlorine complying with AWWA B300 and AWWA B301.

B. Sodium Hypochlorite complying with AWWA B300.

C. Calcium Hypochlorite complying with AWWA B300.

D. All disinfecting agents to be NSF 60 certified. Supply and store in the original container.

PART 3 - EXECUTION

3.01 GENERAL

Perform operations according to AWWA C651 in the sequence below. Successfully complete each operation specified in subsections 3.02 through 3.08 below before continuing to the next operation. The Jurisdiction will provide reasonable quantities of water for flushing and testing.

3.02 SEQUENCE OF TESTING AND DISINFECTION

A. Continuous-Feed or Slug Method (After Water Main Installation): The sequence of testing and disinfection may be modified with approval of the Engineer.

1. Perform initial flush.
2. Perform disinfection.
3. Flush after disinfection.
4. Perform pressure and leak testing.

B. Tablet Method (Concurrent with Water Main Installation): Use this method only if approved by the Engineer. Modify the procedure for flushing, disinfection, and pressure and leak testing as needed if tablet method is used.

1. Perform disinfection.
2. Flush after disinfection.
3. Perform pressure and leak testing.

3.03 INITIAL FLUSHING

A. Flushing:

1. Coordinate flushing with the Jurisdiction.
2. Flush pipe prior to disinfection using potable water.
3. Measure flushing velocity.
4. Obtain a minimum flushing velocity of 3 feet per second in the pipe to be disinfected.

B. Minimum Flushing Rate: According to AWWA C651, Table 3, based on 40 psi residual pressure (see table below).

Table 5030.01: Minimum Flushing Rate

Pipe Diameter (inches)	Flow Rate for Flushing (gpm)	Number of Taps[2]			Number of 2 1/2" Fire Hydrant Outlets[1]
		1"	1 1/2"	2"	
4	120	1	-	-	1
6	260	-	1	-	1
8	470	-	2	-	1
10	730	-	3	2	1
12	1,060	-	-	3	2
16	1,880	-	-	5	2

[1]With a 40 psi pressure in the main with the fire hydrant flowing to atmosphere, a 2 1/2 inch fire hydrant outlet will discharge approximately 1,000 gpm; and a 4 1/2 inch fire hydrant outlet will discharge approximately 2,500 gpm.
[2]Number of taps on pipe based on discharge through 5 feet of galvanized iron pipe with one 90° elbow.

3.03 INITIAL FLUSHING (Continued)

C. Property Protection: Protect public and private property from damage during flushing operations.

3.04 PRESSURE AND LEAK TESTING

A. Remove debris from within the pipe. Clean and swab out pipe, if required.

B. Secure unrestrained pipe ends against uncontrolled movement.

C. Isolate new piping from the existing water system.

D. Fill and flush all new piping with potable water. Ensure all trapped air is removed.

E. Pressurize the new pipe to the test pressure at the highest point in the isolated system. Do not pressurize to more than 5 psi over the test pressure at the highest point in the isolated system.

F. Test and monitor the completed piping system at 1.5 times the system working pressure or 150 psi, whichever is greater, for 2 continuous hours.

G. If at any time during the test the pressure drops to 5 psi below the test pressure, repressurize the pipe by pumping in potable water in sufficient quantity to bring the pressure back to the original test pressure.

H. Accurately measure the amount of water required to repressurize the system to the test pressure.

I. Maximum allowable leakage rate:

$$L = \frac{(S)(D)(P)^{0.5}}{148{,}000}$$

Where:
L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal pipe diameter, in inches
P = average test pressure, in pounds per square inch

The following table assumes an average test pressure (P) of 150 psi and 1,000 feet of test section.

Table 5030.03: Maximum Allowable Leakage Rate

Pipe Diameter (inches)	Allowable Leakage Rate (gallons/hour/1,000 feet of pipe)
4	0.33
6	0.50
8	0.66
10	0.83
12	0.99
14	1.16
16	1.32
18	1.49
20	1.66
24	1.99
30	2.48
36	2.98

3.04 PRESSURE AND LEAK TESTING (Continued)

J. If the average measured leakage per hour exceeds the maximum allowable leakage rate, repair and retest the water main.

K. If the measured pressure loss does not exceed 5 psi, the test will be considered acceptable.

L. Repair all visible leaks regardless of the amount of leakage.

3.05 DISINFECTION

A. General:

1. Disinfect according to AWWA C651. The tablet method contained in AWWA C651 is not to be used unless approved by the Engineer.

2. Keep piping to be chlorinated isolated from lines in service and from points of use.

3. Coordinate disinfection and testing with the Engineer.

B. Procedure:

1. Induce a flow of potable water through the pipe.

2. Introduce highly chlorinated water to the pipe at a point within 5 pipe diameters of the pipe's connection to an existing potable system, or within 5 pipe diameters of a closed end, if there is no connection to an existing system.

3. Introduce water containing a minimum of 25 mg/L free chlorine until the entire new pipe contains a minimum of 25 mg/L free chlorine.

4. Retain chlorinated water in the pipe for at least 24 hours and no more than 48 hours.

3.06 FINAL FLUSHING

A. Flush pipe using potable water until chlorine residual equals that of the existing potable water system.

B. Dispose of chlorinated water to prevent damage to the environment. Dechlorinate highly chlorinated water from testing before releasing into the ground or sewers. Obtain Jurisdiction approval prior to flushing activities.

1. Check with the local sewer department for the conditions of disposal to the sanitary sewer.

2. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in the following table.

3.06 FINAL FLUSHING (Continued)

Table 5030.02: Amounts of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water

Residual Chlorine Concentration mg/L	Sulfur Dioxide (SO_2) lb	Sodium Bisulfite ($NaHSO_3$) lb	Sodium Sulfite (Na_2SO_3) lb	Sodium Thiosulfate ($Na_2S_2O_3 + 5H_2O$) lb	Ascorbic Acid ($C_6O_8H_6$) lb
1	0.8	1.2	1.4	1.2	2.1
2	1.7	2.5	2.9	2.4	4.2
10	8.3	12.5	14.6	12.0	20.9
50	41.7	62.6	73.0	60.0	104

3.07 BACTERIA SAMPLING

Test water mains according to AWWA C651, except as modified below:

A. Collect samples every 1,200 feet of new water main plus one set from the end of the line and at least one from each branch greater than one pipe length. If trench water entered the new main during construction, or if excessive quantities of dirt and debris entered the main, reduce the sampling interval to every 200 feet of new main.

B. Collect samples according to one of the following methods as directed by the Engineer:

1. Collect an initial set of samples after flushing and then an additional set after a minimum of 24 hours without any water use. The engineer may reduce the sampling interval to 16 hours.

2. Allow water to sit in the new main for a minimum of 16 hours after flushing without any water use. Collect an initial set of samples and allow the sampling ports to run for a minimum of 15 minutes. Collect a second set of samples from the sampling ports.

3.08 RE-DISINFECTION

If the initial disinfection fails to produce satisfactory bacteriological samples, flush the main again and reinitiate the sampling process. If check samples show the presence of coliform organisms, re-chlorinate the main prior to flushing and sampling until satisfactory results are obtained.

3.09 PUTTING WATER MAIN IN SERVICE

Put the completed water system in service only after both sets of bacterial samples have passed and obtaining permission from the Jurisdiction.

END OF SECTION

Insert tab here called

DIVISION 6
Structures for Sanitary and Storm Sewers

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Deep Well Rectangular Storm Sewer Manhole 6010.403

Rectangular Base/Circular Top Storm Sewer Manhole 6010.404

Tee-section Storm Sewer Manhole 6010.405

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STRUCTURES FOR SANITARY AND STORM SEWERS

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D. Connection to Existing Manholes and Intakes

E. Removal of Manholes and Intakes

F. Special Structures for Storm Sewers

G. Excavation and Backfill of Structures

1.02 DESCRIPTION OF WORK

A. Construct sanitary and storm sewer manholes to provide access to sewer systems for maintenance and cleaning purposes.

B. Construct storm sewer intakes for collection of surface water and conveyance to the storm sewer system.

C. Modify existing manholes and intakes as necessitated by other improvements adjacent to the manholes or intakes.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Shop drawings of steel reinforcement, showing sizes, lengths, bends, and counts, if required.

B. Concrete mix design, if required by Engineer.

C. Shop drawing schedule of new manholes and/or intakes showing total depth, relative elevations of all connecting sanitary or storm sewer lines, all drops, and orientation of connecting lines.

D. Results of required testing.

E. Catalog cuts of iron castings and sewer line connection gaskets.

F. Gradation and soil classification reports for structure bedding and backfill materials.

G. Dewatering plan.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Store reinforcing steel only on pallets or lagging.

B. Follow the aggregate storage and concrete transport requirements in Iowa DOT Article 2301.02, C.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. Do not place concrete when stormy or inclement weather will prevent good quality work.

B. Cold weather placement is restricted per Iowa DOT Article 2403.03, F.

1.08 MEASUREMENT AND PAYMENT

A. Manhole:

1. **Measurement:** Each type and size of manhole will be counted.

2. **Payment:** Payment will be at the unit price for each type and size of manhole.

3. **Includes:** Unit price includes, but is not limited to, excavation; furnishing and installing pipe; lining (if specified); furnishing, placing, and compacting bedding and backfill material; base; structural concrete; reinforcing steel; precast units (if used); concrete fillets; pipe connections; infiltration barriers (sanitary sewer manholes only); castings; and adjustment rings.

B. Intake:

1. **Measurement:** Each type and size of intake will be counted.

2. **Payment:** Payment will be at the unit price for each type and size of intake.

3. **Includes:** Unit price includes, but is not limited to, excavation; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; base; structural concrete; reinforcing steel; precast units (if used); concrete fillets; pipe connections; castings; adjustment rings; and the insert/boxout.

C. Drop Connection:

1. **Internal Drop Connection:**
   a. **Measurement:** Each size of internal drop connection will be counted.
   b. **Payment:** Payment will be at the unit price for each size of internal drop connection.
   c. **Includes:** Unit price includes, but is not limited to, cutting the hole and installing a flexible watertight connector, providing and installing the receiving bowl, flexible coupler between the bowl and the drop pipe, the PVC drop pipe, pipe brackets and bolts, the bottom elbow, repair of fillet if required, and a splash guard if required.

2. **External Drop Connection:**
   a. **Measurement:** Each size of external drop connection will be counted.
   b. **Payment:** Payment will be at the unit price for each size of external drop connection.
   c. **Includes:** Unit price includes, but is not limited to, the connection to the manhole and all pipe; fittings; concrete encasement; and furnishing, placing, and compacting bedding and backfill material.

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Casting Extension Rings:

1. **Measurement:** Each casting extension ring will be counted.

2. **Payment:** Payment will be at the unit price for each casting extension ring.

3. **Includes:** Unit price includes, but is not limited to, furnishing and installing each casting extension ring and reinstalling the casting lid.

E. Manhole or Intake Adjustment, Minor:

1. **Manhole Adjustment, Minor:**
   a. **Measurement:** Each existing manhole adjusted to finished grade by addition or removal of adjustment rings or adjustment of adjustable casting will be counted.
   b. **Payment:** Payment will be made at the unit price for each minor manhole adjustment.
   c. **Includes:** Unit price includes, but is not limited to, removing existing casting and existing adjustment rings, furnishing and installing adjustment rings, furnishing and installing new casting, and installing new infiltration barrier (sanitary sewer manholes only).

2. **Intake Adjustment, Minor:**
   a. **Measurement:** Each existing intake adjusted to finished grade by addition or removal of adjustment rings or adjustment of adjustable casting will be counted.
   b. **Payment:** Payment will be made at the unit price for each minor intake adjustment.
   c. **Includes:** Unit price includes, but is not limited to, removing existing casting and existing adjustment rings, furnishing and installing adjustment rings, and furnishing and installing new casting.

F. Manhole or Intake Adjustment, Major:

1. **Manhole Adjustment, Major:**
   a. **Measurement:** Each existing manhole adjusted to grade by addition or removal of riser, cone or flat top sections, or the exchange of existing riser sections with sections having different vertical dimensions will be counted.
   b. **Payment:** Payment will be at the unit price for each major adjustment.
   c. **Includes:** Unit price includes, but is not limited to, removal of existing casting, adjustment rings, top sections, and risers; excavation; concrete and reinforcing steel or precast sections; furnishing and installing new casting; installing new infiltration barrier (sanitary sewer manholes only); placing backfill material; and compaction.

2. **Intake Adjustment, Major:**
   a. **Measurement:** Each existing intake adjusted to grade by addition or removal of riser, cone or flat top sections, or the exchange of existing riser sections with sections having different vertical dimensions will be counted.
   b. **Payment:** Payment will be at the unit price for each major adjustment.
   c. **Includes:** Unit price includes, but is not limited to, removal of existing casting, adjustment rings, top sections, and risers; excavation; concrete and reinforcing steel or precast sections; furnishing and installing new casting; placing backfill material; and compaction.

1.08 MEASUREMENT AND PAYMENT (Continued)

G. Connection to Existing Manhole or Intake:

1. Connection to Existing Manhole:
- **a. Measurement:** Each connection made to an existing manhole will be counted.
- **b. Payment:** Payment will be made at the unit price for each sewer connection.
- **c. Includes:** Unit price includes, but is not limited to, coring or cutting into the existing manhole, removal of existing fillet, pipe connections, replacement of fillet, grout, and waterstop (when required).

2. Connection to Existing Intake:
- **a. Measurement:** Each connection made to an existing intake will be counted.
- **b. Payment:** Payment will be made at the unit price for each sewer connection.
- **c. Includes:** Unit price includes, but is not limited to, coring or cutting into the existing intake, removal of existing fillet, pipe connections, replacement of fillet, grout, and waterstop (when required).

H. Remove Manhole or Intake:

1. Remove Manhole:
- **a. Measurement:** Each manhole removed will be counted.
- **b. Payment:** Payment will be made at the unit price for each manhole.
- **c. Includes:** Unit price includes, but is not limited to, removal of casting, concrete, and reinforcement; plugging pipes; filling remaining structure with flowable mortar; and placing compacted fill over structure to finished grade.

2. Remove Intake:
- **a. Measurement:** Each intake removed will be counted.
- **b. Payment:** Payment will be made at the unit price for each intake.
- **c. Includes:** Unit price includes, but is not limited to, removal of casting, concrete, and reinforcement; plugging pipes; filling remaining structure with flowable mortar; and placing compacted fill over structure to finished grade.

PART 2 - PRODUCTS

2.01 MANHOLE AND INTAKE TYPES

Table 6010.01: Manhole and Intake Types

	Figure No.	Type	Description
Sanitary Sewer Manholes	6010.301	SW-301	Circular Sanitary Sewer Manhole
	6010.302	SW-302	Rectangular Sanitary Sewer Manhole
	6010.303	SW-303	Sanitary Sewer Manhole Over Existing Sewer
	6010.304	SW-304	Rectangular Base/Circular Top Sanitary Sewer Manhole
	6010.305	SW-305	Tee-section Sanitary Sewer Manhole
Storm Sewer Manholes	6010.401	SW-401	Circular Storm Sewer Manhole
	6010.402	SW-402	Rectangular Storm Sewer Manhole
	6010.403	SW-403	Deep Well Rectangular Storm Sewer Manhole
	6010.404	SW-404	Rectangular Base/Circular Top Storm Sewer Manhole
	6010.405	SW-405	Tee-section Storm Sewer Manhole
	6010.406	SW-406	Shallow Rectangular Storm Sewer Manhole
Intakes	6010.501	SW-501	Single Grate Intake
	6010.502	SW-502	Circular Single Grate Intake
	6010.503	SW-503	Single Grate Intake with Manhole
	6010.504	SW-504	Single Grate Intake with Flush-top Manhole
	6010.505	SW-505	Double Grate Intake
	6010.506	SW-506	Double Grate Intake with Manhole
	6010.507	SW-507	Single Open-throat Intake, Small Box
	6010.508	SW-508	Single Open-throat Intake, Large Box
	6010.509	SW-509	Double Open-throat Intake, Small Box
	6010.510	SW-510	Double Open-throat Intake, Large Box
	6010.511	SW-511	Rectangular Area Intake
	6010.512	SW-512	Circular Area Intake
	6010.513	SW-513	Open-sided Area Intake
	6010.515	SW-515	Triple Rectangular Area Intake
	6010.541	SW-541	Open-Throat Curb Intake Under Pavement
	6010.542	SW-542	Extension Unit for Open-Throat Curb Intake Under Pavement
	6010.545	SW-545	Single Open-Throat Curb Intake with Extended Opening

2.02 PRECAST

Comply with ASTM C 478 (circular) and ASTM C 913 (rectangular).

2.03 CAST-IN-PLACE

A. Concrete: Use Class C concrete. Comply with the following Iowa DOT Specifications and Materials I.M.s.

1. Iowa DOT Specifications Sections:

a. 2403 – Structural Concrete
b. 4101 – Portland Cement
c. 4102 – Water for Concrete and Mortar
d. 4103 – Liquid Admixtures for Portland Cement Concrete
e. 4104 – Burlap for Curing Concrete
f. 4106 – Plastic Film and Insulating Covers for Curing Concrete
g. 4108 – Supplementary Cementitious Materials
h. 4109 – Aggregate Gradations
i. 4110 – Fine Aggregate for Portland Cement Concrete
j. 4115 – Coarse Aggregate for Portland Cement Concrete

2.03 CAST-IN-PLACE (Continued)

2. Iowa DOT Materials I.M.s:
a. 316 – Flexural Strength of Concrete
b. 318 – Air Content of Freshly Mixed Concrete by Pressure
c. 403 – Chemical Admixtures for Concrete
d. 528 – Structural Concrete Plant Inspection
e. 529 – Portland Cement Concrete Proportions
f. 534 – Mobile Mixture Inspection

B. Reinforcement: Comply with Iowa DOT Section 4151 for epoxy coated reinforcement.

2.04 NON-SHRINK GROUT

Comply with Iowa DOT Materials I.M. 491.13.

2.05 PRECAST RISER JOINTS

A. Joint Ends:

1. Use tongue and groove ends.

2. If cast-in-place base is used, provide bottom riser with square bottom edge.

B. Joint Sealant:

1. Sanitary Sewers:
a. Rubber O-ring or Profile Gasket: Flexible joint, complying with ASTM C 443.
b. Bituminous Jointing Material: Use a cold-applied mastic sewer joint sealing compound recommended by the manufacturer for the intended use and approved by the Engineer. Comply with ASTM C 990.
c. Butyl Sealant Wrap: Comply with ASTM C 877.

2. Storm Sewers: All joint sealants used on sanitary sewers may also be used for storm sewers. The following may also be used.
a. Rubber Rope Gasket Jointing Material: Comply with ASTM C 990.
b. Engineering Fabric Wrap: If specified in the contract documents, supply engineering fabric wrap complying with Iowa DOT Article 4196.01, B.

2.06 MANHOLE OR INTAKE TOP

A. Capable of supporting HS-20 loading.

B. Use eccentric cone on sanitary sewer manholes unless otherwise specified or allowed.

2.07 BASE

A. Sanitary Sewer Manhole:

1. Circular Manhole: Integral base and lower riser section according to ASTM C 478.

2. All Other Manholes: Use precast or cast-in-place concrete base.

B. Storm Sewer Manhole: Use precast or cast-in-place concrete base.

C. Intake: Use precast or cast-in-place concrete base.

2.08 PIPE CONNECTIONS

A. Flexible, Watertight Gasket: Comply with ASTM C 923.

B. Non-Shrink Grout: Comply with Section 6010, 2.04.

C. Waterstop: Provide elastomeric gasket that surrounds pipe and attaches with stainless steel bands and is designed to stop the movement of water along the interface between a pipe and a surrounding concrete collar.

D. Concrete Collar: Comply with Section 6010, 2.02 and 2.03.

2.09 MANHOLE OR INTAKE ADJUSTMENT RINGS (Grade Rings)

A. Use one of the following materials for grade adjustments of manhole or intake frame and cover assemblies:

1. Reinforced Concrete Adjustment Rings: Comply with ASTM C 478. Provide rings free from cracks, voids, and other defects.

2. High Density Polyethylene Adjustment Rings: Comply with ASTM D 1248 for recycled plastic.
   a. Test and certify material properties by the methods in the following table.

Table 6010.02: Test Methods

Property	Test Method	Acceptable Value
Melt Flow Index	ASTM D 1238	0.30 to 30 g/10 min.
Density	ASTM D 792	0.94 to 0.98 g/cm^3
Tensile Strength	ASTM D 638	2,000 to 5,000 lb/in^2

   b. Do not use polyethylene grade adjustment rings when they are exposed to heat shrink infiltration barriers.
   c. When used in a single configuration, provide tapered adjustment ring with thickness that varies from 1/2 inch to 3 inches.
   d. Install adjustment rings on clean, flat surfaces according to the manufacturer's recommendations. Comply with ASTM D 36 with minimum 350°F softening point for butyl rubber sealant.

3. Expanded Polypropylene Adjustment Rings: Comply with ASTM D 4819 for expanded polypropylene when tested according to ASTM D 3575.
   a. Use adhesive meeting ASTM C 920, Type S, Grade N5, Class 25.
   b. Provide finish rings with grooves on the lower surface and flat upper surface.
   c. If a heat shrinkable infiltration barrier is used, ensure surface temperature does not exceed 300° during installation process.

B. Ensure the inside diameter of the adjustment ring is not less than the inside diameter of the manhole frame or not less than the inside dimension of the intake grate opening.

2.10 CASTINGS (Ring, Cover, Grate, and Extensions)

A. Gray Cast Iron: AASHTO M 306.

B. Ductile Iron: ASTM A 536, Grade 80-55-06 or 70-50-05.

2.10 CASTINGS (Ring, Cover, Grate, and Extensions) (Continued)

C. Composite: AASHTO M 306.

1. Hardware: Attach lid to frame with 316 stainless steel hardware.

2. Slip Resistance: Greater than 0.6 when tested according to ASTM C 1028.

3. Ultraviolet Resistance: Meet ASTM G 154 Cycle 1 for a minimum of 1,000 hours.

4. Detection: Must be detectable using standard detection equipment.

D. Load Capacity: Standard duty unless otherwise shown on the casting figures.

1. Standard Duty: Casting certified for 40,000 pound proof-load according to AASHTO M 306.

2. Light Duty: Casting certified according to requirements of AASHTO M 306 for a 16,000 pound proof-load (HS-20). 40,000 pound proof-load is not required.

E. Casting Types:

1. Manholes: The following table lists the manhole casting types.

Table 6010.03: Manhole Casting Types

	Figure No.	Casting Type	Number of Pieces	Ring/ Cover	Bolted Frame	Bolted Cover (Floodable)	Gasket
Sanitary Sewer	6010.601	SW-601, A	2	Fixed	Yes	No	Yes[1]
	6010.601	SW-601, B	3	Adjustable	No	No	Yes[1]
	6010.601	SW-601, C	2	Fixed	Yes	Yes	Yes[1]
	6010.601	SW-601, D	3	Adjustable	No	Yes	Yes[1]
Storm Sewer	6010.602	SW-602, E[2]	2	Fixed	Yes	No	No
	6010.602	SW-602, F[2]	3	Adjustable	No	No	No
	6010.602	SW-602, G[2]	2	Fixed	No	No	No

[1] Machine bearing surfaces required.

[2] Storm sewer casting may include environmental symbols and/or messages such as “DUMP NO WASTE, DRAINS TO RIVER.”

2. Intakes:

a. Comply with Figures 6010.602, 6010.603, 6010.604, and the contract documents.

b. Castings may include environmental symbols and/or messages such as “DUMP NO WASTE, DRAINS TO RIVER.”

3. Manhole Casting Extension Ring:

a. Match the dimensions of the existing ring and cover with an allowable diameter tolerance of -1/4 inch for the frame ridge and +1/4 inch for the cover recess.

b. Provide extension ring with height as required to raise the top of the casting to make it level or no more than 1/4 inch below the finished pavement surface. Maximum ring height is 3 inches.

2.11 ADDITIONAL MATERIALS FOR SANITARY SEWER MANHOLES

A. Infiltration Barrier:

1. External Chimney Seal:

a. Rubber Sleeve and Extension:

1) Corrugated; minimum thickness of 3/16 inches, according to ASTM C 923.
2) Minimum allowable vertical expansion of at least 2 inches.

b. Compression Bands:

1) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces.
2) 16 gauge ASTM C 923, Type 304 stainless steel, minimum 1 inch width, minimum adjustment range of 4 inches more than the manhole outside diameter.
3) For standard two-piece castings, shape top band to lock sleeve to manhole frame's base flange. For three-piece adjustable castings, shape top band to lock sleeve to upper piece of adjustable frame.
4) Stainless steel fasteners complying with ASTM F 593 and 594, Type 304.

2. Internal Chimney Seal:

a. Rubber Sleeve and Extension:

1) Double pleated, minimum thickness 1/8 inch thick, according to ASTM C 923.
2) Minimum allowable vertical expansion of at least 2 inches.
3) Integrally formed expansion band recess top and bottom with multiple sealing fins.

b. Expansion Bands:

1) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces to make a watertight seal.
2) 16 gauge ASTM C 923, Type 304 stainless steel, minimum 1 inch width, minimum adjustment range of 2 inches more than the manhole inside diameter.
3) Positive stainless steel locking mechanism permanently securing the band in its expanded position after tightening.

3. Molded Shield:

a. Barrier Shield:

1) Medium density polyethylene, according to ASTM D 1248.
2) Certified for 40,000 pound proof-load according to AASHTO M 306.
3) Diameter to match cone section and internal dimension of casting.

b. Sealant: Butyl material meeting ASTM C 990.

4. Heat Shrink Sleeve: Heat-shrinkable wrap around sleeve designed for protection of buried and exposed sanitary sewer manholes. Do not use with polyethylene adjustment rings.

a. Primer: Compatible with concrete, ductile and cast iron, and sleeve material.

b. Sleeve and Backing:

Property	Standard	Value
Water Absorption	ASTM D 570	0.05% maximum
Low Temperature Flexibility	ASTM D 2671	-40° F
Tensile Strength	ASTM D 638	2,900 psi minimum
Elongation	ASTM D 638	600% minimum
Hardness	ASTM D 2240	Shore D: 46
Shrink Factor	---	40% minimum
Thickness	---	0.1 inch minimum

c. Adhesive: Softening point of 212° F maximum meeting ASTM E 28.

2.11 ADDITIONAL MATERIALS FOR SANITARY SEWER MANHOLES (Continued)

B. Riser Section Coating:

1. Exterior: When exterior waterproof coating is specified, provide bituminous or coal tar coating.

2. Interior: When interior manhole lining is specified, provide lining according to Section 4010, 2.01 (lined, reinforced concrete pipe).

2.12 CONCRETE FILLET

A. Cast-in-place Base: Provide a cast-in-place concrete fillet with concrete complying with the requirements of Section 6010, 2.03.

B. Precast Base Section:

1. For sanitary sewers, provide a precast concrete fillet, unless otherwise allowed by the Engineer. Comply with Section 6010, 3.01.

2. For storm sewers, provide a cast-in-place concrete fillet with concrete complying with the requirements of Section 6010, 2.03.

2.13 STEPS

A. Depths:

1. For manholes and intakes less than 20 feet deep, do not install steps unless otherwise specified in the contract documents.

2. For manholes and intakes deeper than 20 feet, install steps to meet OSHA regulations.

B. Requirements:

1. ASTM C 478.

2. Manufacture using polypropylene encased steel.

3. Uniformly space steps at 12 to 16 inches.

4. Align with vertical side of eccentric top section.

5. Place first step no more than 36 inches from top of casting.

2.14 PRECAST CONCRETE TEE

A. Tee and Eccentric Reducers: ASTM C 478.

B. Composite Tee: Comply with Figure 6010.305. May be substituted for pipe diameters less than 48 inches.

2.15 CASTING ANCHOR BOLTS AND WASHERS

A. Material: Stainless steel or hot-dipped galvanized.

B. Diameter: Provide bolts and washers 1/8 inch smaller than hole or slot in the casting frame, but no less than 1/2 inch diameter.

C. Bolt Length: As required to pass through adjustment rings and into manhole or intake structure to embedment depth recommended by anchor manufacturer.

2.16 DROP CONNECTION

A. Internal:

1. **Receiving Bowl:** Marine grade fiberglass meeting ASTM D 790, ASTM D 638, and ASTM D 2583 with non-magnetic stainless steel anchor bolts meeting the manufacturer's recommendation.

2. **Flexible Coupler:** Provide flexible couple matching the size of the receiving bowl and the drop pipe.

3. **Drop Pipe and Bottom Elbow:** Provide drop pipe an equivalent diameter of the influent pipe. Limit pipe size to maintain space available for maintenance activities. Provide solid wall SDR 35 PVC pipe and elbow complying with Section 4010, 2.01, A or Schedule 40 PVC pipe and elbow complying with ASTM D 1785.

4. **Pipe Brackets:** ASTM A 240, Type 304 or Type 316 stainless steel with stainless steel nuts and bolts.

B. External:

1. **Pipe and Fittings:** Comply with Section 4010, 2.01, G for ductile iron pipe and fittings.

2. **Concrete Encasement:** Comply with Section 7010, 2.02.

3. **Embedment Material:** Comply with Section 3010, 2.02, A or 2.06 for backfill material from the top of the elbow to the bottom of the sewer main.

2.17 EXCAVATION AND BACKFILL MATERIAL

Comply with Section 3010 for bedding and backfill materials.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS FOR INSTALLATION OF MANHOLES AND INTAKES

A. Excavation: Excavate according to Section 3010.

B. Subgrade Preparation:

1. **Cut Sections (Undisturbed Soil):** Prepare subgrade to accurate elevation required to place subbase.

2. **Fill Sections:** Compact to 95% of maximum Standard Proctor Density and hand grade to accurate elevation required to place subbase, or install stabilization material as directed by the Engineer.

3. **Unstable Soil:** Install stabilization material as directed by the Engineer.

C. Subbase: Install 8 inch thick pad of Class I bedding material a minimum of 12 inches outside footprint of the structure.

D. Installation of Manhole or Intake Structure: When necessary, adjust wall height and depth of base to provide a minimum of 48 inches between form grade elevation and top of base. Form walls and construction joints for cast-in-place intakes or install precast intake boxes to ensure intake lids are set to match the longitudinal slope of the adjacent street unless otherwise specified in the contract documents.

1. **Cast-in-place:** Comply with Section 6010, 3.02.

2. **Precast:** Comply with Section 6010, 3.03.

E. Pipes: Install and bed pipes and connect to manhole or intake. Install pipe flush with inside wall of structure. Place bedding and pipe embedment material according to Section 3010.

1. **Cast-in-place Structures:**
   - **a. Storm:** Form structure walls around pipe.
   - **b. Sanitary:** Form or core circular opening and install flexible, watertight gasket according to Section 6010, 2.08. Keep void between pipe and manhole section free of debris and concrete.

2. **Precast Storm Sewer Manholes or Intakes:** If annular space between pipe and structure is less than 2 inches, fill with non-shrink grout. If annular space is 2 inches or greater, construct a concrete collar around the pipe according to Section 6010, 3.05.

3. **Precast Sanitary Sewer Manholes:** Connect to structure with flexible, watertight gasket according to Section 6010, 2.08. Keep void between pipe and manhole section free of debris and concrete.

4. **Sanitary Sewer Manholes on Existing Pipe:** Install waterstop according to Section 6010, 2.08.

F. Joint Sealant:

1. **Sanitary Sewer Manholes:**
   a. Install rubber O-ring or profile gasket (precast structures).
   b. Apply bituminous jointing material or butyl sealant wrap to exterior of all sanitary sewer manhole joints.

3.01 GENERAL REQUIREMENTS FOR INSTALLATION OF MANHOLES AND INTAKES (Continued)

2. Storm Sewer Manhole and Intakes:
a. Apply bituminous jointing material or install rubber rope gasket.
b. If indicated in the contract documents, apply engineering fabric wrap to joints.

G. Fillet:

1. Construct manhole or intake fillet up to one-half of pipe diameter to produce a smooth half-pipe shape between pipe inverts.

2. Slope fillet top toward pipe 1/2 inch per foot perpendicular to flow line.

3. For sanitary sewer, keep void between pipe and structure wall free of debris and concrete.

4. For precast fillets, remove any projections and repair any voids to provide a hydraulically smooth channel between ends of pipes.

H. Top Sections: Install manhole eccentric cone or flat top section or install intake top.

I. Adjustment Ring(s):

1. Bed each concrete ring with bituminous jointing material in trowelable or rope form.

2. Bed each polyethylene or expanded polypropylene ring with manufacturer's approved product and according to manufacturer's recommended installation procedure.

3. Construct manholes and intakes with the following adjustment ring stack heights:
a. Minimum: 4 inches for new manholes and intakes. No minimum for rehabilitation projects.
b. Maximum: 12 inches for new manholes and intakes; 16 inches for existing manholes and intakes.

4. For greater adjustment, modify lower riser section(s).

J. Casting:

1. Install the type of casting specified in the contract documents and adjust to proper grade.

2. Where a manhole or intake is to be in a paved area, adjust the casting to match the slope of the finished surface.

3. Three-piece Castings:
a. Attach the frame to the structure with four anchor bolts.
b. Set initial position of movable portion of the casting in the center of the adjustment range.
c. Remove height-adjustment bolts or mechanism after the paving is completed.

3.01 GENERAL REQUIREMENTS FOR INSTALLATION OF MANHOLES AND INTAKES (Continued)

K. Infiltration Barrier: Install on sanitary sewer manholes.

1. Internal or External Chimney Seal:

a. Do not use external chimney seal if seal will be permanently exposed to sunlight.
b. Extend seal 3 inches below the lowest adjustment ring.
c. Extend seal to 2 inches above the flange of the casting for a standard two-piece casting, or 2 inches above the top of the base section of the casting for an adjustable three-piece casting.
d. Use multiple seals, if necessary.
e. Install compression bands (external chimney seal) or expansion bands (internal chimney seal) to lock the rubber sleeve or extension into place and to provide a positive watertight seal. Once tightened, lock the bands into place. Use only manufacturer recommended installation tools and sealants.

2. Molded Shield:

a. Clean surface of structure cone section.
b. Apply sealant to the top surface of the cone section. Use sufficient sealant to accommodate flaws in the surface of the cone section.
c. Cut molded shield to height by adding the dimensions of the adjustment rings and casting height. Be sure not to interfere with seating of the lid into the casting frame.
d. Seat the molded shield against the sealant on the cone section.
e. Add adjustment rings and casting to meet final grade.

3. Heat Shrink Sleeve:

a. Ensure all surfaces are clean, dry, and free of foreign objects and sharp edges.
b. Warm the surface to drive off any moisture.
c. Cut sleeve to required length per manufacturer's requirements.
d. Apply primer to manhole and casting surface.
e. Place sleeve according to manufacturer's requirements.
f. Apply heat to the sleeve, smooth out wrinkles, and remove trapped air.
g. Cut the sleeve at the casting gussets. Reheat to place the sleeve onto the casting.
h. Trim off any excess material.

L. Backfill and Compaction:

1. Place suitable backfill material after concrete in structure has reached at least 3,000 psi compressive strength or 550 psi flexural strength. If concrete strength is not determined, place backfill at least 14 calendar days after initial concrete placement.

2. Place backfill material simultaneously on all sides of walls and structures so the fill is kept at approximately the same elevation at all times.

3. Compact the 3 feet closest to all walls using pneumatic or hand tampers only. Ensure proper and uniform compaction of backfill around structure.

3.02 ADDITIONAL REQUIREMENTS FOR CAST-IN-PLACE CONCRETE STRUCTURES

A. Forms:

1. Comply with Iowa DOT Article 2403.03, B.

2. Form all cast-in-place manholes and intakes on both the inside and the outside face above the base. Do not form against excavated earthen surface.

3.02 ADDITIONAL REQUIREMENTS FOR CAST-IN-PLACE CONCRETE STRUCTURES (Continued)

B. Reinforcing Steel:

1. Comply with Iowa DOT Section 2404.

2. Lap bars a minimum of 36 diameters, unless otherwise specified in the contract documents.

3. Provide a minimum of 3 inches of clearance for structure bases and 2 inches of clearance for walls and tops.

C. Concrete Mixing:

1. Comply with Iowa DOT Article 2403.02, D.

2. When using ready-mixed concrete, comply with ASTM C 94.

D. Concrete Placing:

1. Comply with Iowa DOT Article 2403.03, C.

2. Do not place concrete when the air temperature is less than 40°F without the approval of the Engineer. When placement of concrete below 40°F is allowed, comply with Iowa DOT Article 2403.03, F.

3. Place concrete continuously in each section until complete. Do not allow more than 30 minutes to elapse between depositing adjacent layers of concrete within each section.

4. Comply with Iowa DOT Article 2403.03, D for concrete vibration.

5. Form 1 1/2 inch by 3 inch keyed construction joints at locations shown in the contract documents.

6. Provide a broom finish on portions of structure that are to become part of exposed pavement.

E. Stripping and Cleaning:

1. Remove forms for manhole and intake walls and tops according to Iowa DOT Article 2403.03, M. References to culverts include all sanitary and storm structures. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used in determining concrete strength of structure tops.

2. Finish surfaces according to Iowa DOT Article 2403.03, P. Give exposed surfaces a Class 2 finish.

F. Curing:

1. Comply with Iowa DOT Article 2403.03, E.

2. For surfaces visible to the public, use only curing compounds complying with ASTM C 309, Type 1-D or Type 2.

3.02 ADDITIONAL REQUIREMENTS FOR CAST-IN-PLACE CONCRETE STRUCTURES (Continued)

G. Exterior Loading:

1. Restrict exterior loads on concrete according to Iowa DOT Article 2403.03, N.

2. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used.

H. Repairs: After visual inspection of the completed manhole or intake, repair honeycomb areas, visible leaks, tie holes, or other damaged areas. Remove concrete webs or protrusions.

I. Concrete Testing: The Engineer will conduct testing.

3.03 ADDITIONAL REQUIREMENTS FOR PRECAST CONCRETE STRUCTURES

A. Substitutions: If approved by the Engineer, precast structures may be substituted for designated cast-in-place structures. Comply with the requirements of Section 6010, 3.02 or Iowa DOT Materials I.M. 445.

B. Cast-in-place Base:

1. Comply with Section 6010, 3.02 for placement of concrete.

2. Ensure proper vertical and horizontal alignment of base riser section.

C. Precast Base or Base with Integral Riser Section: Place base or base with integral riser section and ensure proper vertical and horizontal alignment.

D. Additional Riser Sections: Install additional riser sections as required.

E. Lift Holes: Install rubber plug in lift holes. Cover plug and hole with non-shrink grout.

3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE

A. Casting Extension Rings:

1. Install casting extension rings only when specified in the contract documents, and only in conjunction with pavement overlays.

2. Install according to the manufacturer's recommendation and adjust for proper alignment.

B. Minor Adjustment (Adding or Removing Adjustment Rings):

1. Remove casting.

2. Modify adjustment ring stack height by one of the following methods:
   a. Add adjustment rings as necessary to adjust existing manhole or intake to finished pavement grade or finished topsoil grade, to a maximum ring stack height of 16 inches. Bed each concrete ring with bituminous jointing material. Bed each polyethylene ring with manufacturer's approved product.
   b. Remove one or more adjustment rings, as appropriate, to reduce casting elevation.

3. Install new casting on modified adjustment ring stack. Existing casting may be reinstalled when specified in the contract documents.

3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE (Continued)

4. Replace infiltration barrier for sanitary sewer manhole using only new materials.

C. Major Adjustment (Adding, Removing, or Modifying Riser or Cone Section): When adjustment is greater than can be accomplished through adding or removing adjustment rings, a major adjustment will be required.

1. Remove casting.

2. Remove top.

3. Remove and replace or modify existing riser section and/or top section according to the method approved by the Engineer.

4. Install new frame and cover or grate. Existing casting may be reinstalled when specified in the contract documents.

5. Replace infiltration barrier for sanitary sewer manhole using only new materials.

3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE

A. General:

1. Remove existing fillet as necessary to install pipe at required elevation and develop hydraulic channel.

2. Insert pipe into structure and trim end flush with inside wall of structure.

3. Install replacement fillet as necessary.

4. Place backfill material according to Section 3010.

B. Concrete Collar:

1. For new pipes 12 inches or smaller, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to a minimum thickness and width of 6 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.

2. For new pipes larger than 12 inches, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to minimum thickness and width of 9 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.

C. Sanitary Sewer:

1. General:
a. Core new openings in existing manholes unless otherwise specified in the contract documents.
b. Divert flow as necessary. Obtain approval of the diversion plan from the Engineer. Maintain sanitary sewer service at all times unless otherwise specified in the contract documents.

2. Cored Opening:
a. Insert flexible watertight connector into new opening.
b. Install and tighten internal expansion sleeve to hold flexible connector in place.
c. Insert pipe through flexible connector and tighten external compression ring.
d. Do not install grout or concrete collar for cored opening with flexible connector.

3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE (Continued)

3. Cut and Chipped Opening (Knock-out): Use only when specified or allowed.
a. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
b. Remove concrete and expand opening to a diameter at least 6 inches larger than the outside diameter of the new pipe.
c. Cut off all reinforcing steel protruding from the structure wall.
d. Install waterstop around new pipe centered within structure wall.
e. Fill opening between structure and pipe with non-shrink grout.
f. Construct concrete collar around pipe and exterior manhole opening.
g. Provide pipe joint, non-shear coupling, or other approved flexible coupling within 2 feet of structure wall to allow for differential settlement between the new sewer and the structure.

D. Storm Sewer:

1. Cut and Chipped Opening:
a. Use for pipe sizes 12 inches in diameter or larger.
b. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
c. Remove concrete and expand opening to a diameter at no more than 4 inches larger than the outside diameter of the new pipe.
d. Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.
e. Cut off all reinforcing steel protruding from the structure wall.

2. Cored Opening:
a. Core new openings in existing manholes or intakes for all pipes less than 12 inches in diameter.
b. Opening to be no greater than 2 inches larger than the outside diameter of the pipe.
c. Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.

3. Fill Opening: Fill opening between manhole or intake wall and outside of pipe with non-shrink grout or construct a concrete collar around the pipe according to Section 6010, 3.05, B.

3.06 DROP CONNECTION TO SANITARY SEWER MANHOLE

A. Internal:

1. Core opening in existing manhole wall and install flexible watertight connector.

2. Cut incoming pipe so a maximum of 2 inches extends into the manhole.

3. Allow 1 inch clearance between bottom of incoming pipe and top of the receiving bowl. Connect receiving bowl to manhole with stainless steel anchor bolts as recommended by the manufacturer.

4. Install flexible coupler connecting the receiving bowl and the drop pipe.

5. Mount drop pipe on the side of the manhole with stainless steel brackets spaced a maximum of 4 feet apart. Provide a minimum of two brackets per pipe segment.

6. Remove existing concrete fillet as required to accommodate bottom elbow.

3.06 DROP CONNECTION TO SANITARY SEWER MANHOLE (Continued)

7. Install elbow at bottom of drop pipe to match concrete fillet and create a smooth flow transition. Align elbow so discharge is directed at outlet pipe or at 45 degrees to manhole flow.

8. Repair fillet according to Section 6010, 3.01, G.

9. Comply with Figure 6010.308.

B. External:

1. Core opening in existing manhole wall and install flexible watertight connector, if required.

2. Install ductile iron pipe and fittings according to Section 5010, 3.01 and 3.02.

3. Place concrete from the base of the manhole to the top of the elbow.

4. Comply with Section 3010, 3.05 for bedding and backfill of the external drop piping.

5. Comply with Figure 6010.307.

3.07 REMOVAL OF MANHOLE OR INTAKE

A. Unless otherwise specified, remove the entire structure to a minimum of 10 feet below top of subgrade in paved areas or 10 feet below finished grade in other areas.

B. Pipes:

1. Contact the Engineer to verify the sewer line is not in use.

2. Construct sewer plug by completely filling the end of the pipe with concrete. Force concrete into the end of the pipe for a distance of 16 inches, or one-half the pipe diameter, whichever is greater.

3. If specified in the contract documents, fill the line to be abandoned with flowable mortar or CLSM (comply with Section 3010) by gravity flow or pumping.

C. Fill remaining structure using flowable mortar.

D. Place compacted backfill over remaining structure as required for embankment or compacted backfill.

3.08 CLEANING, INSPECTION, AND TESTING

Clean, inspect, and test structures according to Section 6030.

END OF SECTION

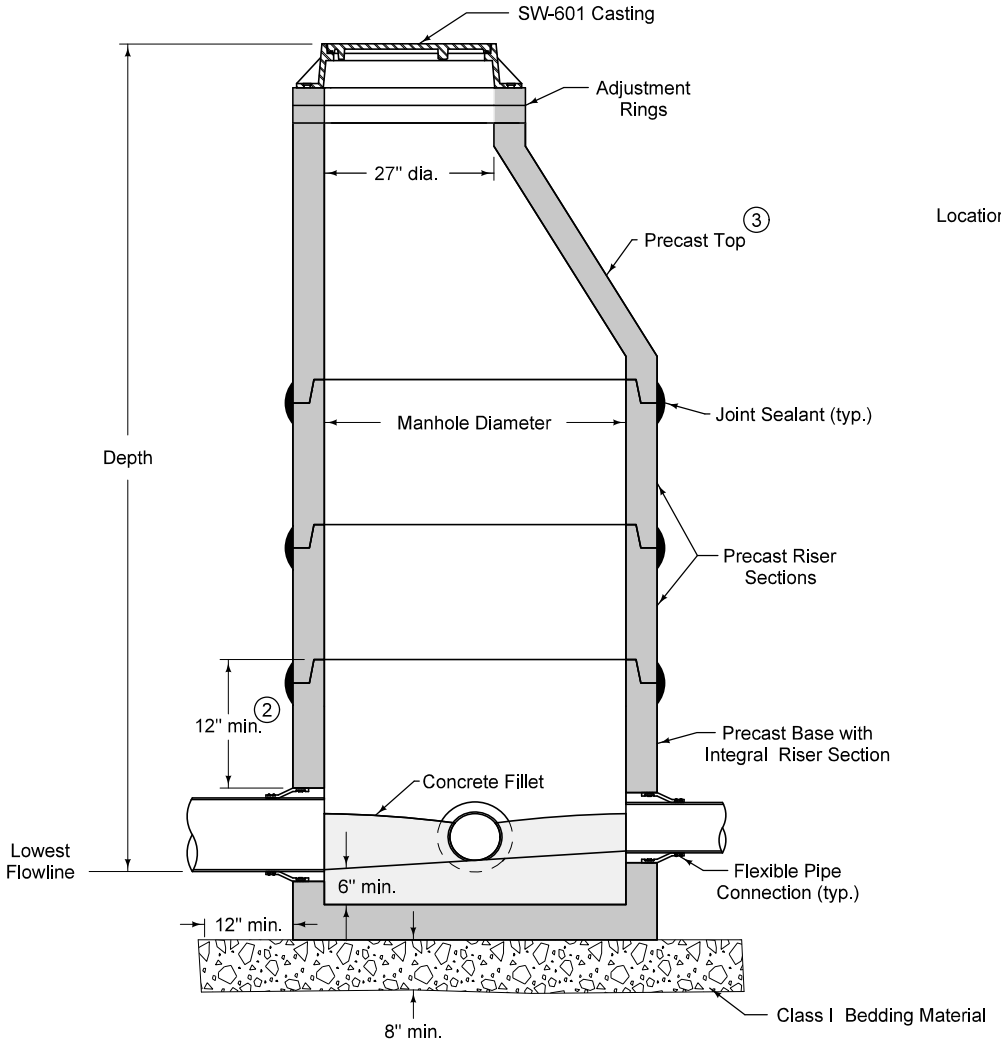
If manhole depth exceeds 20 feet, install steps.

Install infiltration barrier.

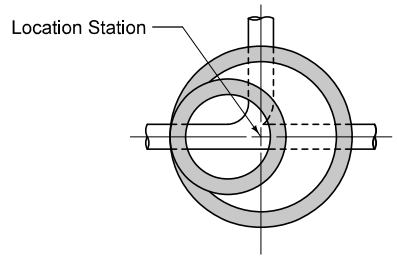
(1) For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings.

(2) 12 inch minimum riser height above all pipe openings.

(3) When specified, provide an eccentric flat top In Lieu of eccentric cone section.



TYPICAL SECTION



PLAN

Manhole Diameter (inches)	Maximum Pipe Diameter (inches) for 2 Pipes (1)	
	At 180° Separation	At 90° Separation
48	24	18
60	36	24
72	42	30
84	48	36
96	60	42

FIGURE 6010.301 SHEET 1 OF 1

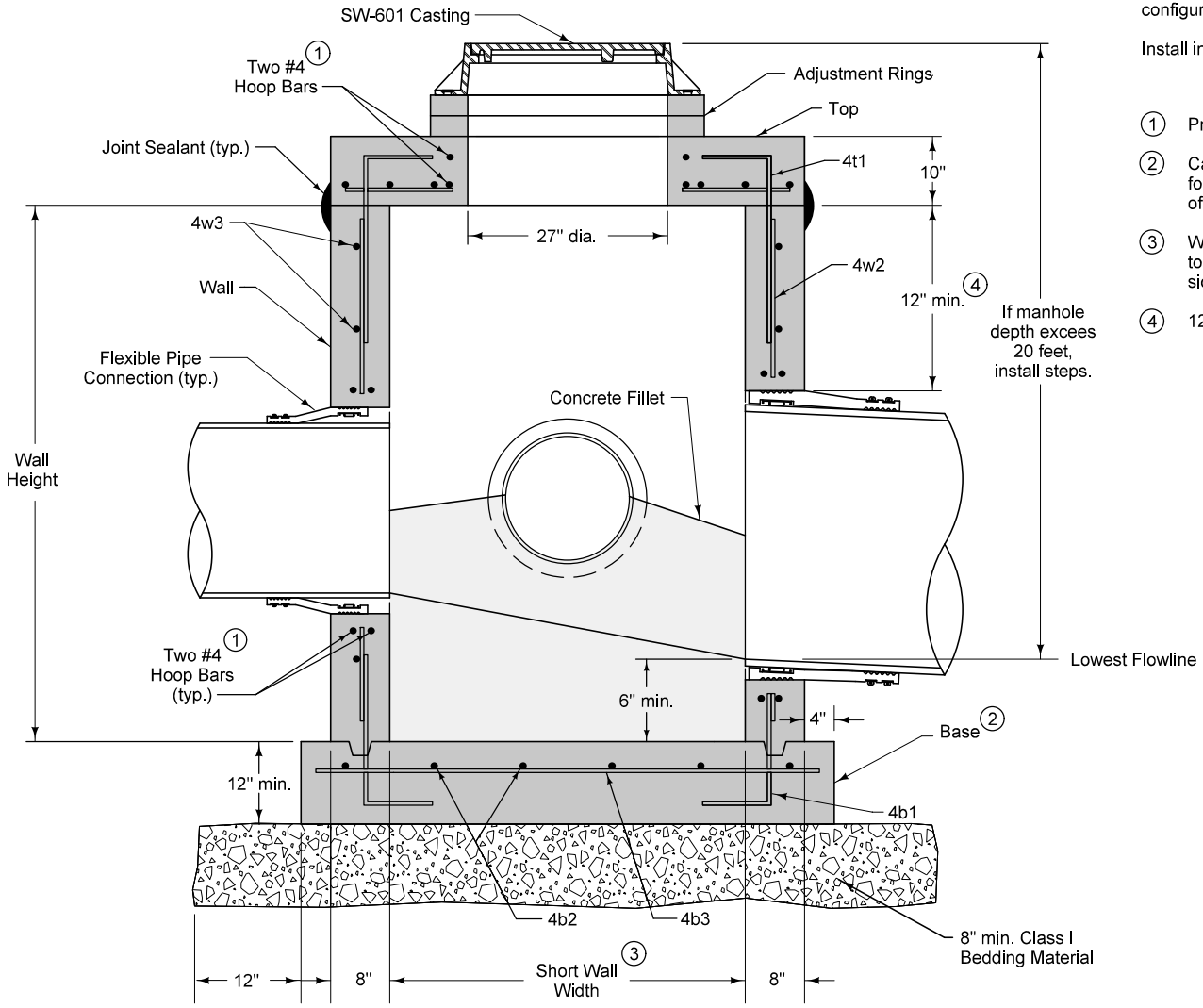
SUDAS | IOWADOT | REVISION 5 10-18-22

FIGURE 6010.301 | STANDARD ROAD PLAN | SW-301 | SHEET 1 of 1

REVISIONS: Added circle note 3.

Paul D. Wigand, SUDAS DIRECTOR | Steven Nichols, DESIGN METHODS ENGINEER

CIRCULAR SANITARY SEWER MANHOLE



TYPICAL SECTION

Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.

Install infiltration barrier.

(1) Provide two #4 hoop bars at top opening and at all pipe openings.

(2) Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

(3) Wall widths vary with pipe diameter and range from 4 feet minimum to 9 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.

(4) 12 inch minimum wall height above all pipe openings.

FIGURE 6010.302 | SHEET 1 OF 2

SUDAS	IOWADOT	REVISION 3	04-20-21
FIGURE 6010.302	STANDARD ROAD PLAN	SW-302	SHEET 1 of 2

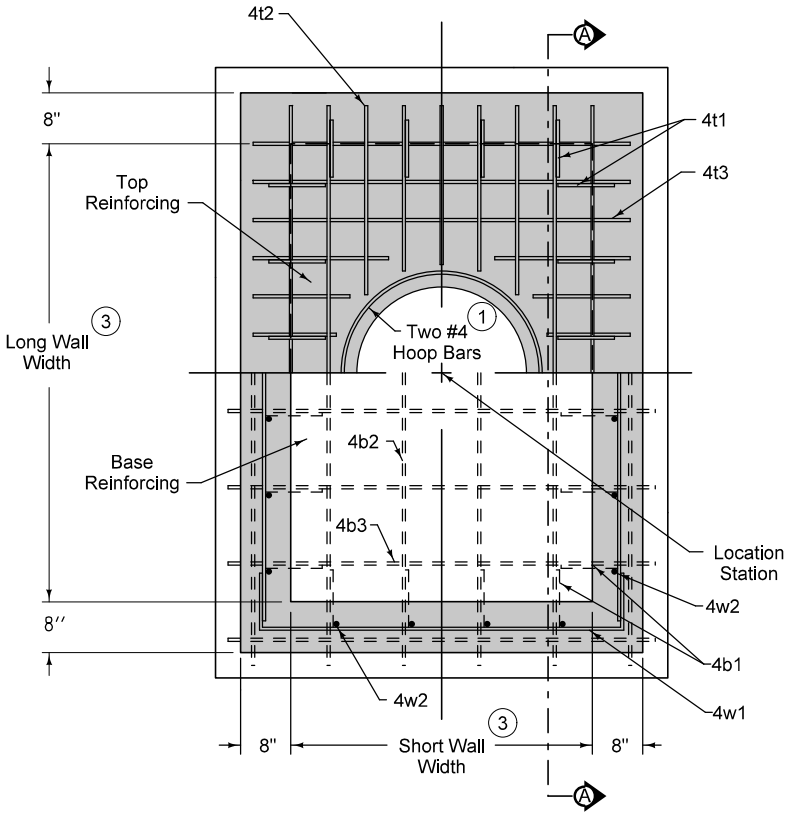
REVISIONS: Added infiltration barrier note.

Paul D. Wigand
SUDAS DIRECTOR

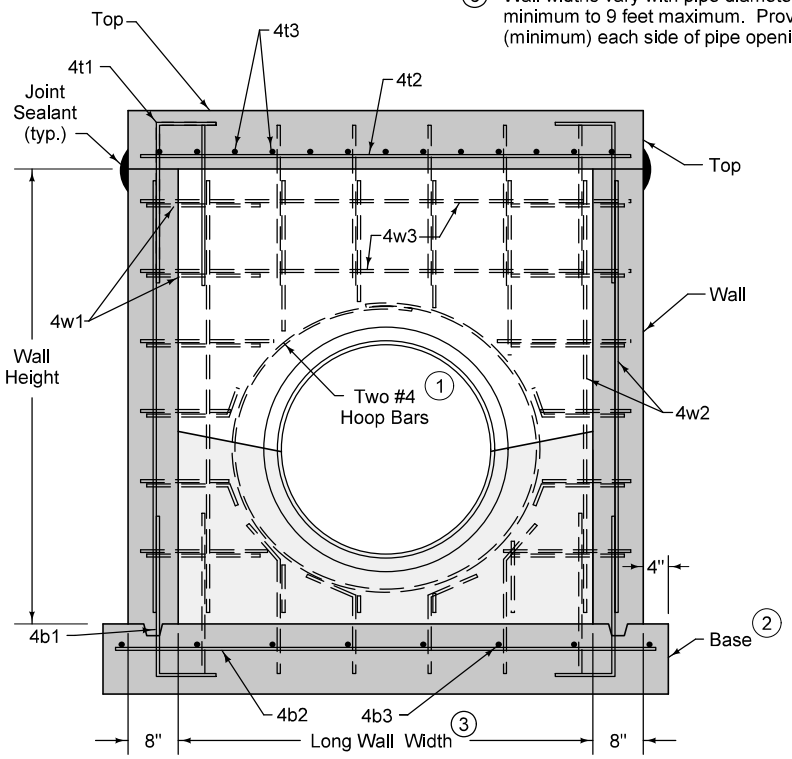
Stuart Nicholson
DESIGN METHODS ENGINEER

RECTANGULAR SANITARY SEWER MANHOLE

1. Provide two #4 hoop bars at top opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. Wall widths vary with pipe diameter and range from 4 feet minimum to 9 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.

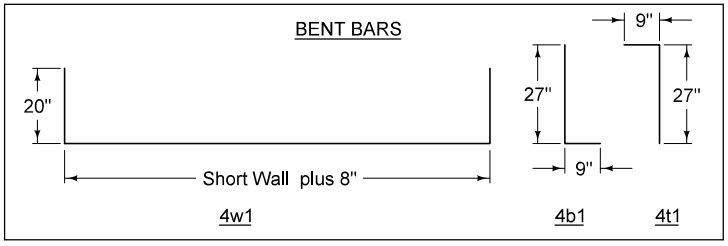


PLAN



SECTION A-A

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
4b1	4	Base	⌟	36"	12"
4b2	4	Base	—	Long Wall plus 18"	12"
4b3	4	Base	—	Short Wall plus 18"	12"
4t1	4	Top	⌝	36"	12"
4t2	4	Top	—	Long Wall plus 12"	6"
4t3	4	Top	—	Short Wall plus 12"	6"
4w1	4	Wall	⌐¬	Short Wall plus 48"	12"
4w2	4	Wall	—	Wall Height minus 4"	12"
4w3	4	Wall	—	Long Wall plus 12"	12"



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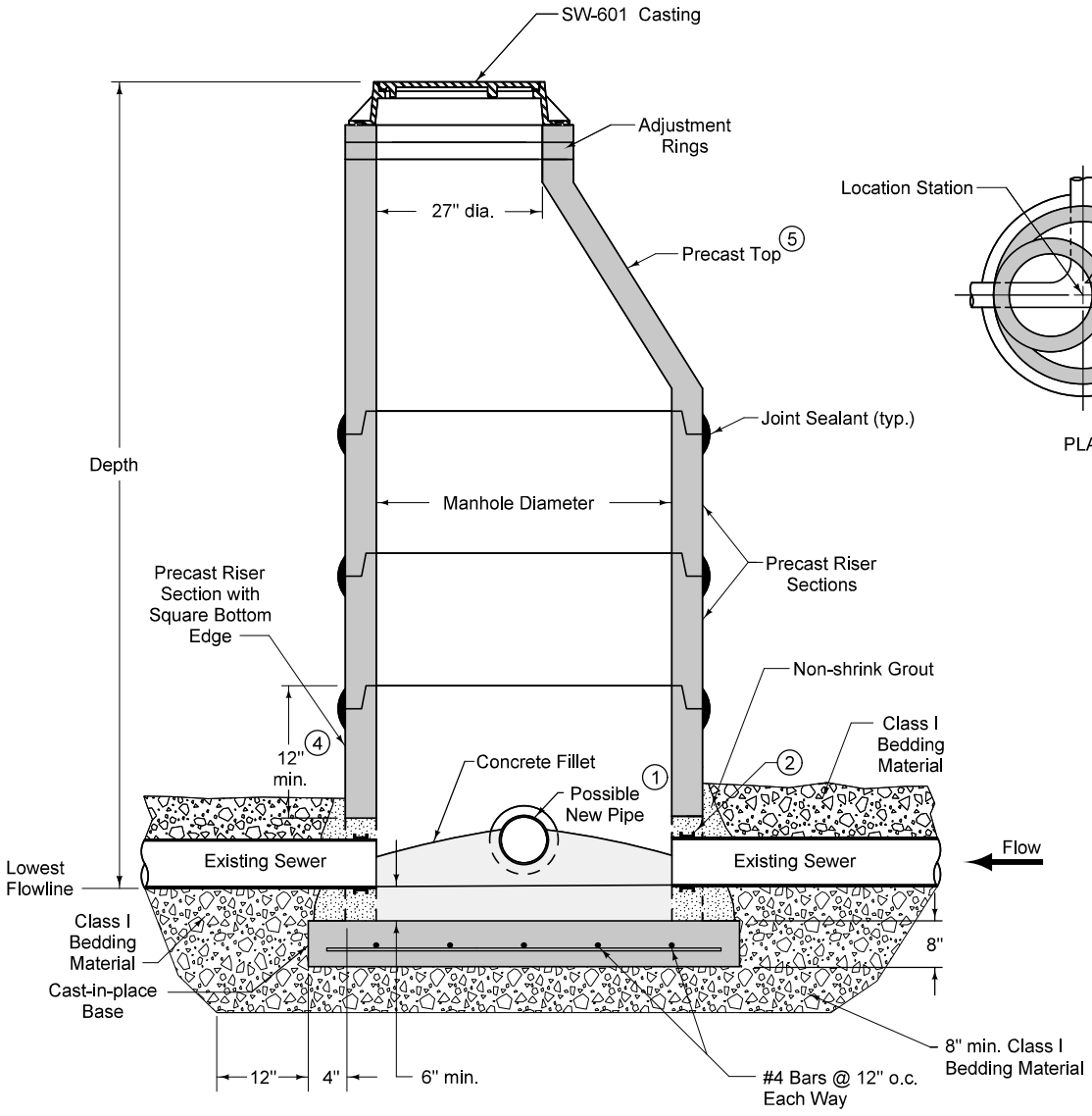
FIGURE 6010.302 | STANDARD ROAD PLAN | SW-302 | SHEET 2 of 2

REVISIONS: Added Infiltration barrier note.

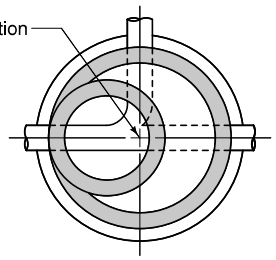
Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

RECTANGULAR SANITARY SEWER MANHOLE

FIGURE 6010.302 SHEET 2 OF 2



TYPICAL SECTION



PLAN

If manhole depth exceeds 20 feet, install steps.

Install infiltration barrier.

(1) For new pipe connections, provide cored opening with flexible pipe connector.

(2) For existing pipe connections, provide an arched opening with a diameter up to 6 inches larger than outside diameter of pipe. Install waterstop around existing pipe. Fill void between pipe and opening with non-shrink grout.

(3) For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings.

(4) 12 inch minimum riser height above all pipe openings.

(5) When specified, provide an eccentric flat to In Lieu of eccentric cone section.

Manhole Diameter (inches)	Maximum Pipe Diameter (inches) for 2 Pipes (3)	
	At 180° Separation	At 90° Separation
48	24	18
60	36	24
72	42	30
84	48	36
96	60	42

FIGURE 6010.303 SHEET 1 OF 1

SUDAS | IOWA DOT

REVISION 5 10-18-22

FIGURE 6010.303 | STANDARD ROAD PLAN | SW-303

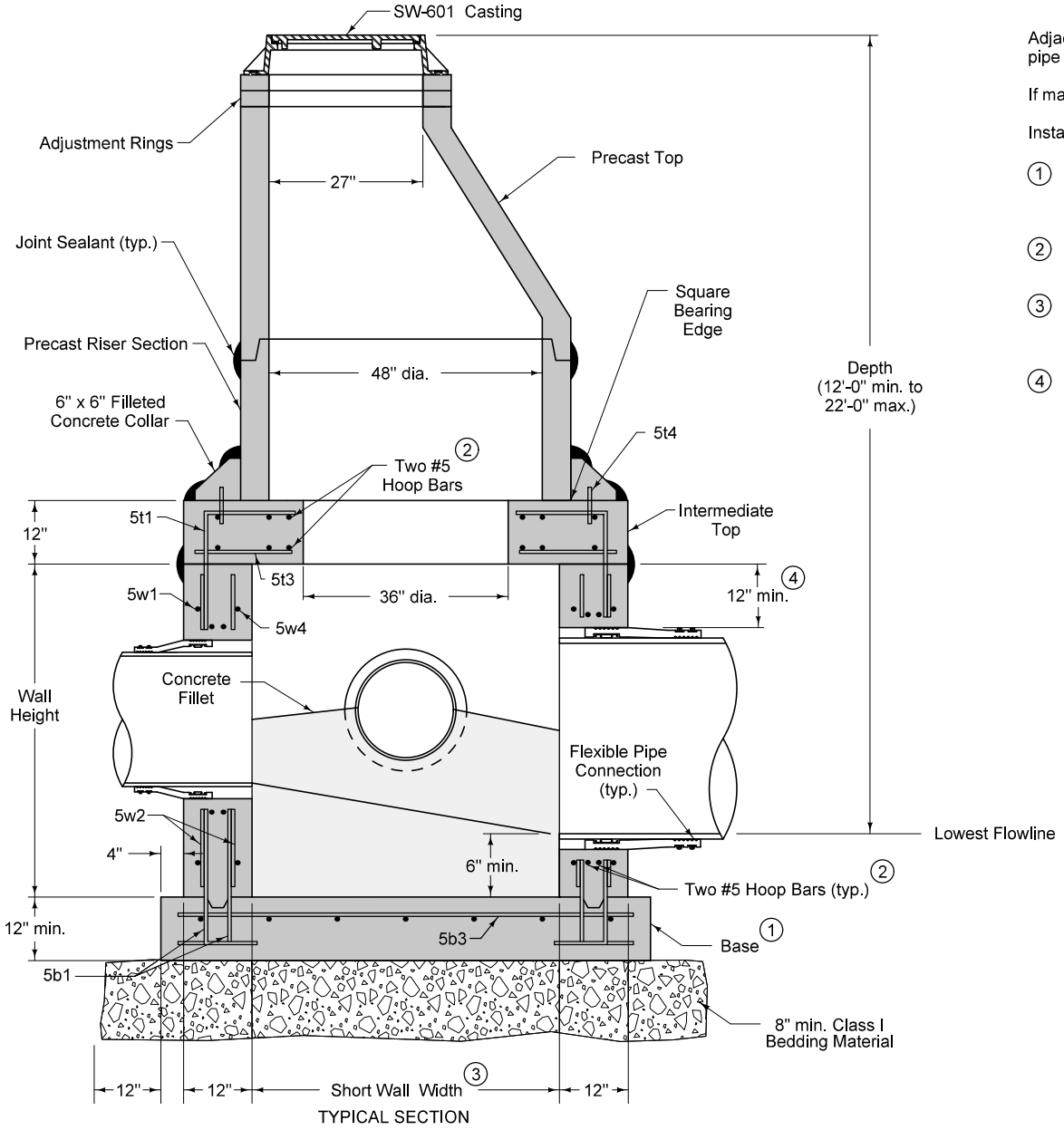
SHEET 1 of 1

REVISIONS: Added circle note 5.

Paul D. Wigand
SUDAS DIRECTOR

Steven Nichols
DESIGN METHODS ENGINEER

SANITARY SEWER MANHOLE OVER EXISTING SEWER



TYPICAL SECTION

Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.

If manhole depth exceeds 20 feet, install steps.

Install infiltration barrier.

(1) Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

(2) Provide two #5 hoop bars at intermediate top opening and at all pipe openings.

(3) Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.

(4) 12 inch minimum wall height above all pipe openings.

FIGURE 6010.304 SHEET 1 OF 2

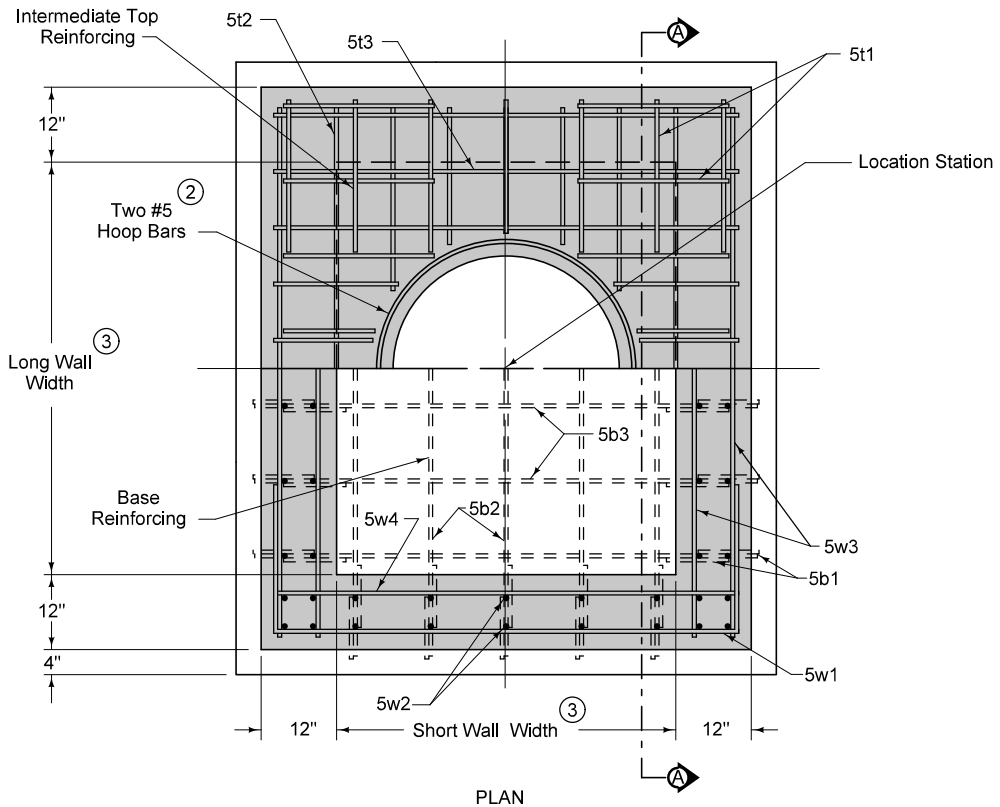
SUDAS | IOWADOT | REVISION 4 04-20-21

FIGURE 6010.304 | STANDARD ROAD PLAN | SW-304 | SHEET 1 of 2

REVISIONS: Added manhole depth note and infiltration barrier note.

Paul D. Wigand, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

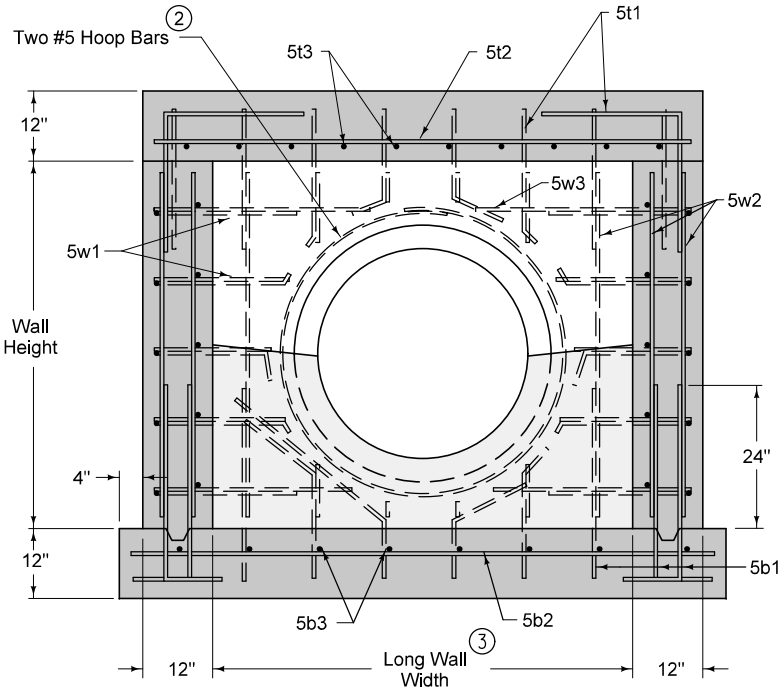
RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE



PLAN

2 Provide two #5 hoop bars at intermediate top opening and at all pipe openings.

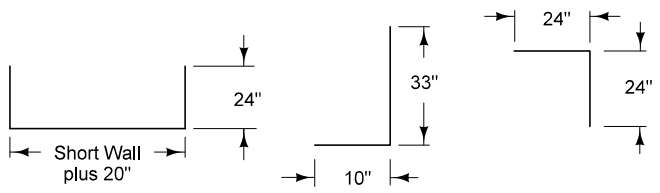
3 Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall opening (minimum) each side of pipe opening.



SECTION A-A

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
5t1	5	Top	L	48"	12"
5t2	5	Top	—	Long Wall plus 20"	9"
5t3	5	Top	—	Short Wall plus 20"	9"
5t4	5	Top	—	8"	12"
5b1	5	Base	L	43"	12"
5b2	5	Base	—	Long Wall plus 26"	12"
5b3	5	Base	—	Short Wall plus 26"	12"
5w1	5	Top	⌐	Short Wall plus 68"	12"
5w2	5	Top	—	Wall Height minus 4"	12"
5w3	5	Top	—	Long Wall plus 20"	12"
5w4	5	Top	—	Short Wall plus 20"	12"

BENT BARS



SUDAS | IOWADOT | REVISION 4 04-20-21

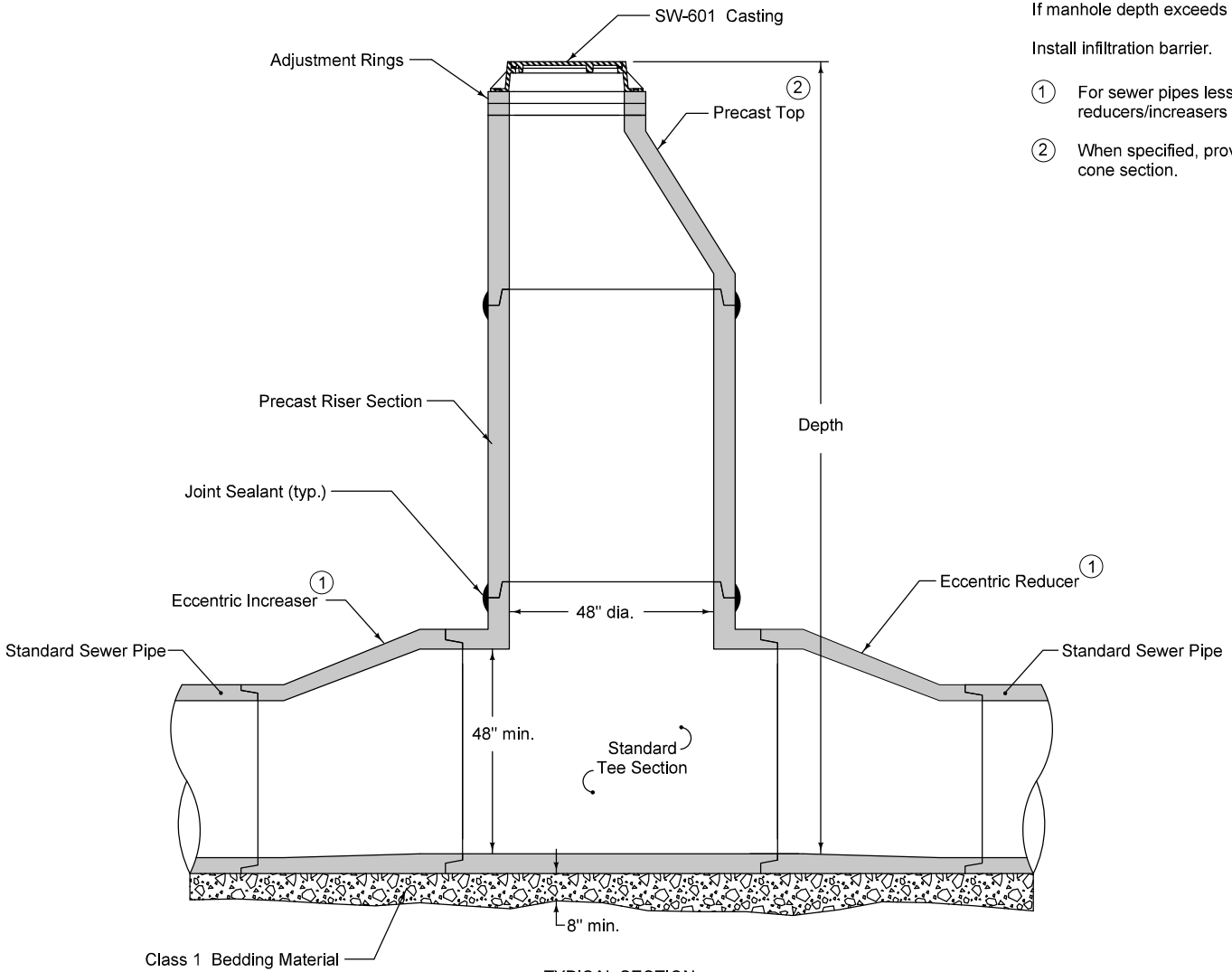
FIGURE 6010.304 | STANDARD ROAD PLAN | SW-304 | SHEET 2 of 2

REVISIONS: Added manhole depth note and Infiltration barrier note.

Paul D. Wigand, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE

FIGURE 6010.304 SHEET 2 OF 2



TYPICAL SECTION

1

STANDARD TEE

If manhole depth exceeds 20 feet, install steps.

Install infiltration barrier.

1. For sewer pipes less than 48 inches in diameter, install eccentric reducers/increasers with a standard tee or utilize a composite tee.

2. When specified, provide an eccentric flat top In Lieu of eccentric cone section.

SUDAS	IOWA DOT	REVISION 4 10-18-22
FIGURE 6010.305	STANDARD ROAD PLAN	SW-305
		SHEET 1 of 2

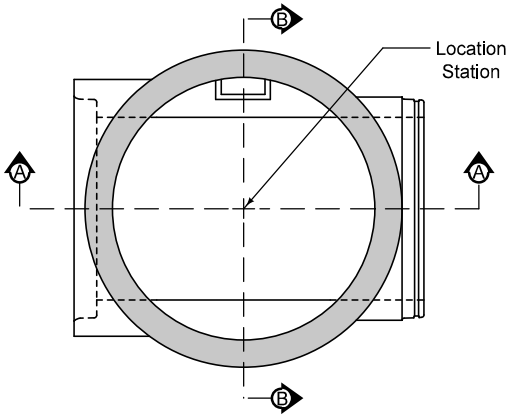
REVISIONS: Added circle note 2.

Paul D. Wigard, SUDAS DIRECTOR

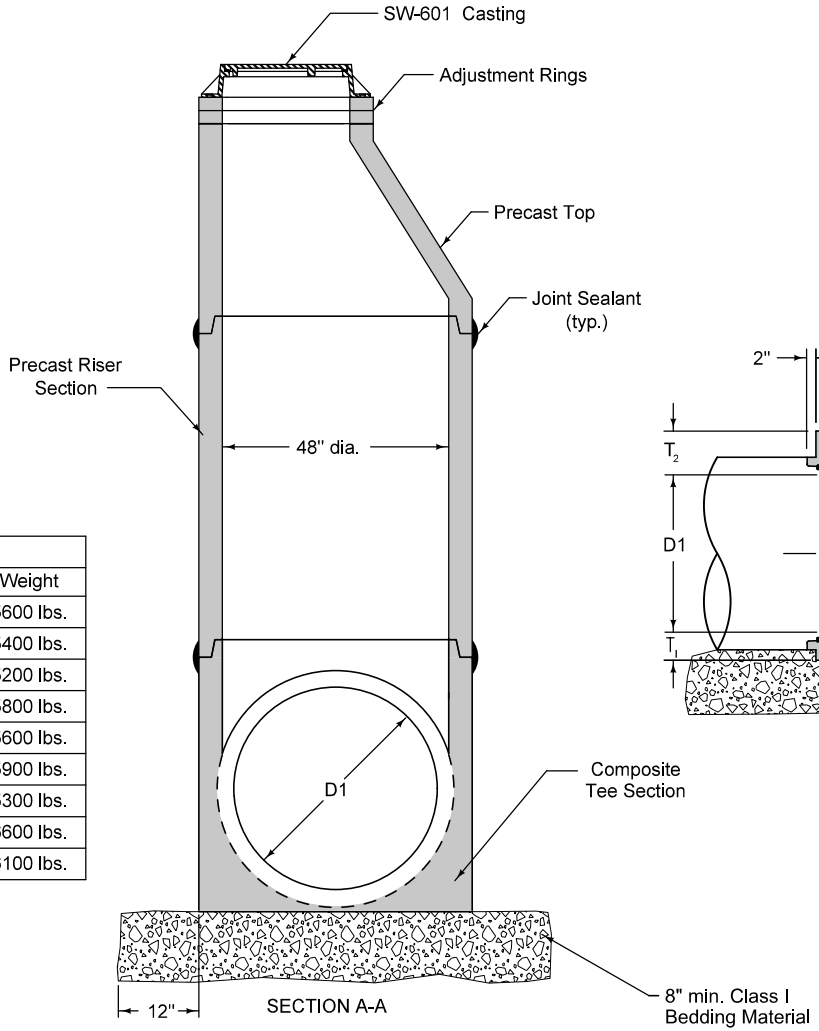
DESIGN METHODS ENGINEER

TEE-SECTION
SANITARY SEWER MANHOLE

FIGURE 6010.305 SHEET 1 OF 2

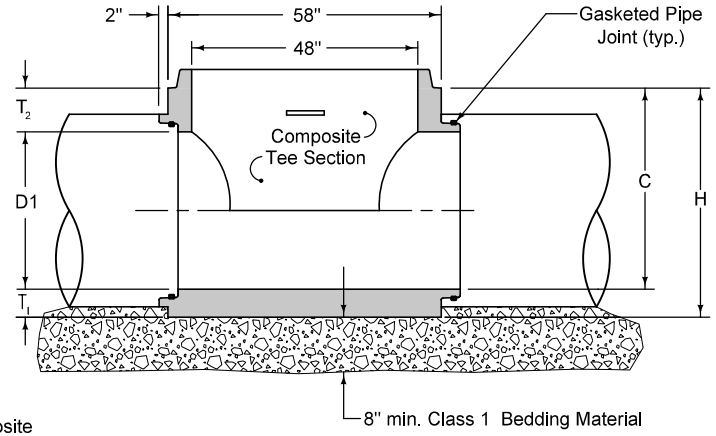


PLAN



SECTION A-A

Install infiltration barrier.



SECTION B-B

COMPOSITE TEE DIMENSIONS						
Size	D1	H	T_1	T_2	C	Weight
48" on 12"	12"	50"	$8\frac{1}{2}$"	$29\frac{1}{2}$"	$41\frac{1}{2}$"	5600 lbs.
48" on 15"	15"	50"	7"	28"	43"	5400 lbs.
48" on 18"	18"	50"	$5\frac{1}{2}$"	$26\frac{1}{2}$"	$44\frac{1}{2}$"	5200 lbs.
48" on 21"	21"	48"	$9\frac{1}{2}$"	$17\frac{1}{2}$"	$38\frac{1}{2}$"	5800 lbs.
48" on 24"	24"	48"	8"	16"	40"	5600 lbs.
48" on 27"	27"	48"	$9\frac{1}{2}$"	$11\frac{1}{2}$"	$38\frac{1}{2}$"	5900 lbs.
48" on 30"	30"	48"	8"	10"	40"	5300 lbs.
48" on 33"	33"	54"	$9\frac{1}{2}$"	$11\frac{1}{2}$"	$44\frac{1}{2}$"	6600 lbs.
48" on 36"	36"	54"	8"	10"	46"	6100 lbs.

COMPOSITE TEE

Alternate to standard tee with eccentric reducer (for pipes 36" and smaller).

SUDAS | IOWADOT

REVISION: 4 | 10-18-22

FIGURE 6010.305 | STANDARD ROAD PLAN | SW-305

SHEET 2 of 2

REVISIONS: Added circle note 2.

Paul D. Wigand, SUDAS DIRECTOR

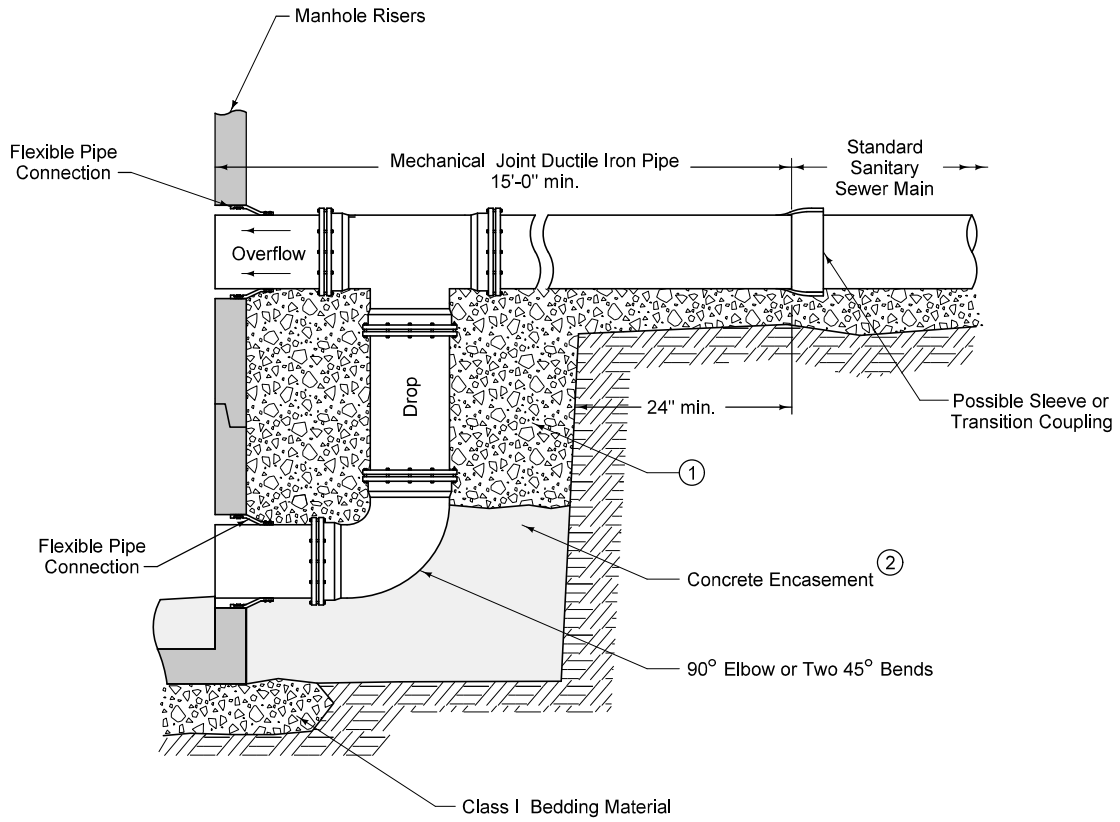
Stuart Nicholson, DESIGN METHODS ENGINEER

TEE-SECTION
SANITARY SEWER MANHOLE

FIGURE 6010.305 SHEET 2 OF 2

Figure 6010.306

RESERVED FOR FUTURE USE



Construct drop and overflow from ductile iron pipe of same diameter specified for sewer main. Provide mechanical joints for all ductile iron pipe and fittings.

1. Place Class I bedding material, CLSM, flowable mortar, or concrete from top of elbow to bottom of sewer main.
2. Encase elbow in concrete. 12 inches minimum on all sides.

SUDAS | IOWADOT

REVISION 2 04-21-20

FIGURE 6010.307 | STANDARD ROAD PLAN | SW-307

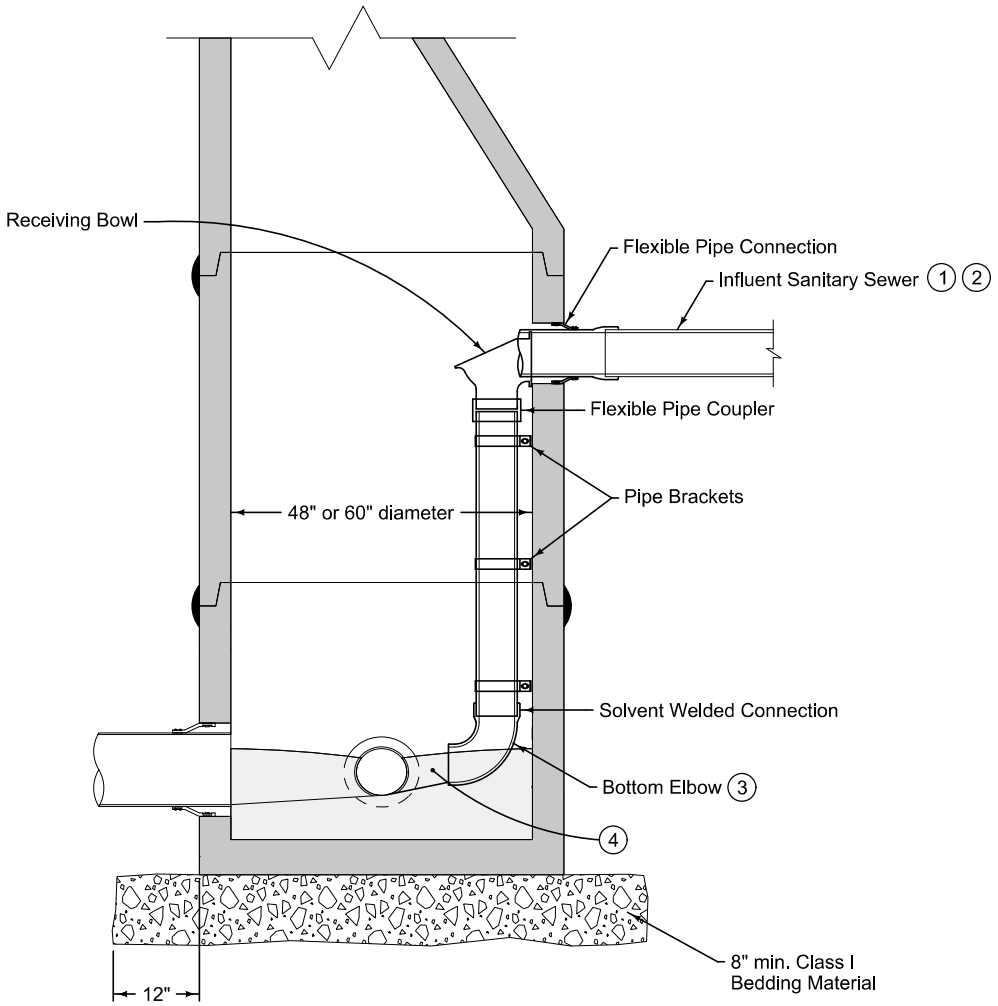
SHEET 1 of 1

REVISIONS: Changed 1 to I on Bedding Material in Note 1. Added EXTERNAL to title.

Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

EXTERNAL DROP CONNECTION FOR SANITARY SEWER MANHOLE

FIGURE 6010.307 SHEET 1 OF 1



1. Core drill openings at least 12 inches from existing manhole joints.
2. Install flexible pipe coupler or pipe joint on new sanitary sewer 18 to 24 inches from outside of manhole wall.
3. Align elbow so discharge is directed at outlet pipe or at 45 degrees to manhole flow.
4. Reshape fillet to provide a smooth transition and to direct flow to outlet.

FIGURE 6010.308 | SHEET 1 OF 1

SUDAS | IOWADOT

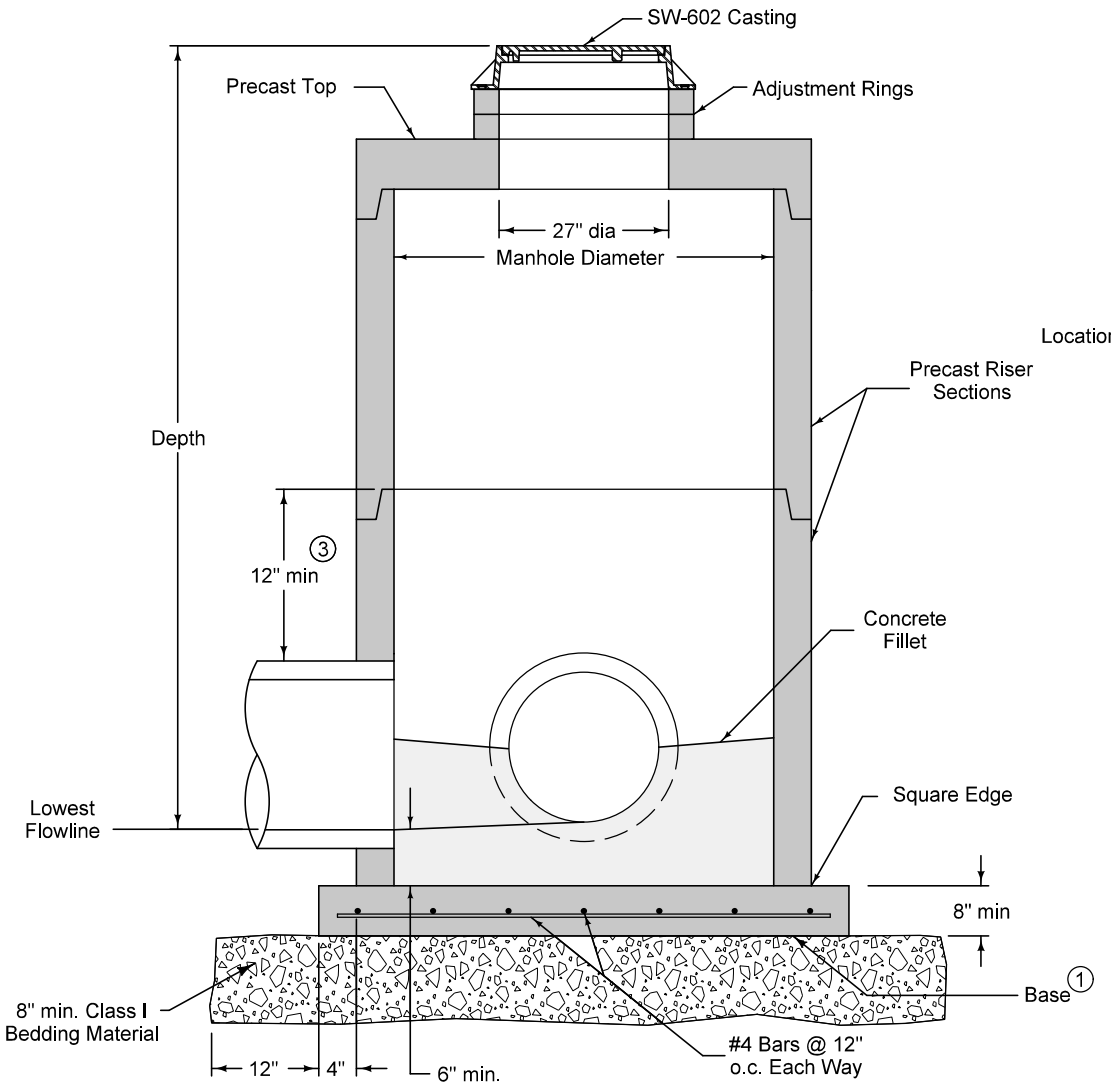
REVISION	
1	04-20-21

FIGURE 6010.308 | STANDARD ROAD PLAN | SW-308 | SHEET 1 of 1

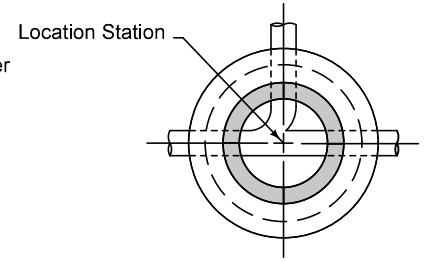
REVISIONS: Deleted top of manhole.

Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

INTERNAL DROP CONNECTION FOR SANITARY SEWER MANHOLE



TYPICAL SECTION



PLAN

If manhole depth exceeds 20 feet, install steps.

①Cast-in-place base shown. If base is precast integral with bottom riser, the footprint of the base is not required to extend beyond the outer edge of the riser.

②For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings.

③12 inch minimum riser height above all pipe openings.

Manhole Diameter (inches)	Maximum Pipe Diameter② (inches) for 2 Pipes	
	At 180° Separation	At 90° Separation
48	24	18
60	36	24
72	42	30
84	48	36
96	60	42

FIGURE 6010.401 SHEET 1OF 1

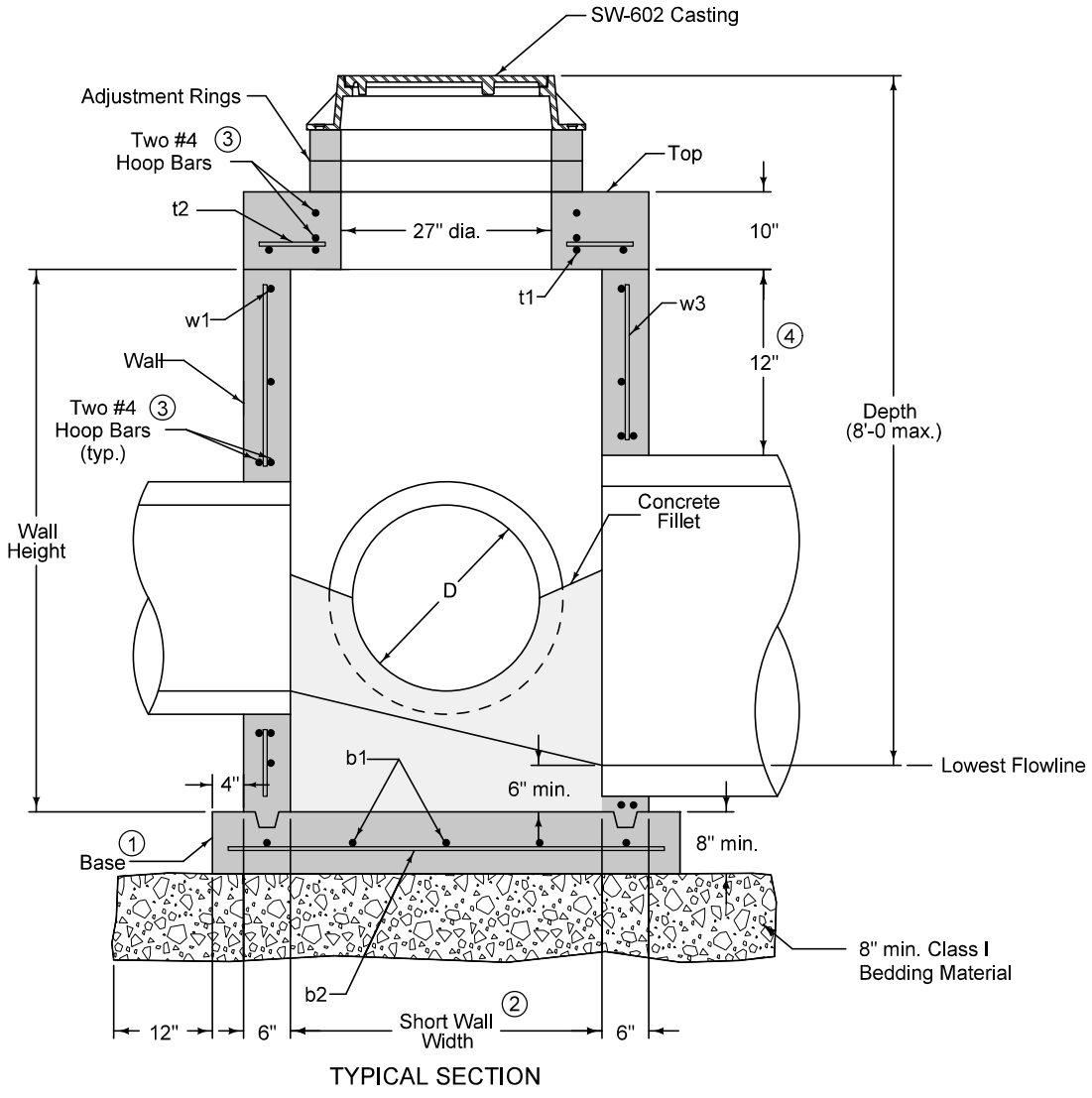
SUDAS | IOWADOT | REVISION 3 04-20-21

FIGURE 6010.401 | STANDARD ROAD PLAN | SW-401 | SHEET 1 of 1

REVISIONS: Added manhole depth note.

Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

CIRCULAR STORM SEWER MANHOLE



TYPICAL SECTION

Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.

① Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

② Wall widths vary with pipe diameter and range from 40 inches minimum to 77 inches maximum. Provide 6 inches of wall width (minimum) each side of pipe opening.

③ Provide two #4 hoop bars at top opening and at all pipe openings.

④ 12 inch minimum wall height above all pipes.

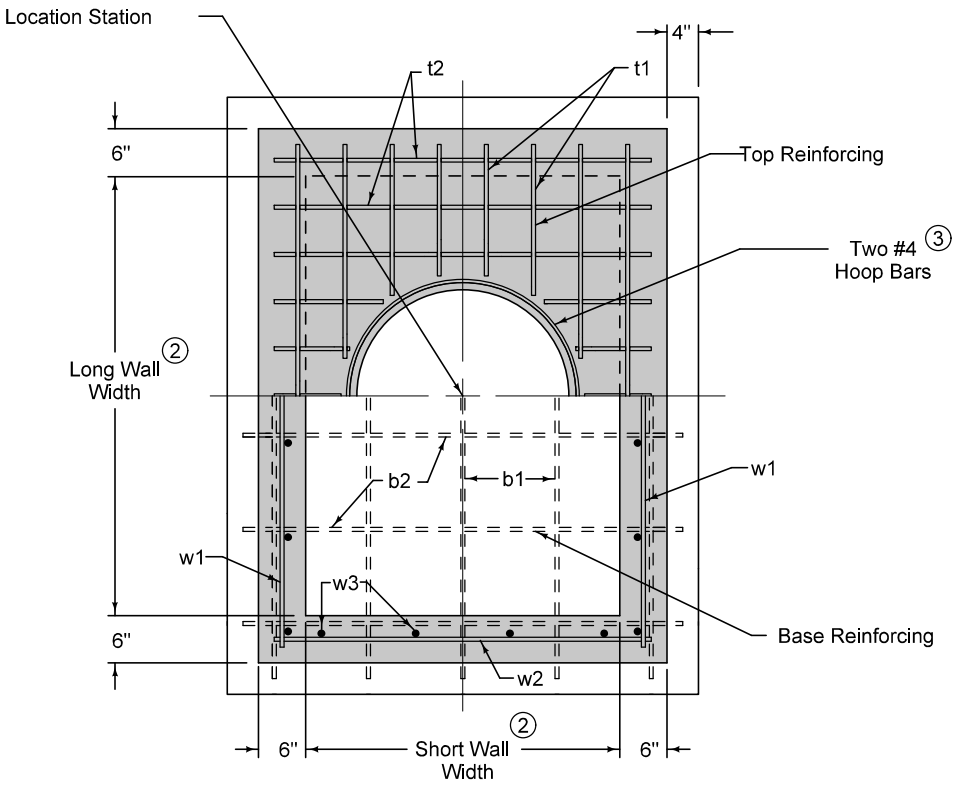
SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 6010.402	STANDARD ROAD PLAN	SW-402
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand — SUDAS DIRECTOR
Stuart Nicholson — DESIGN METHODS ENGINEER

RECTANGULAR STORM SEWER MANHOLE

FIGURE 6010.402 SHEET 1 OF 2



PLAN

② Wall widths vary with pipe diameter and range from 40" minimum to 77" maximum. Provide 6" of wall width (minimum) each side of pipe opening.

③ Provide two #4 hoop bars at top opening and at all pipe openings.

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
t1	See Table	Top	——	Long Wall plus 8"	6"
t2	See Table	Top	——	Short Wall plus 8"	6"
b1	See Table	Base	——	Long Wall plus 14"	12"
b2	See Table	Base	——	Short Wall plus 14"	12"
w1	See Table	Walls	——	Long Wall plus 8"	12"
w2	See Table	Walls	——	Short Wall plus 8"	12"
w3	See Table	Walls	——	Wall Height minus 4"	12"

Diameter of Largest Pipe, D	Minimum Bar Size
48" or 54"	6
33" to 42"	5
30" or smaller	4

FIGURE 6010.402 SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 2 04-21-20

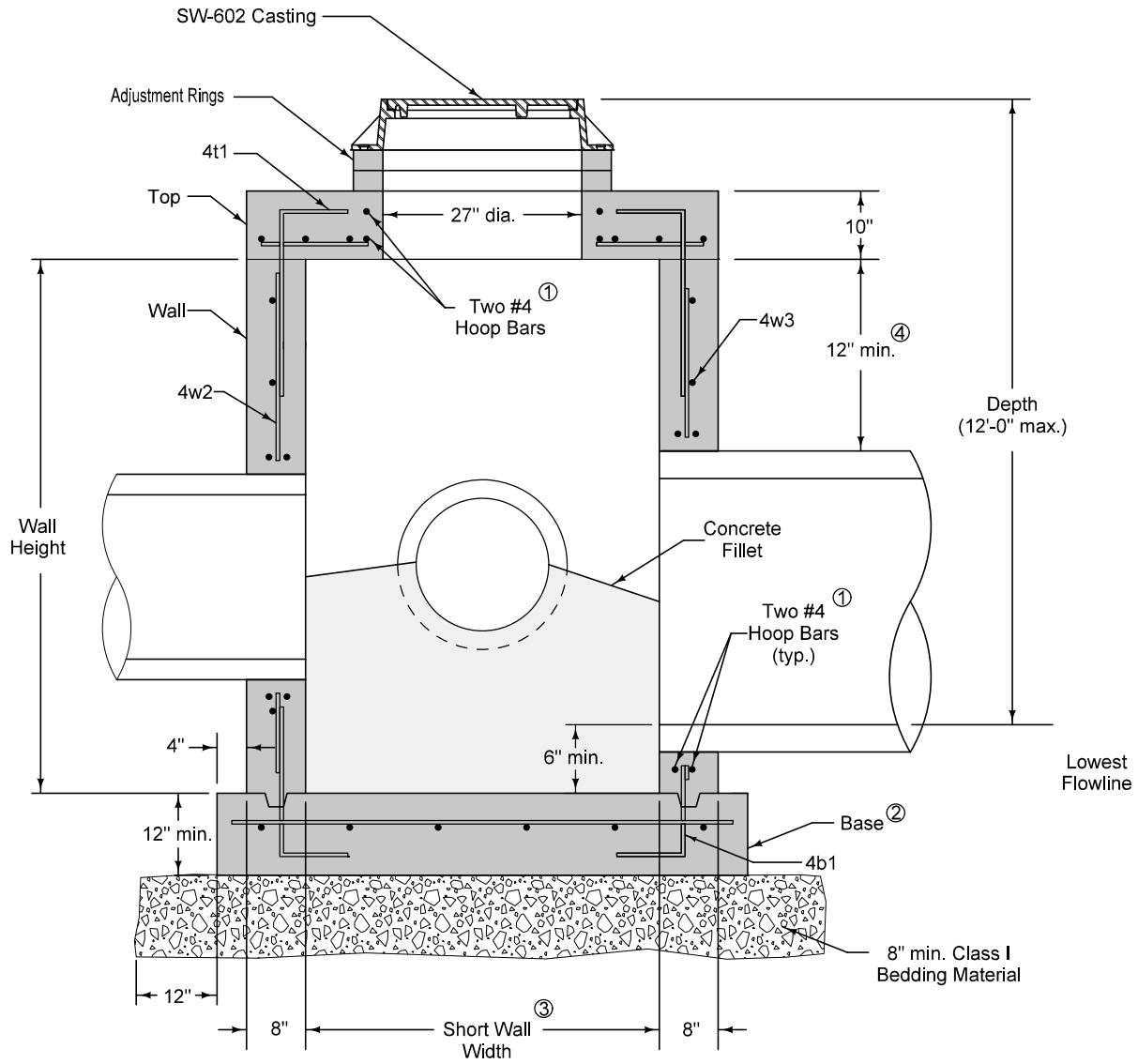
FIGURE 6010.402 | STANDARD ROAD PLAN | SW-402 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

RECTANGULAR STORM SEWER MANHOLE



TYPICAL SECTION

Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.

① Provide two #4 hoop bars at top opening and at all pipe openings.

② Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

③ Wall widths vary with pipe diameter and range from 4 feet minimum to 9 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.

④ 12 inch minimum wall height above all pipes.

SUDAS	IOWA DOT	REVISION 2	04-21-20
FIGURE 6010.403	STANDARD ROAD PLAN	SW-403	SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

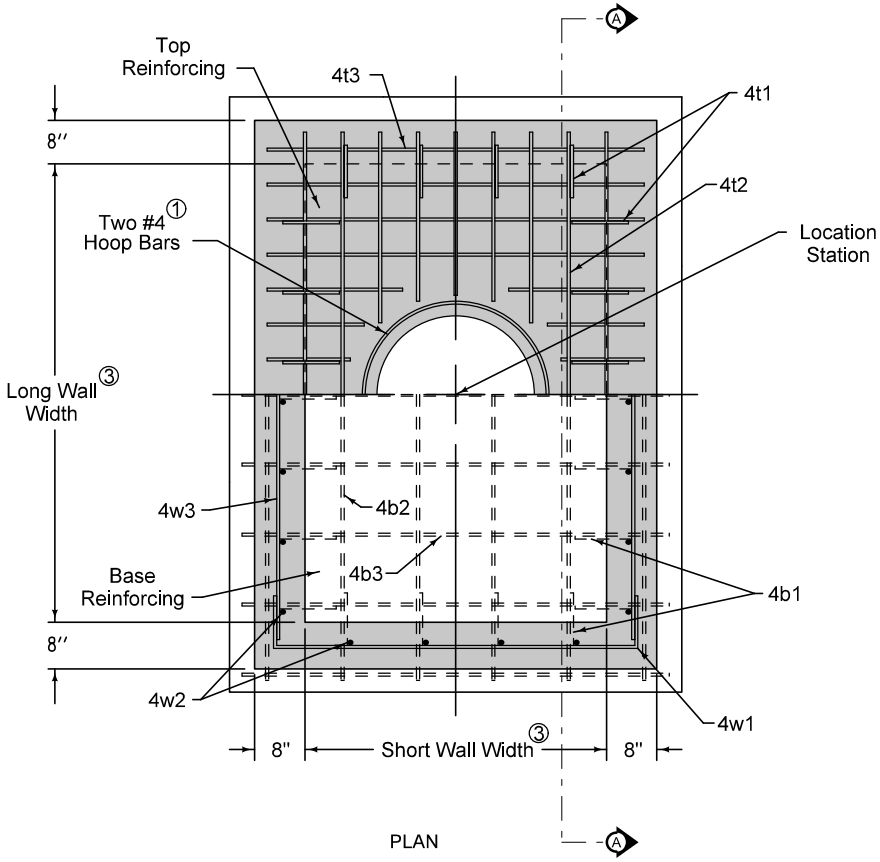
Paul D. Wigand — SUDAS DIRECTOR
Stuart Nielsen — DESIGN METHODS ENGINEER

DEEP WELL RECTANGULAR STORM SEWER MANHOLE

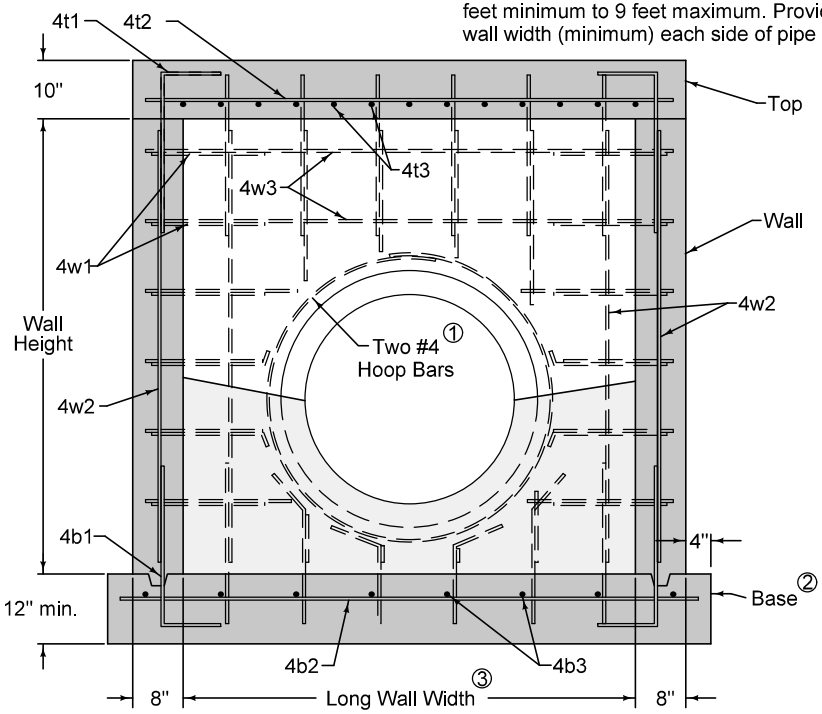
① Provide two #4 hoop bars at top opening and at all pipe openings.

② Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of walls.

③ Wall widths vary with pipe diameter and range from 4 feet minimum to 9 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.

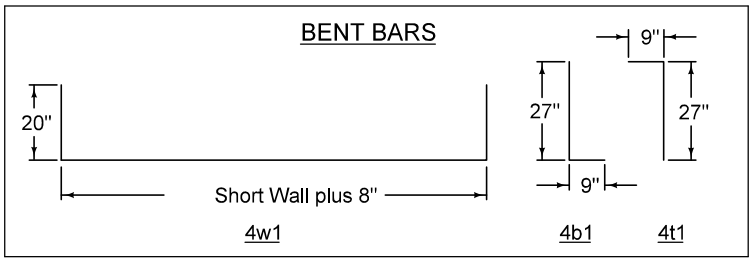


PLAN



SECTION A-A

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
4t1	4	Top	⌐	36"	12"
4t2	4	Top	—	Long Wall plus 12"	6"
4t3	4	Top	—	Short Wall plus 12"	6"
4b1	4	Base	L	36"	12"
4b2	4	Base	—	Long Wall plus 18"	12"
4b3	4	Base	—	Short Wall plus 18"	12"
4w1	4	Walls	⌐¬	Short Wall plus 48"	12"
4w2	4	Walls	—	Wall Height minus 4"	12"
4w3	4	Walls	—	Long Wall plus 12"	12"



SUDAS | IOWA DOT | REVISION 2 04-21-20

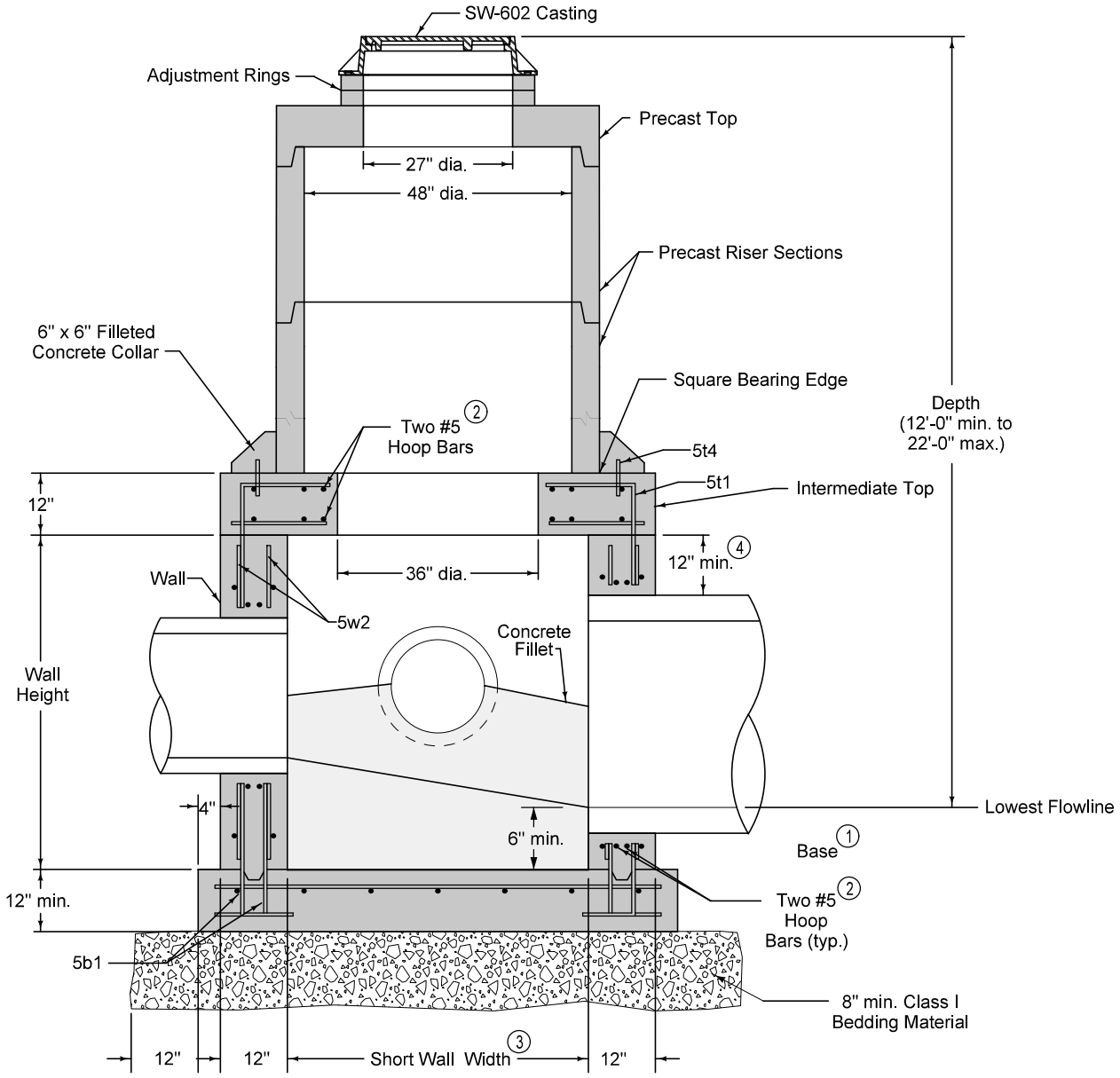
FIGURE 6010.403 | STANDARD ROAD PLAN | SW-403 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

DEEP WELL RECTANGULAR STORM SEWER MANHOLE

FIGURE 6010.403 SHEET 2 OF 2



TYPICAL SECTION

Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.

If manhole depth exceeds 20 feet, install steps.

① Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

② Provide two #5 hoop bars at intermediate top opening and at all pipe openings.

③ Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.

④ 12 inch minimum wall height above all pipes.

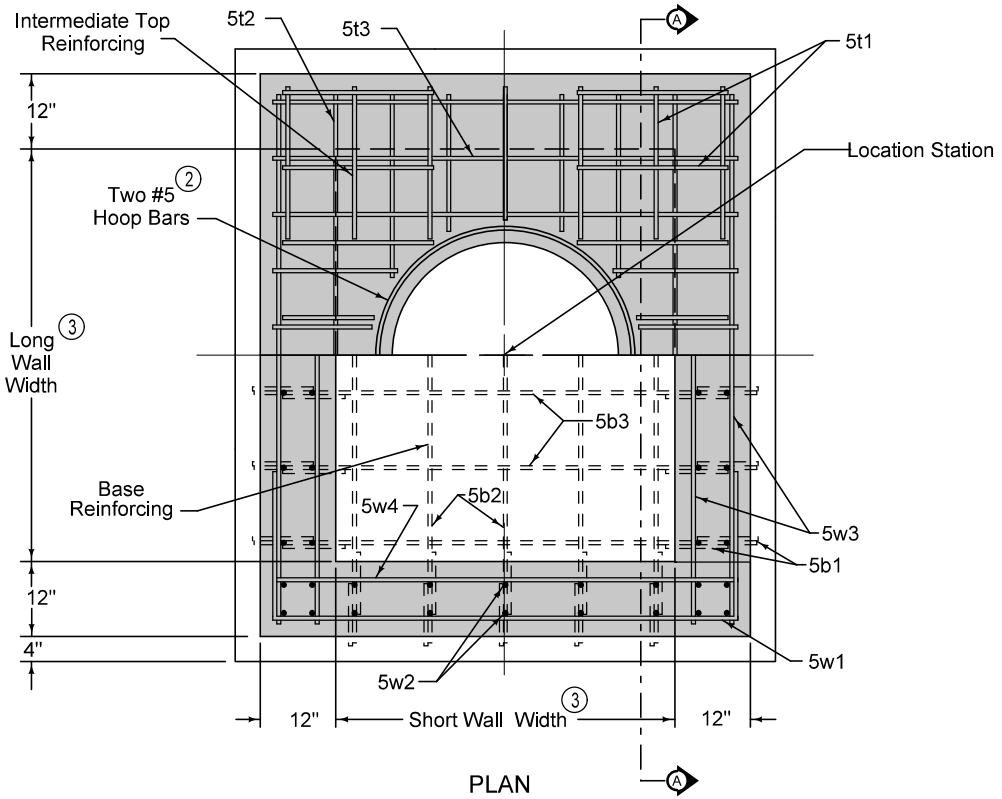
FIGURE 6010.404 SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 4	04-20-21
FIGURE 6010.404	STANDARD ROAD PLAN	SW-404	SHEET 1 of 2

REVISIONS: Added manhole depth note.

Paul D. Wiegand — SUDAS DIRECTOR
Steven Mickelson — DESIGN METHODS ENGINEER

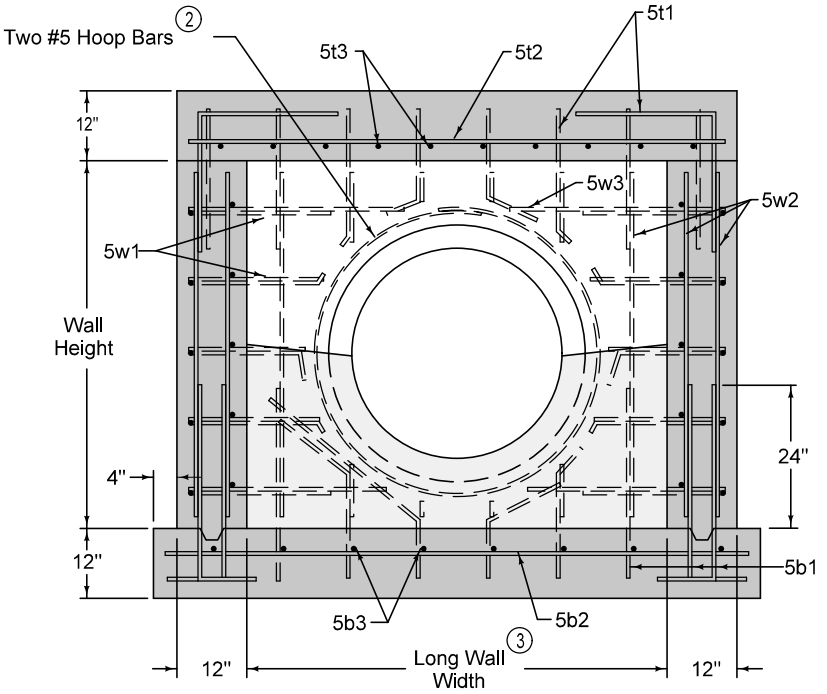
RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE



PLAN

② Provide two #5 hoop bars at intermediate top opening and at all pipe openings.

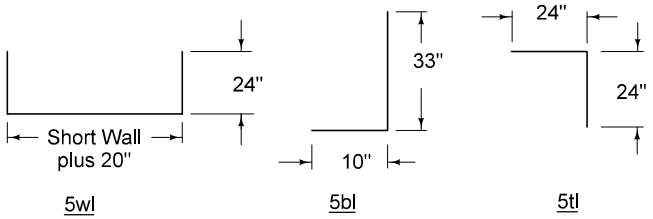
③ Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.



SECTION A-A

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
5t1	5	Top	L	48"	12"
5t2	5	Top	—	Long Wall plus 20"	9"
5t3	5	Top	—	Short Wall plus 20"	9"
5t4	5	Top	—	8"	12"
5b1	5	Base	L	43"	12"
5b2	5	Base	—	Long Wall plus 26"	12"
5b3	5	Base	—	Short Wall plus 26"	12"
5w1	5	Wall	⌐	Short Wall plus 68"	12"
5w2	5	Wall	—	Wall Height minus 4"	12"
5w3	5	Wall	—	Long Wall plus 20"	12"
5w4	5	Wall	—	Short Wall plus 20"	12"

BENT BARS



SUDAS | IOWADOT | REVISION 4 04-20-21

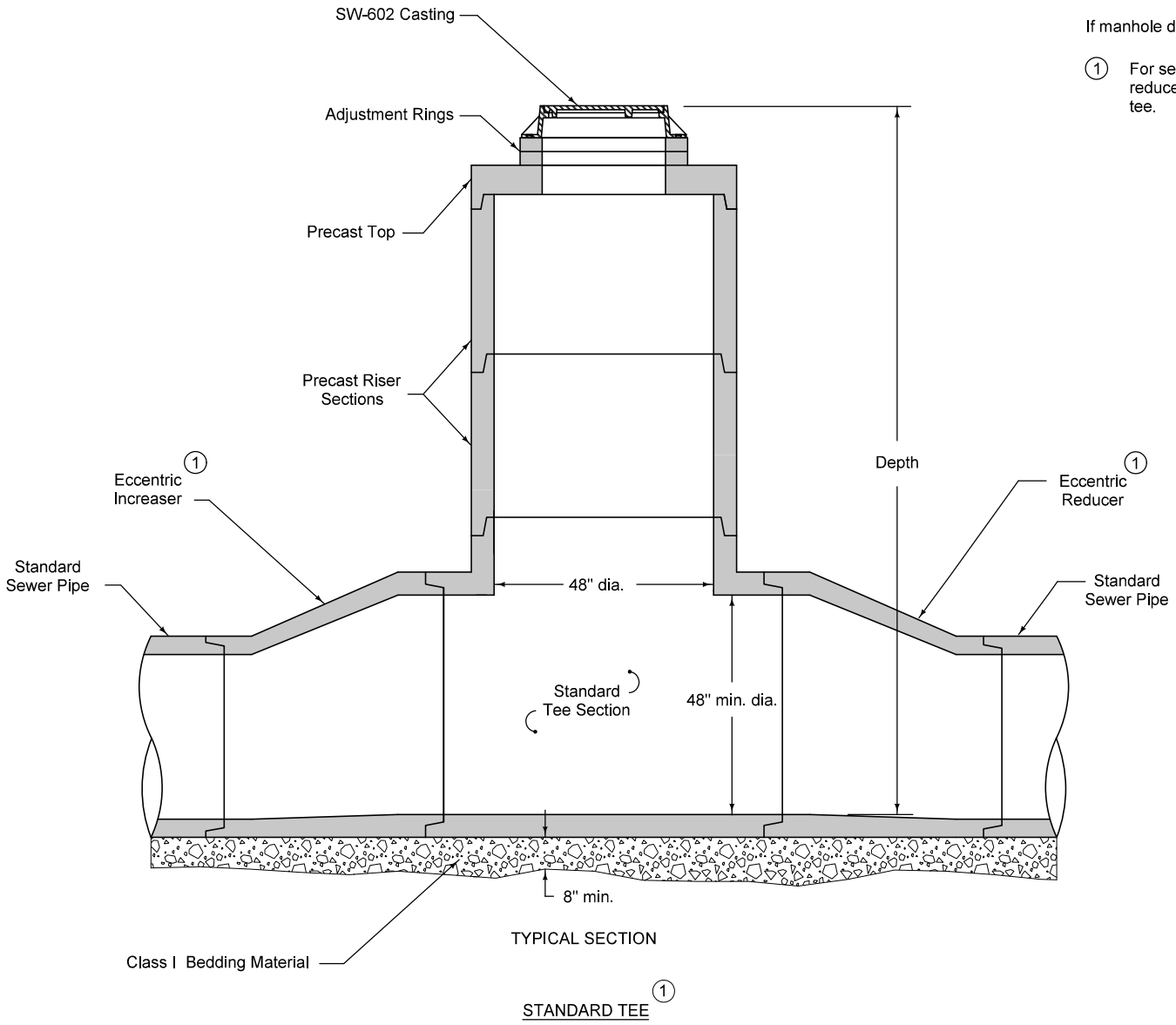
FIGURE 6010.404 | STANDARD ROAD PLAN | SW-404 | SHEET 2 of 2

REVISIONS: Added manhole depth note.

Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE

FIGURE 6010.404 | SHEET 2 OF 2



TYPICAL SECTION

STANDARD TEE 1

If manhole depth exceeds 20 feet, install steps.

1 For sewer pipes less than 48 inch diameter, install eccentric reducers/increasers with a standard tee or utilize a composite tee.

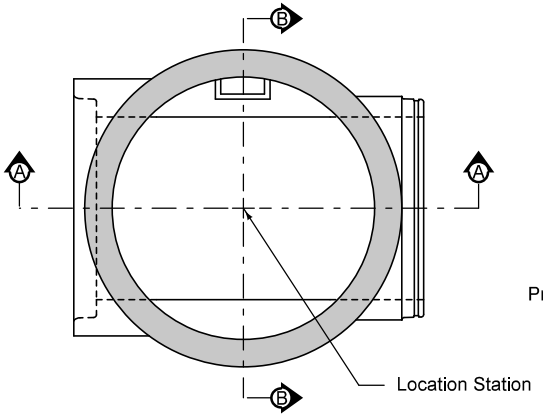
SUDAS	IOWA DOT	REVISION 4 04-20-21
FIGURE 6010.405	STANDARD ROAD PLAN	SW-405
		SHEET 1 of 2

REVISIONS: Added manhole depth note.

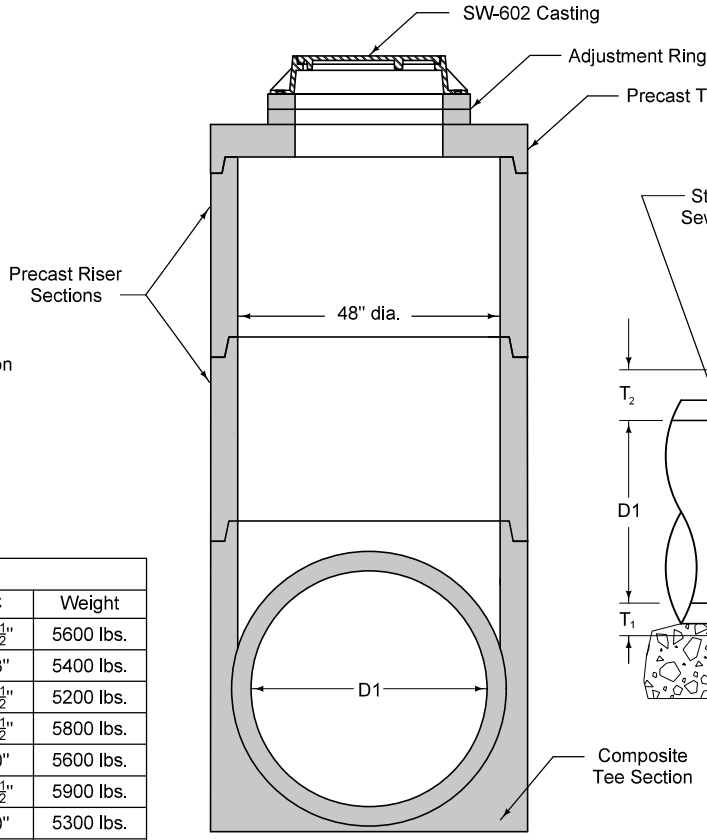
Paul D. Wigard — SUDAS DIRECTOR
Stuart Nicholson — DESIGN METHODS ENGINEER

TEE-SECTION
STORM SEWER MANHOLE

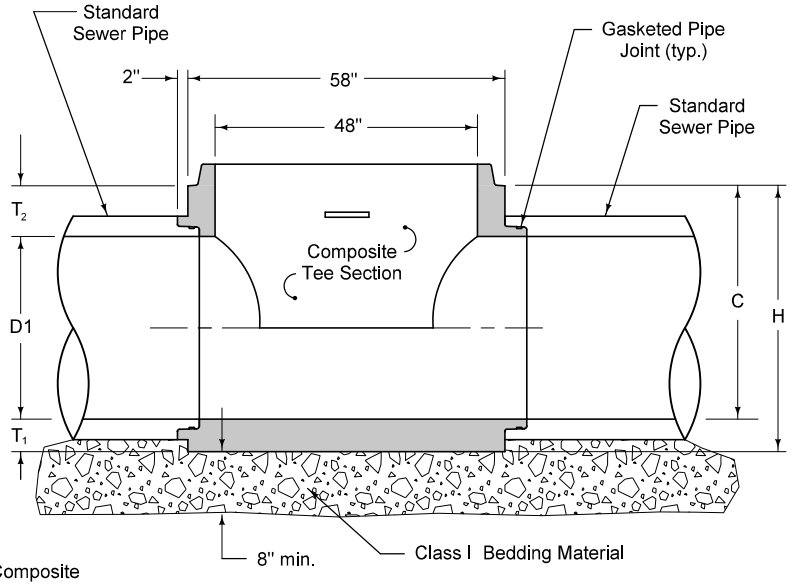
FIGURE 6010.405 SHEET 1 OF 2



PLAN



SECTION B-B



SECTION A-A

COMPOSITE TEE DIMENSIONS						
Size	D1	H	T_1	T_2	C	Weight
48" on 12"	12"	50"	$8\frac{1}{2}$"	$29\frac{1}{2}$"	$41\frac{1}{2}$"	5600 lbs.
48" on 15"	15"	50"	7"	28"	43"	5400 lbs.
48" on 18"	18"	50"	$5\frac{1}{2}$"	$26\frac{1}{2}$"	$44\frac{1}{2}$"	5200 lbs.
48" on 21"	21"	48"	$9\frac{1}{2}$"	$17\frac{1}{2}$"	$38\frac{1}{2}$"	5800 lbs.
48" on 24"	24"	48"	8"	16"	40"	5600 lbs.
48" on 27"	27"	48"	$9\frac{1}{2}$"	$11\frac{1}{2}$"	$38\frac{1}{2}$"	5900 lbs.
48" on 30"	30"	48"	8"	10"	40"	5300 lbs.
48" on 33"	33"	54"	$9\frac{1}{2}$"	$11\frac{1}{2}$"	$44\frac{1}{2}$"	6600 lbs.
48" on 36"	36"	54"	8"	10"	46"	6100 lbs.

COMPOSITE TEE

Alternate to standard tee with eccentric reducer (for pipes 36" and smaller).

FIGURE 6010.405 SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 4 04-20-21

FIGURE 6010.405 | STANDARD ROAD PLAN | SW-405 | SHEET 2 of 2

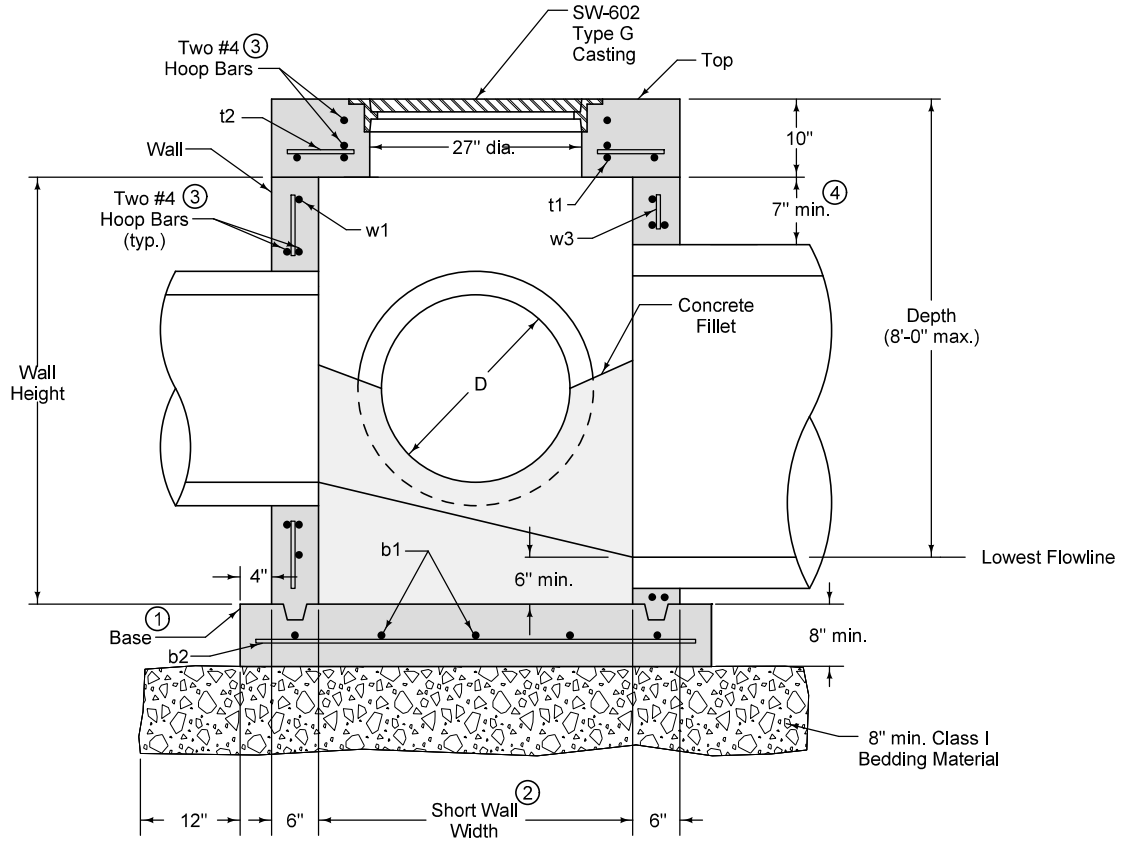
REVISIONS: Added manhole depth note.

Paul D. Wigand, SUDAS DIRECTOR

Stuart Nicholson, DESIGN METHODS ENGINEER

TEE-SECTION
STORM SEWER MANHOLE

Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.



TYPICAL SECTION

① Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

② Wall widths vary with pipe diameter and range from 40 inches minimum to 77 inches maximum. Provide 6 inches of wall width (minimum) each side of pipe opening.

③ Provide two #4 hoop bars at top opening and at all pipe openings.

④ 7 inch minimum wall height above all pipes.

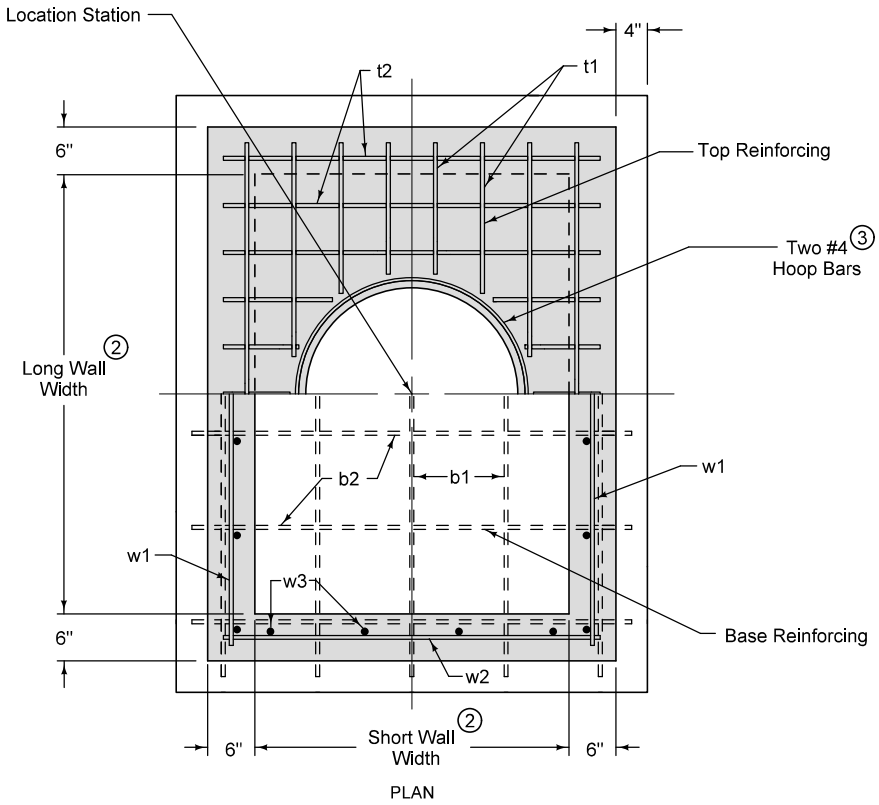
FIGURE 6010.406 SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 6010.406	STANDARD ROAD PLAN	SW-406
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

Paul D. Wigard — SUDAS DIRECTOR
Stuart Nicholson — DESIGN METHODS ENGINEER

SHALLOW RECTANGULAR STORM SEWER MANHOLE



PLAN

② Wall widths vary with pipe diameter and range from 40 inches minimum to 77 inches maximum. Provide 6 inches of wall width (minimum) each side of pipe opening.

③ Provide two #4 hoop bars at top opening and at all pipe openings.

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
t1	See Table	Top	——	Long Wall plus 8"	6"
t2	See Table	Top	——	Short Wall plus 8"	6"
b1	See Table	Base	——	Long Wall plus 14"	12"
b2	See Table	Base	——	Short Wall plus 14"	12"
w1	See Table	Walls	——	Long Wall plus 8"	12"*
w2	See Table	Walls	——	Short Wall plus 8"	12"
w3	See Table	Walls	——	Wall Height minus 4"	12"

*Place a minimum of one w1 bar above each pipe opening

Diameter of Largest Pipe, D	Minimum Bar Size
48" or 54"	6
33" to 42"	5
30" or smaller	4

FIGURE 6010.406 SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 2 04-21-20

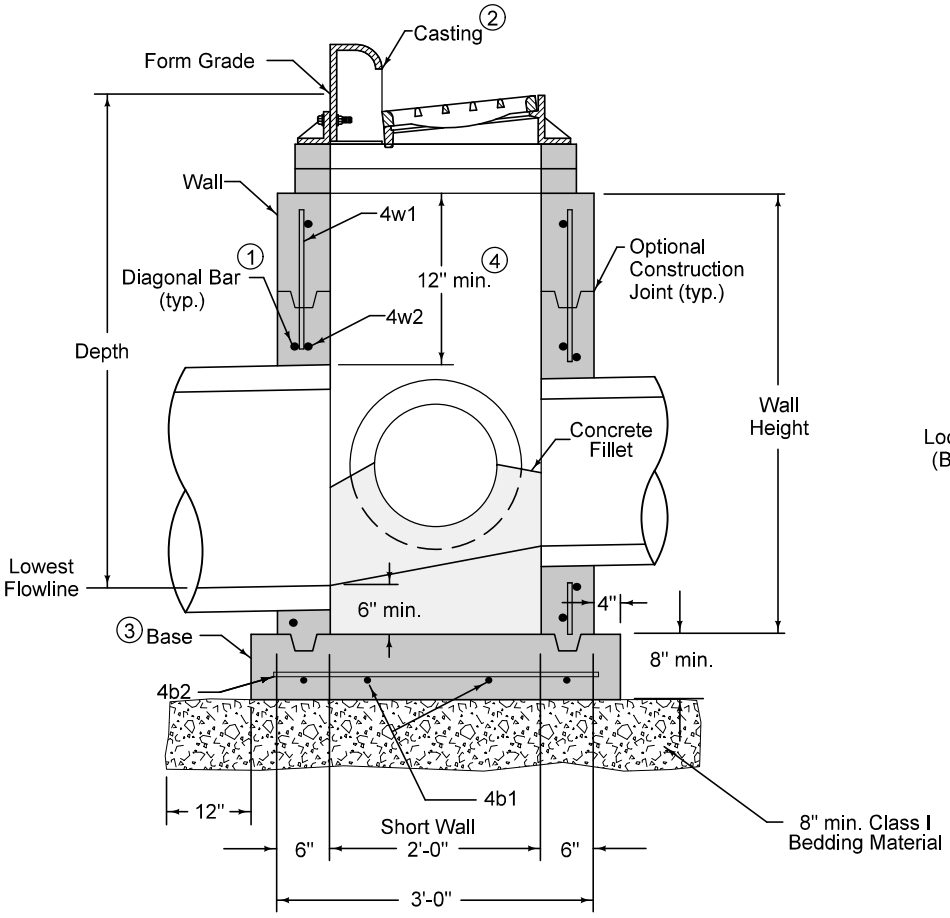
FIGURE 6010.406 | STANDARD ROAD PLAN | SW-406 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

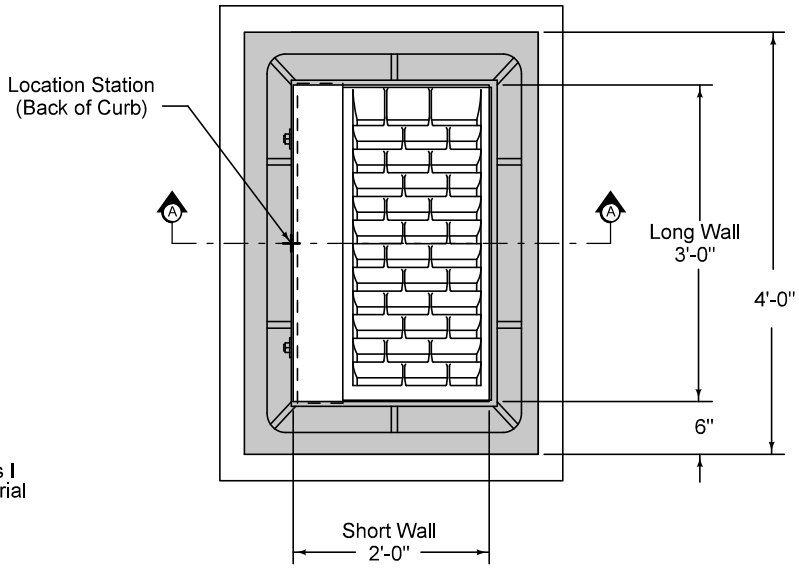
Paul D. Wigand, SUDAS DIRECTOR

Stuart Nicholson, DESIGN METHODS ENGINEER

SHALLOW RECTANGULAR STORM SEWER MANHOLE



SECTION A-A



PLAN

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at all pipe openings.
2. SW-603 Type R unless Type Q is specified in the contract documents.
3. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
4. 12 inch minimum wall height above all pipes.

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Length	Count	Spacing
4w1	4	Walls	———	Wall Height minus 4"	14	12"
4w2	4	Long Walls	———	3'-8"	Varies	12"
4w3	4	Short Walls	———	2'-8"	Varies	12"
4b1	4	Base	———	4'-2"	4	10"
4b2	4	Base	———	3'-2"	5	10"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	15"	18"
Long Wall	24"	30"

SUDAS | IOWA DOT | REVISION 3 04-21-20

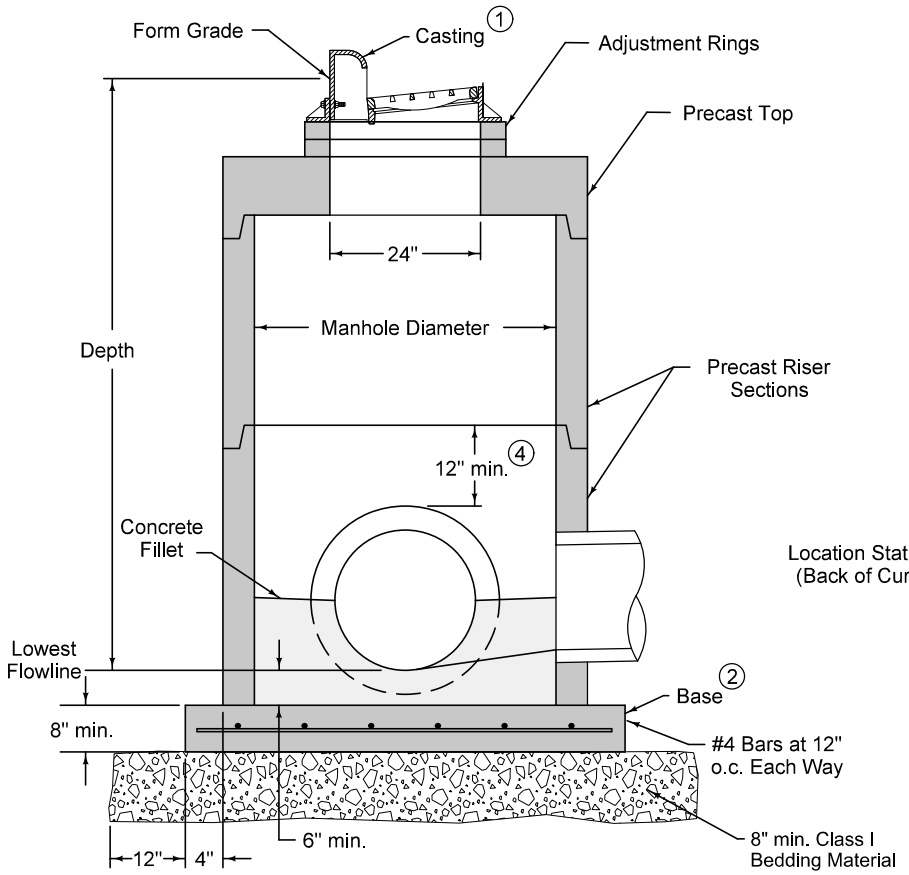
FIGURE 6010.501 | STANDARD ROAD PLAN | SW-501 | SHEET 1 of 1

REVISIONS: Added Class I Bedding Material.

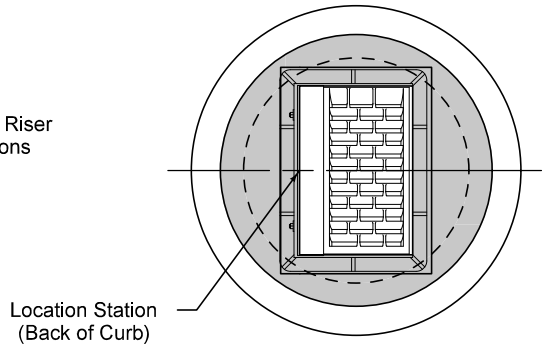
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE

FIGURE 6010.501 | SHEET 1 OF 1



TYPICAL SECTION



PLAN

Refer to SW-514 for boxout details.

① SW-603 Type R unless Type Q is specified in the contract documents.

② Cast-in-place base shown. Base may be square. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

③ For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings.

④ 12 inch minimum riser height above all pipes.

Manhole Diameter (inches)	Maximum Pipe Diameter ③ (inches) for 2 Pipes	
	at 180° Separation	at 90° Separation
48	24	18
60	36	24
72	42	30
84	48	36
96	60	42

SUDAS | IOWA DOT

REVISION: 1 | 04-21-20

FIGURE 6010.502 | STANDARD ROAD PLAN | SW-502 | SHEET 1 of 1

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR

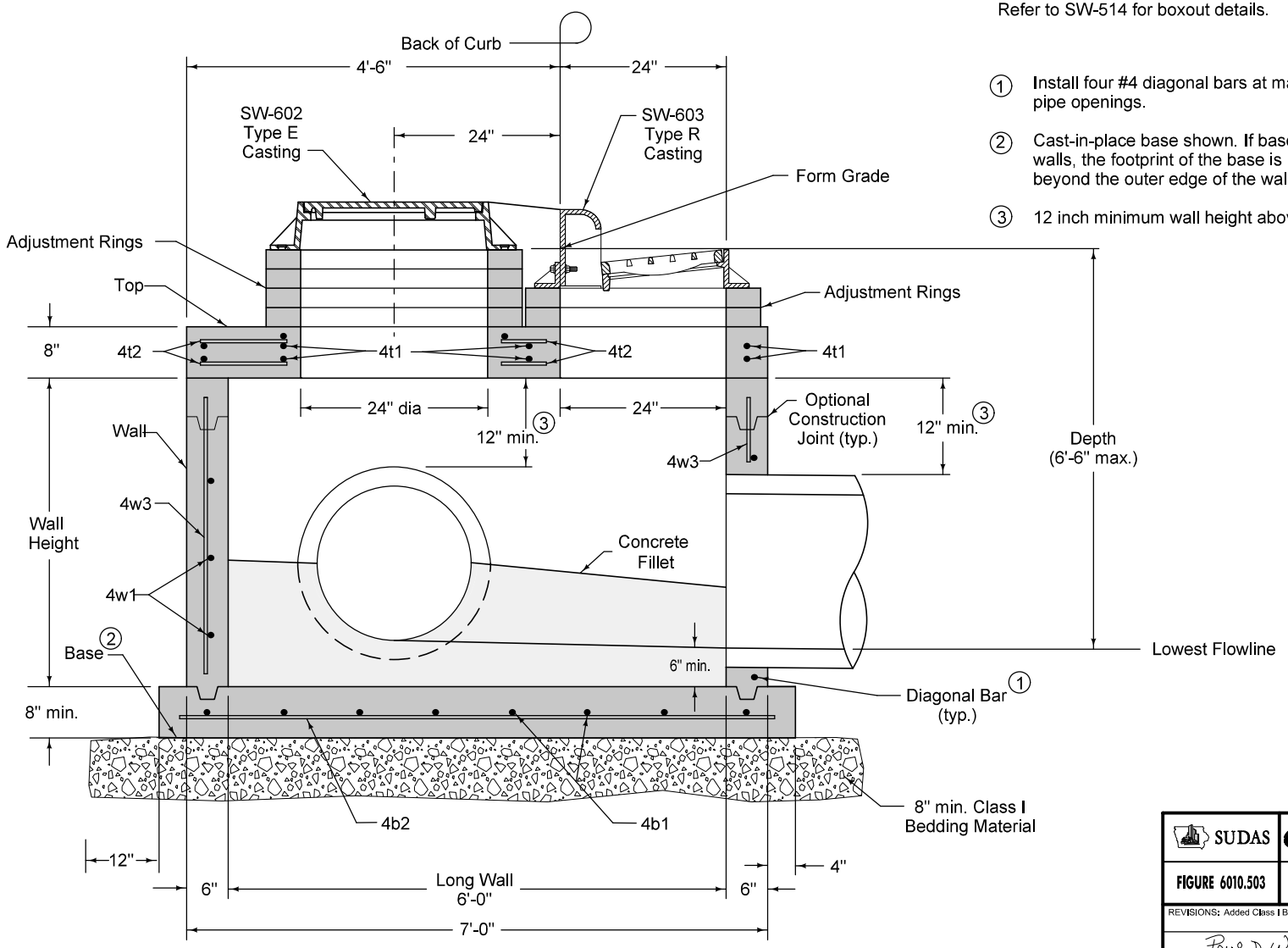
Stuart Nicholson, DESIGN METHODS ENGINEER

CIRCULAR SINGLE GRATE INTAKE

FIGURE 6010.502 SHEET 1 OF 1

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at manhole opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.



TYPICAL SECTION

FIGURE 6010.503 SHEET 1 OF 2

SUDAS | IOWA DOT | REVISION 3 04-21-20

FIGURE 6010.503 | STANDARD ROAD PLAN | SW-503 | SHEET 1 of 2

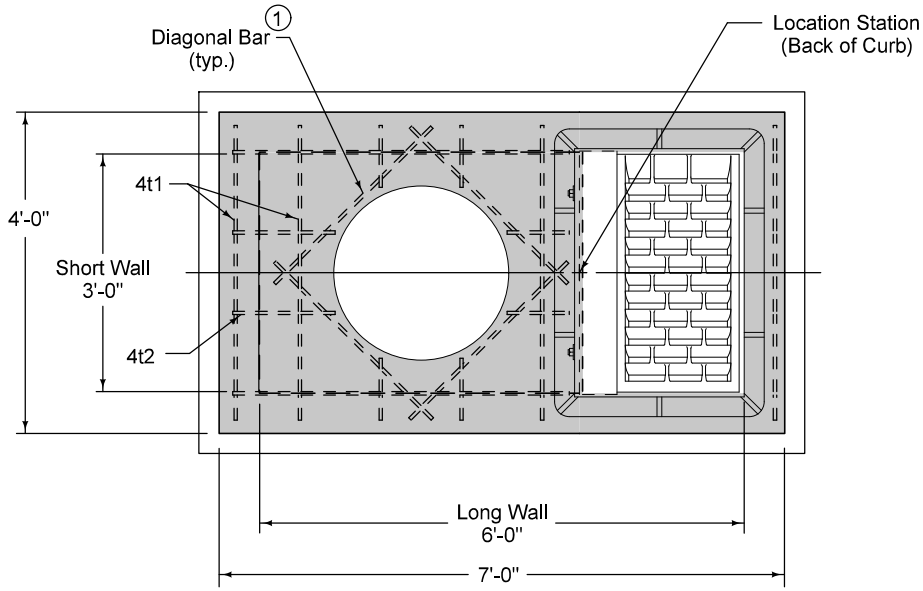
REVISIONS: Added Class I Bedding Material.

Paul D. Wigant, SUDAS DIRECTOR

Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE WITH MANHOLE

① Install four #4 diagonal bars at manhole opening and at all pipe openings.



PLAN

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	12	3'-8"	12"
4t2	4	Top	——	8	4'-2"	12"
4b1	4	Base	——	7	4'-2"	13"
4b2	4	Base	——	5	7'-2"	10"
4w1	4	Short Walls	——	Varies	3'-8"	12"
4w2	4	Long Walls	——	Varies	6'-8"	12"
4w3	4	Walls	——	18	Wall Height minus 4"	13"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	24"	30"
Long Wall	30"	36"

SUDAS | IOWADOT | REVISION 3 04-21-20

FIGURE 6010.503 | STANDARD ROAD PLAN | SW-503 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

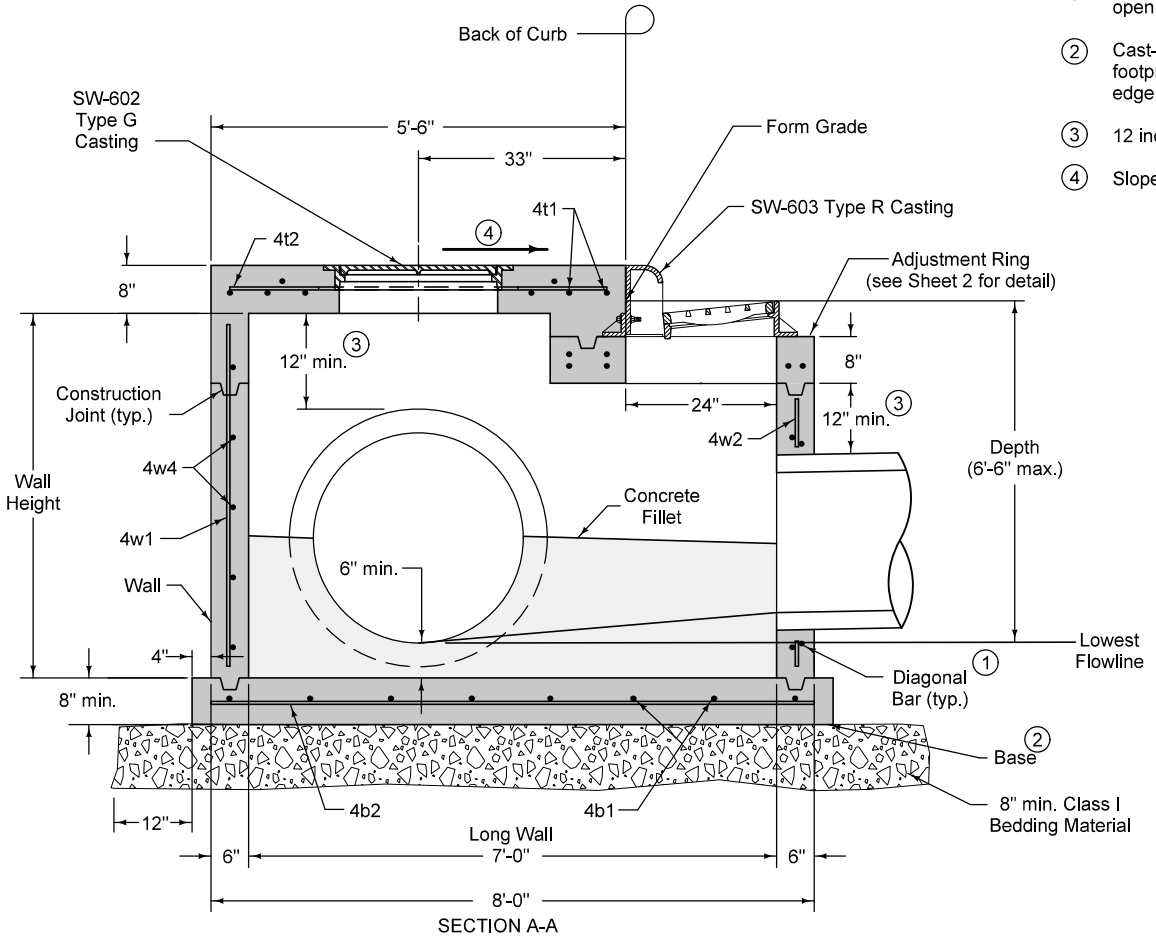
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE WITH MANHOLE

FIGURE 6010.503 SHEET 2 OF 2

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at manhole opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. Slope of 1.5% or as specified in the contract documents.



SECTION A-A

FIGURE 6010.504 | SHEET 1 OF 2

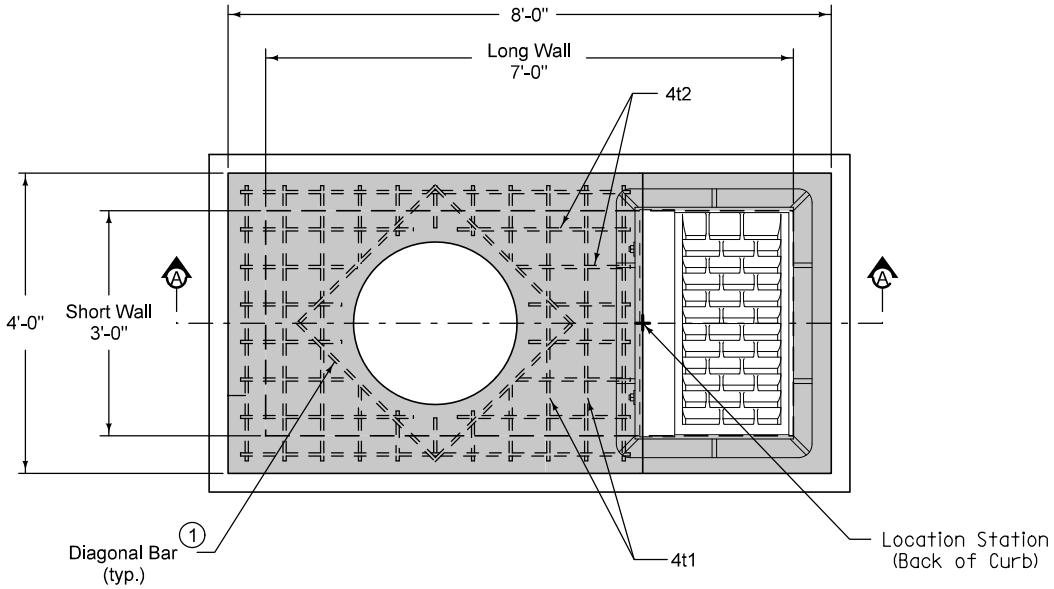
SUDAS	IOWA DOT	REVISION 4 04-21-20
FIGURE 6010.504	STANDARD ROAD PLAN	SW-504 SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

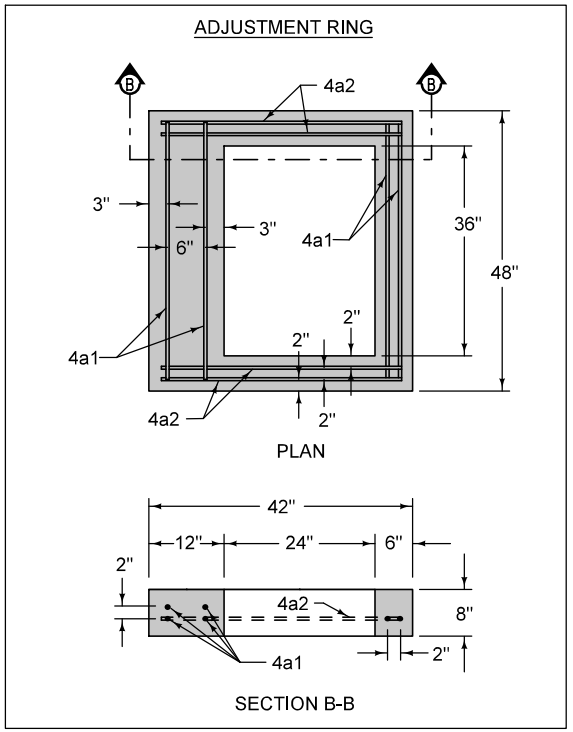
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SINGLE GRATE INTAKE WITH FLUSH-TOP MANHOLE

① Install four #4 diagonal bars at manhole opening and at all pipe openings.



PLAN



REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	1 1	3'-8"	6"
4t2	4	Top	——	8	5'-2"	6"
4b1	4	Base	——	8	4'-2"	13"
4b2	4	Base	——	5	8'-2"	10"
4a1	4	Adj. Ring	——	6	3'-8"	See Adj. Ring Plan
4a2	4	Adj. Ring	——	4	3'-2"	See Adj. Ring Plan
4w1	4	Walls	——	13	Wall Height minus 4"	12"
4w2	4	Walls	——	1 1	Wall Height minus 16"	12"
4w3	4	Long Walls	——	Varies	7'-8"	12"
4w4	4	Short Walls	——	Varies	3'-8"	12"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	18"	24"
Long Wall	30"	36"

SUDAS | IOWADOT | REVISION 4 04-21-20

FIGURE 6010.504 | STANDARD ROAD PLAN | SW-504 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

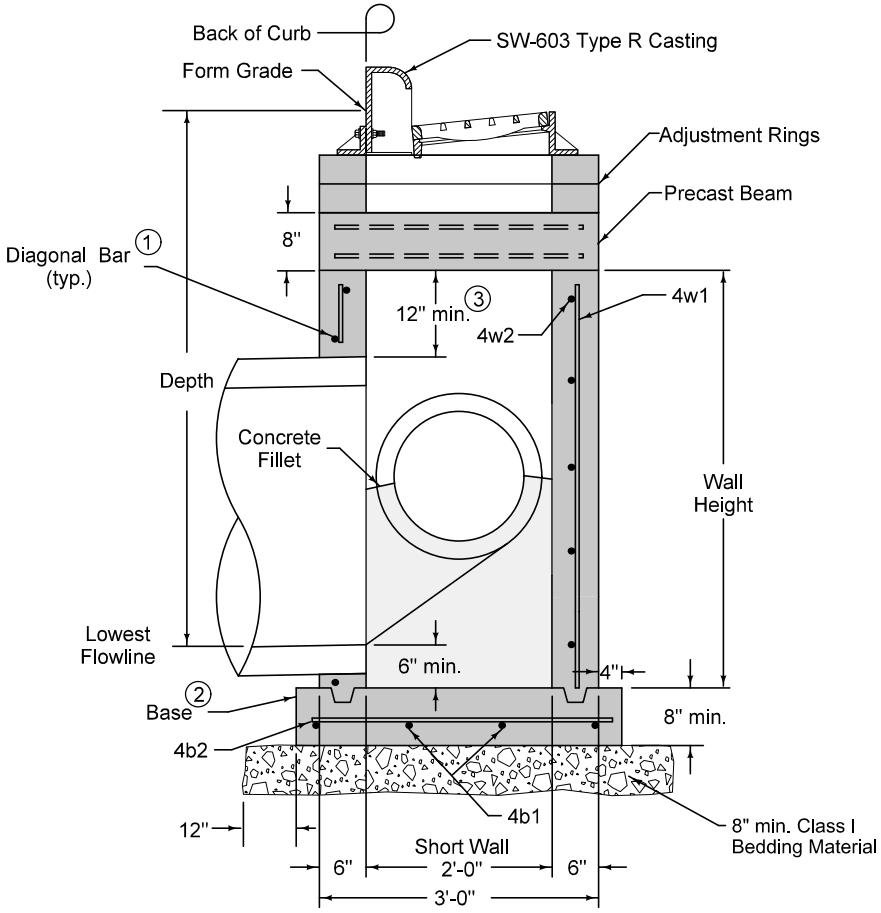
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE WITH FLUSH-TOP MANHOLE

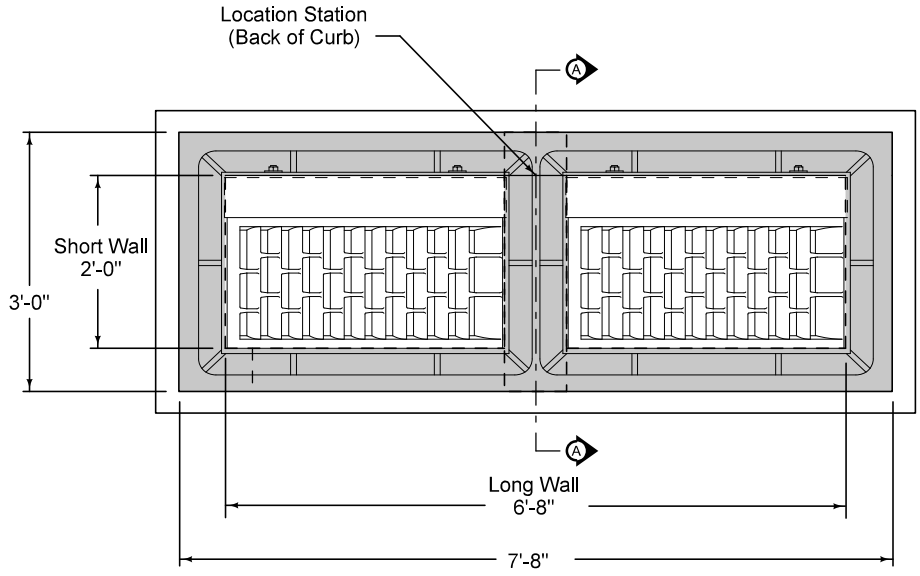
FIGURE 6010.504 | SHEET 2 OF 2

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.



SECTION A-A



PLAN

SUDAS	IOWA DOT	REVISION 3 04-21-20
FIGURE 6010.505	STANDARD ROAD PLAN	SW-505
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

Paul D. Wigant — SUDAS DIRECTOR
Stuart Nicholson — DESIGN METHODS ENGINEER

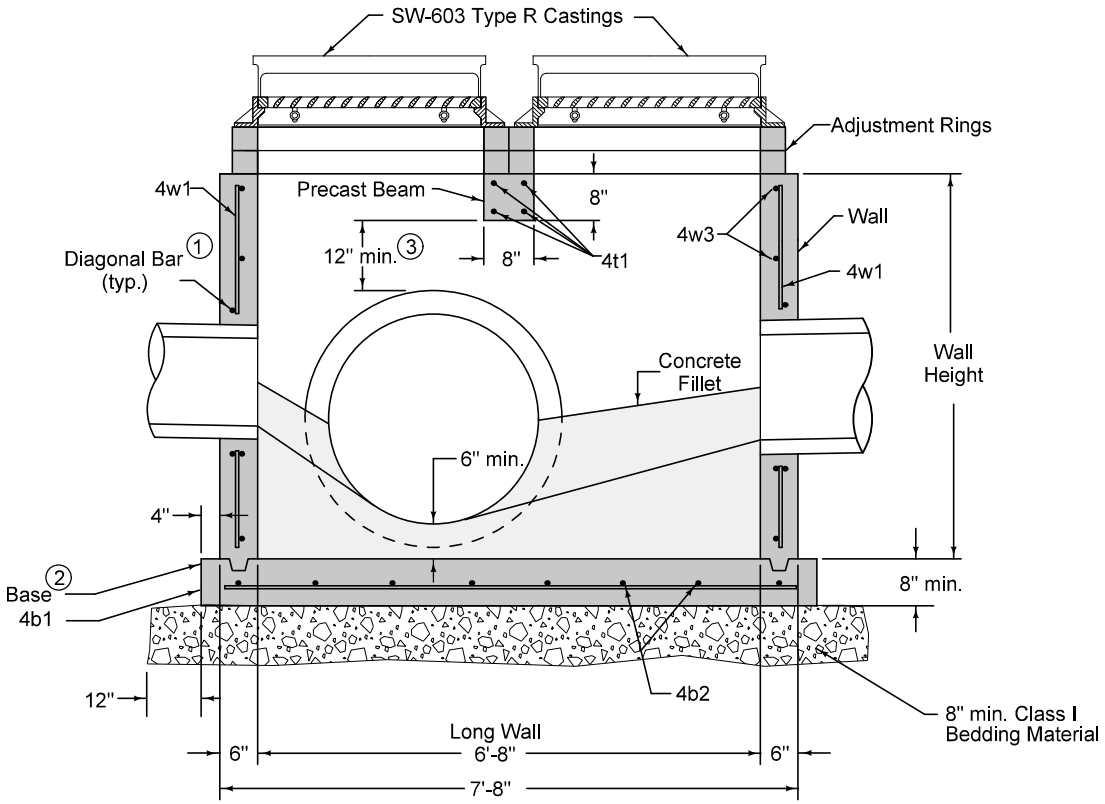
DOUBLE GRATE INTAKE

FIGURE 6010.505 SHEET 1 OF 2

① Install four #4 diagonal bars at all pipe openings.

② Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

③ 12 inch minimum wall height above all pipes.



TYPICAL SECTION

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Beam	——	4	2'-8"	4"
4b1	4	Base	——	4	7'-10"	10"
4b2	4	Base	——	8	3'-2"	12"
4w1	4	Walls	——	20	Wall Height minus 4"	12"
4w2	4	Long Walls	——	Varies	7'-4"	12"
4w3	4	Short Walls	——	Varies	2'-8"	12"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	15"	18"
Long Wall	60"	66"

SUDAS | IOWADOT | REVISION 3 04-21-20

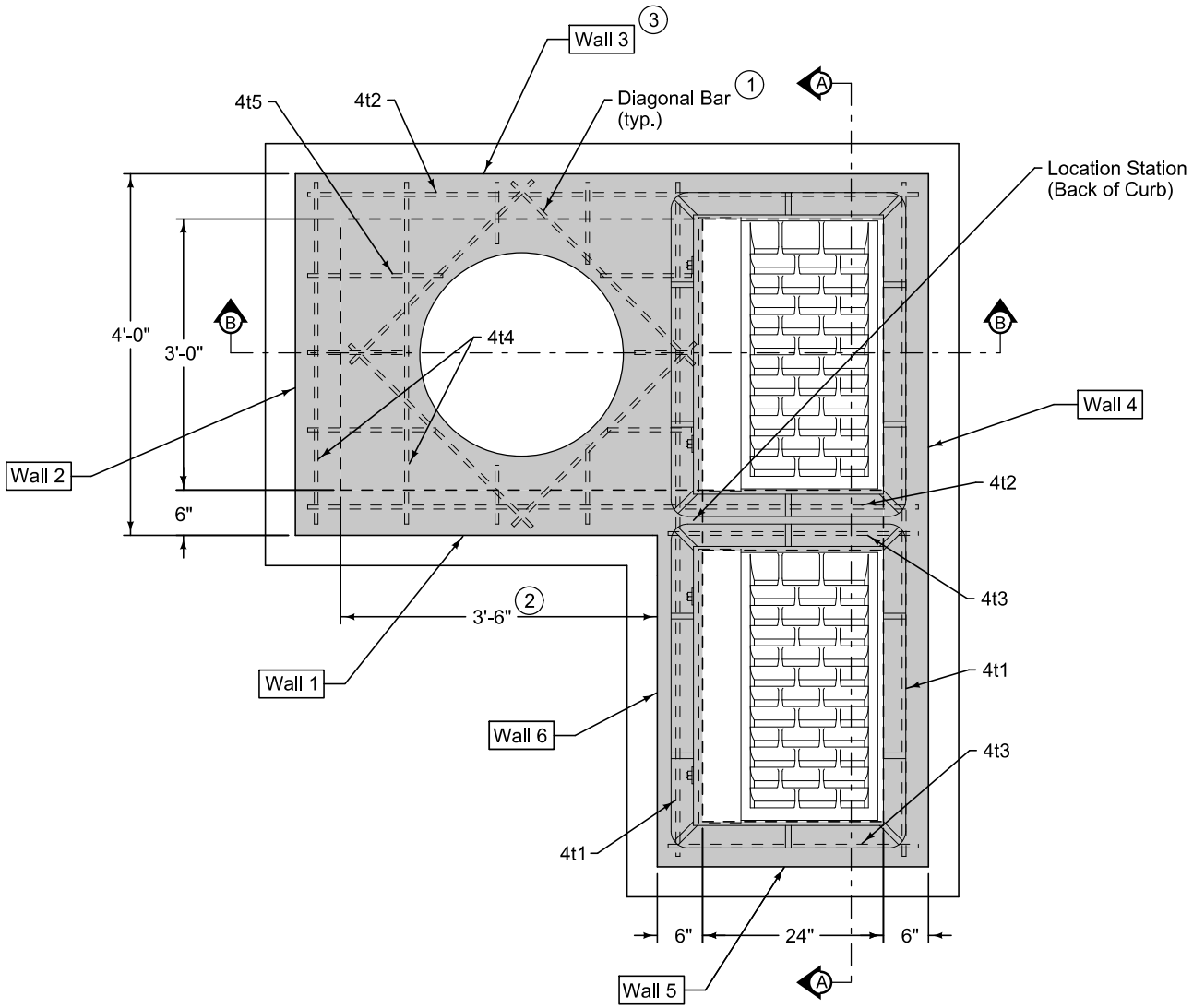
FIGURE 6010.505 | STANDARD ROAD PLAN | SW-505 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

DOUBLE GRATE INTAKE

FIGURE 6010.505 SHEET 2 OF 2



PLAN

Maximum pipe diameters are set based on maximum structure depth of 6 feet-6 inches and the objective of placement of the centerline of the pipe on the centerline of the manhole opening for maintenance purposes.

Refer to SW-514 for boxout details.

(1) Install four #4 diagonal bars at manhole opening and at all pipe openings.

(2) If Wall 1 is widened to 4 feet, the maximum pipe diameter can be increased to 36 inches.

(3) If Wall 1 is widened to 4 feet, the maximum pipe diameter in Wall 3 can be increased to 42 inches.

MAXIMUM PIPE DIAMETERS	
Wall	Max. Dia.
1	30" (2)
2	24"
3	36" (3)
4	42"

FIGURE 6010.506 | SHEET 1 OF 2

SUDAS | IOWA DOT | REVISION 4 04-21-20

FIGURE 6010.506 | STANDARD ROAD PLAN | SW-506

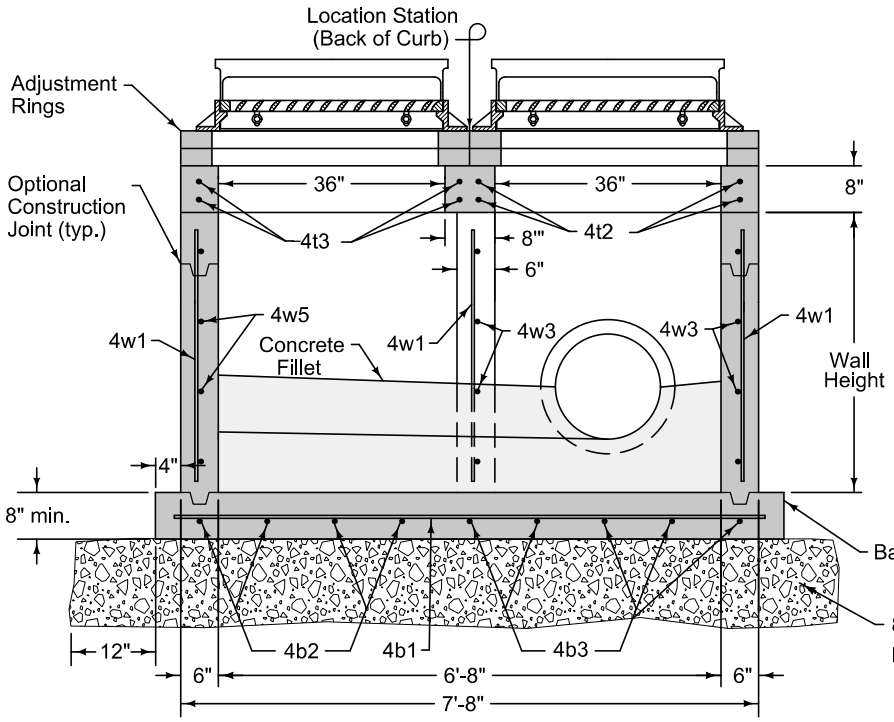
SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

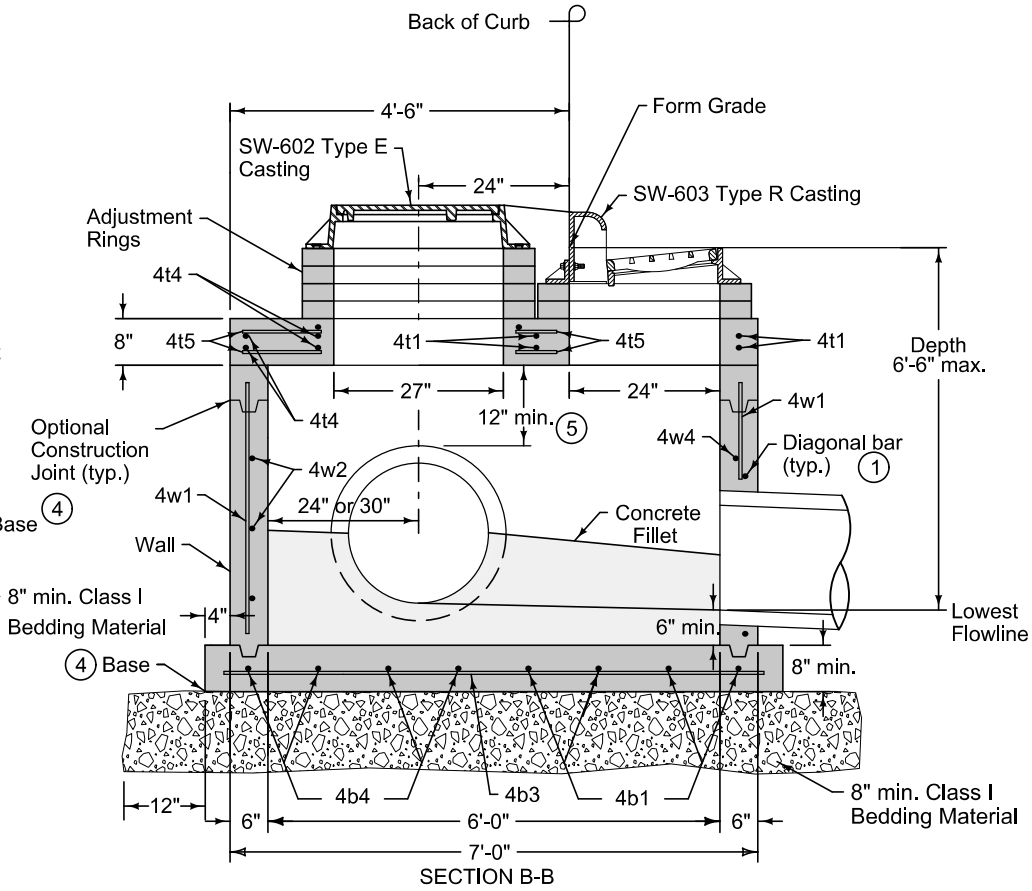
Paul D. Wigard, SUDAS DIRECTOR

DESIGN METHODS ENGINEER

DOUBLE GRATE INTAKE WITH MANHOLE



SECTION A-A



SECTION B-B

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	4	7'-4"	See Detail
4t2	4	Top	——	4	6'-8"	See Detail
4t3	4	Top	——	4	2'-8"	See Detail
4t4	4	Top	——	8	3'-8"	12"
4t5	4	Top	——	6	4'-2"	12"
4b1	4	Base	——	4	7'-10"	12"
4b2	4	Base	——	4	3'-2"	12"
4b3	4	Base	——	5	7'-2"	12"
4b4	4	Base	——	4	4'-2"	12"
4w1	4	Walls	——	29	Wall Height minus 4"	12"
4w2	4	Wall 2	——	Varies	3'-8"	12"
4w3	4	Walls 1 and 3	——	Varies	6'-8"	12"
4w4	4	Wall 4	——	Varies	7'-4"	12"
4w5	4	Wall 5	——	Varies	2'-8"	12"
4w6	4	Wall 6	——	Varies	3'-10"	12"

(1) Install four #4 diagonal bars at manhole opening and at all pipe openings.

(4) Cast-in-place base shown. If base is precast integral with walls, the footprint of base is not required to extend beyond the outer edge of the walls.

(5) 12 inch minimum wall height above all pipes.

SUDAS | IOWA DOT

REVISION: 4 | 04-21-20

FIGURE 6010.506 | STANDARD ROAD PLAN | SW-506

SHEET 2 of 2

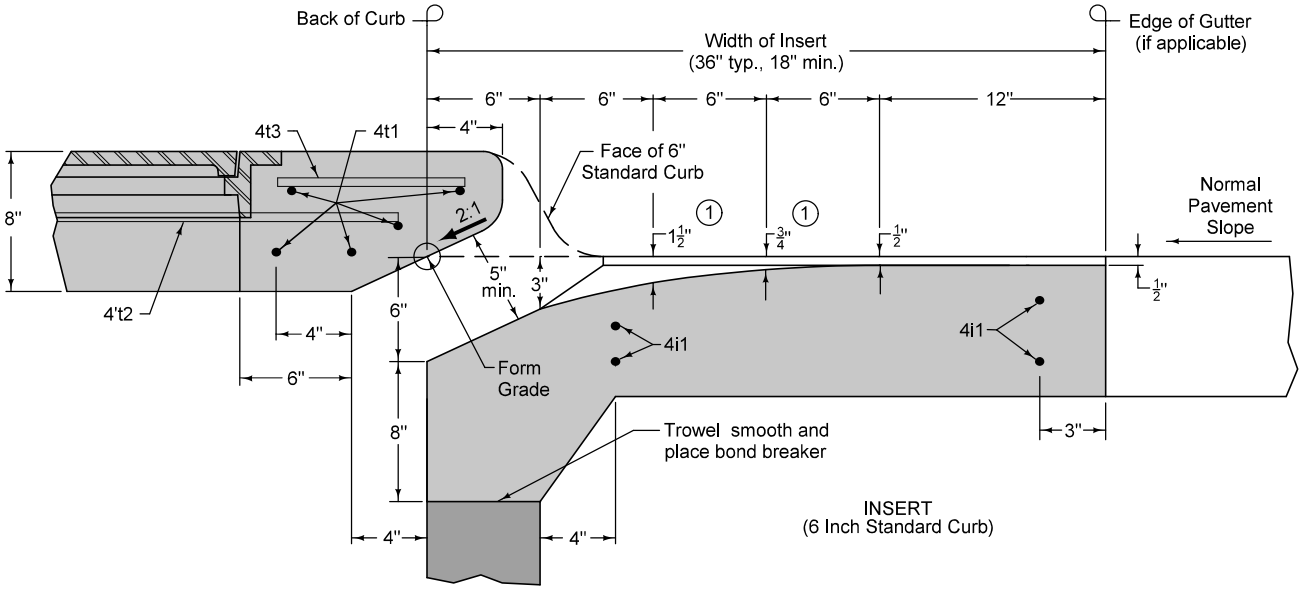
REVISIONS: Added Class I Bedding Material.

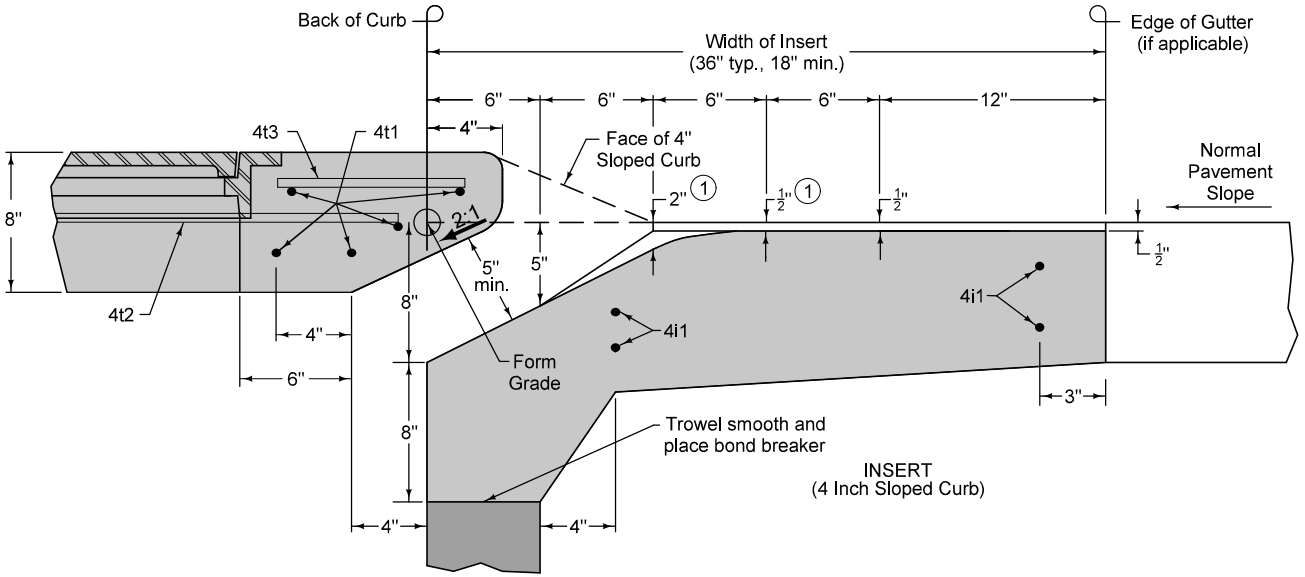
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE GRATE INTAKE WITH MANHOLE

FIGURE 6010.506 | SHEET 2 OF 2





① Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by ½ inch.

FIGURE 6010.507 SHEET 1 OF 2

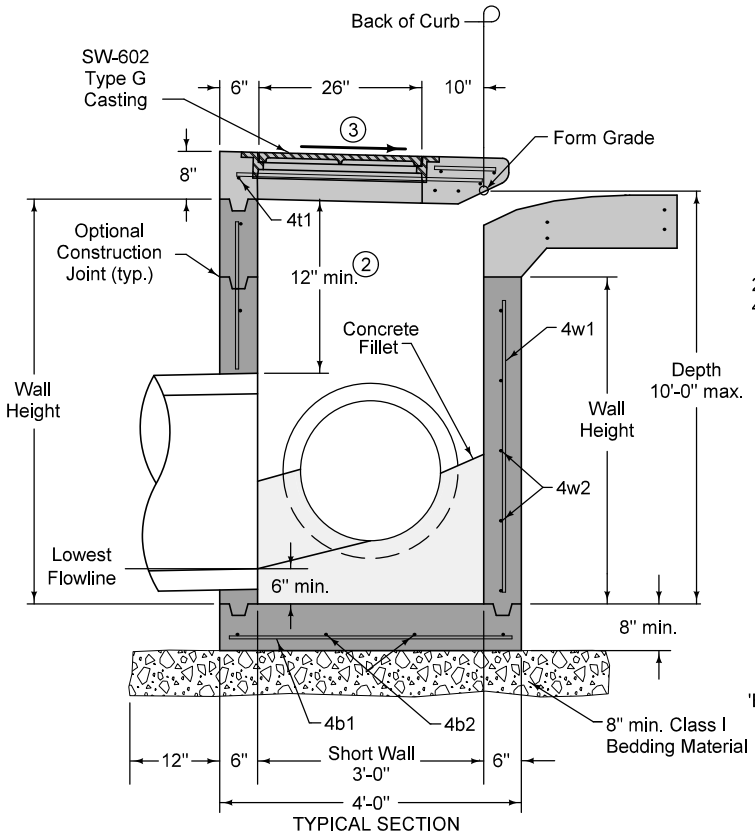
SUDAS	IOWA DOT	REVISION 4 04-21-20
FIGURE 6010.507	STANDARD ROAD PLAN	SW-507
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

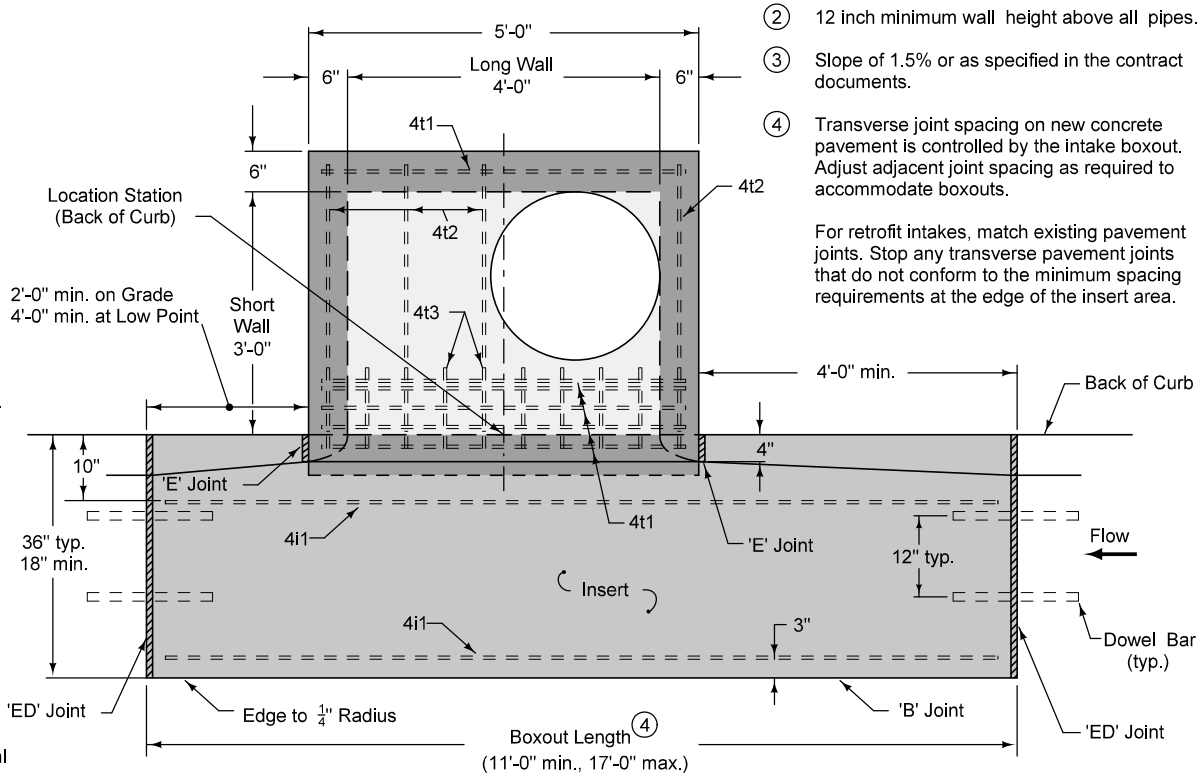
Paul D. Wigand
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, SMALL BOX



TYPICAL SECTION



PLAN

2 12 inch minimum wall height above all pipes.

3 Slope of 1.5% or as specified in the contract documents.

4 Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	24"	30"
Long Wall	30"	36"

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	6	4'-8"	See Insert
4t2	4	Top	——	4	3'-6"	12"
4t3	4	Top	——	10	10"	6"
4b1	4	Base	——	6	3'-6"	1 1"
4b2	4	Base	——	5	4'-6"	10"
4i1	4	Insert	——	4	Boxout Length minus 8"	See Plan
4w1	4	Walls	——	14	Wall Height minus 4"	14"
4w2	4	Long Walls	——	Varies	4'-8"	12"
4w3	4	Short Walls	——	Varies	3'-8"	12"

SUDAS | IOWADOT | REVISION 4 04-21-20

FIGURE 6010.507 | STANDARD ROAD PLAN | SW-507 | SHEET 2 of 2

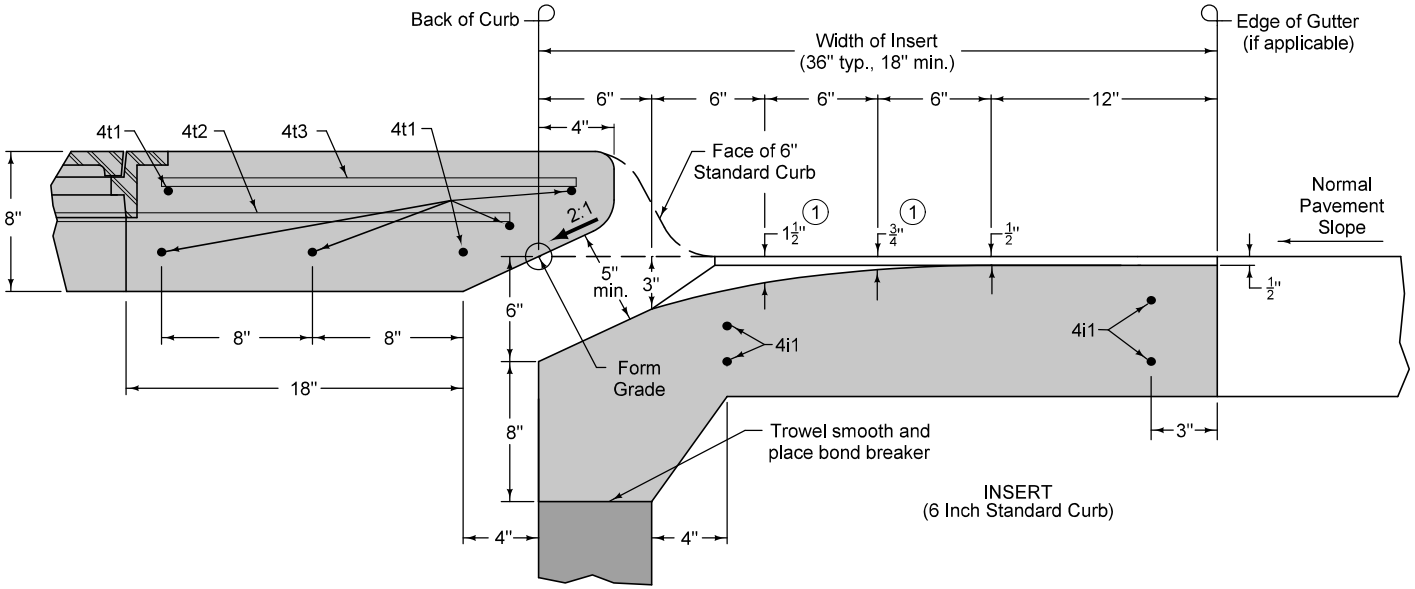
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

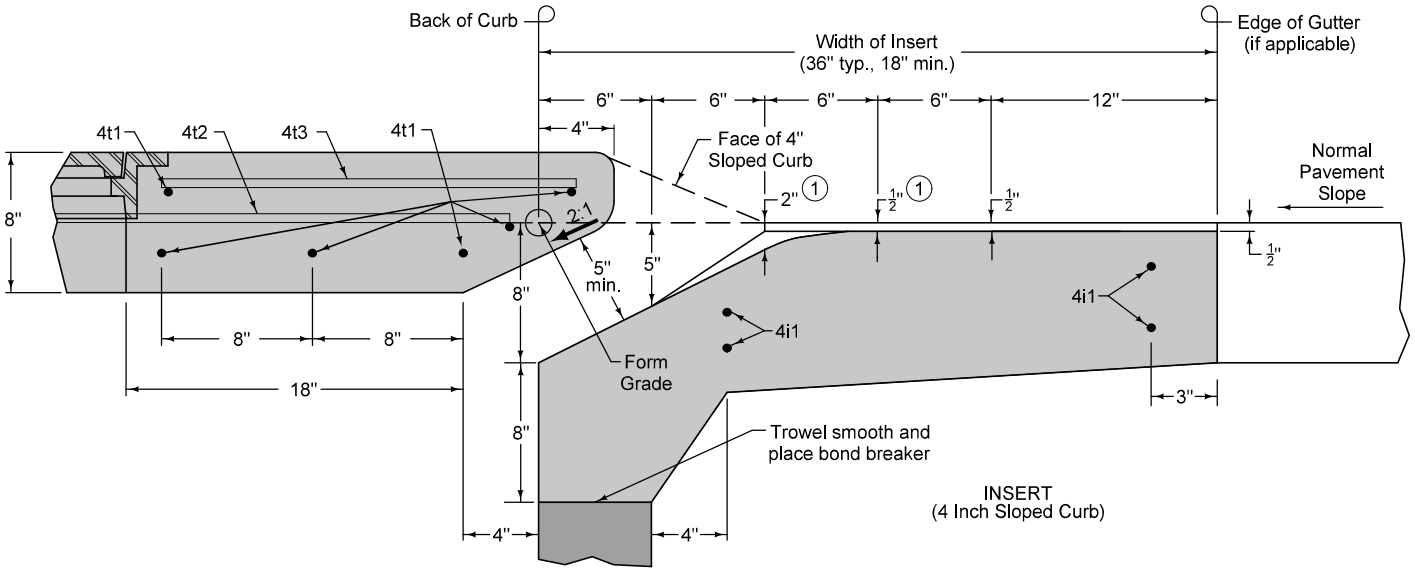
Paul D. Wigand, SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.507 SHEET 2 OF 2





① Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by ½ inch.

FIGURE 6010.508 SHEET 1 OF 2

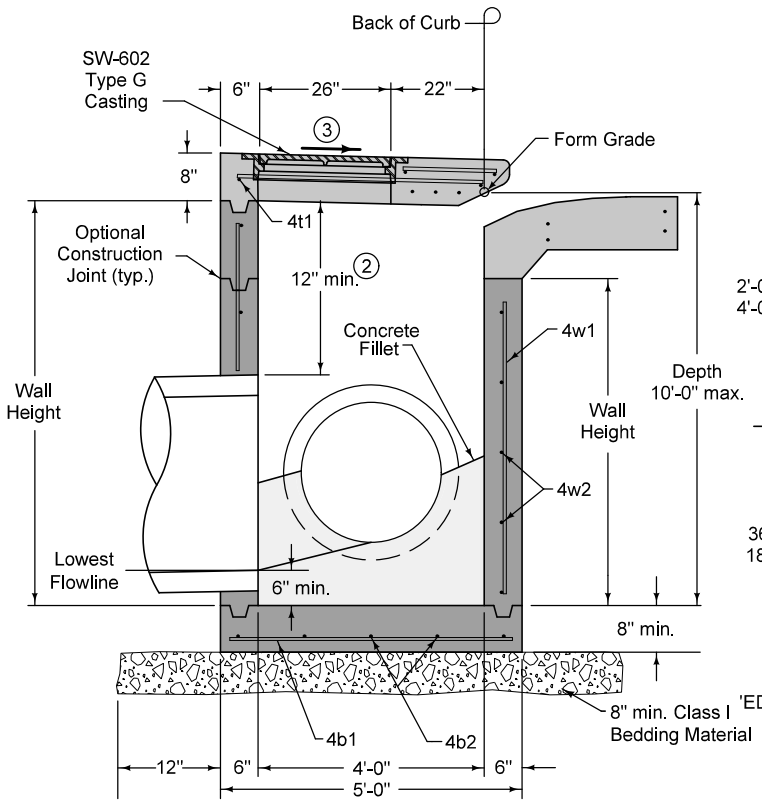
SUDAS	IOWA DOT	REVISION 4	04-21-20
FIGURE 6010.508	STANDARD ROAD PLAN	SW-508	SHEET 1 of 2

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

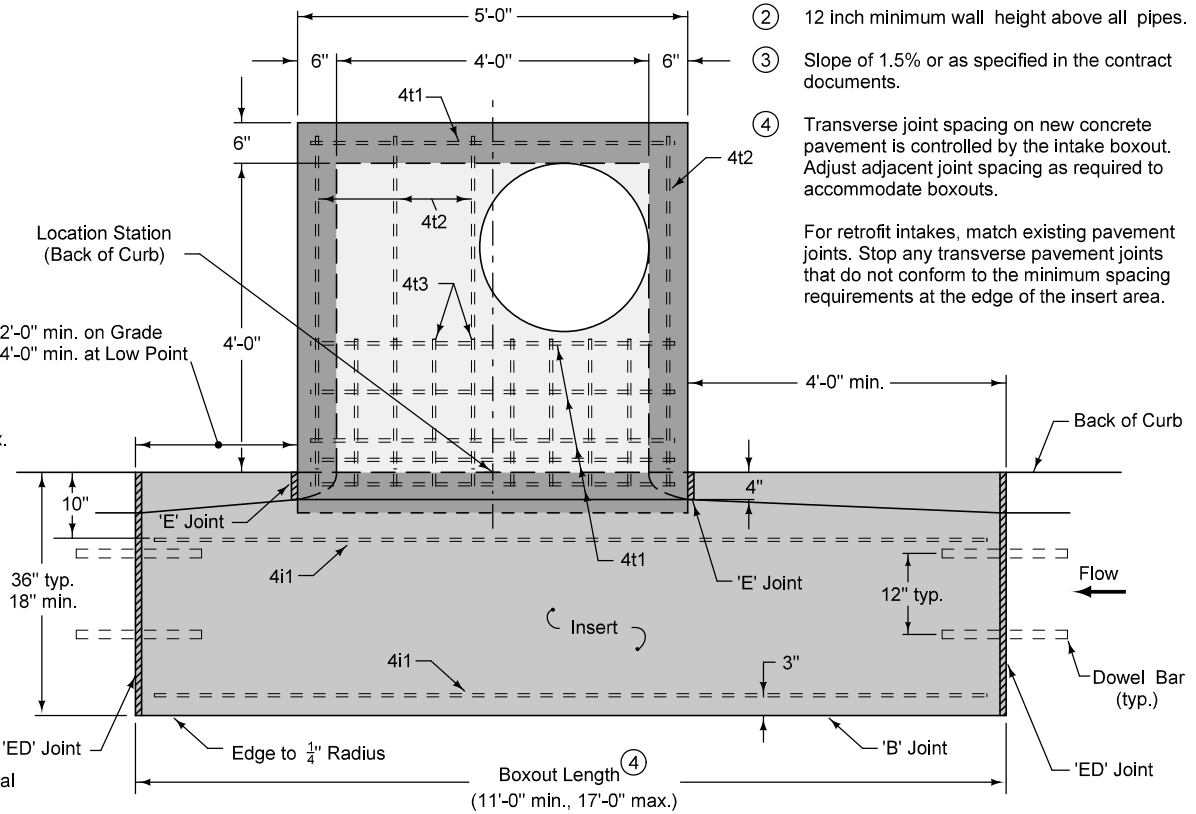
Paul D. Wigand
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, LARGE BOX



TYPICAL SECTION



PLAN

2 12 inch minimum wall height above all pipes.

3 Slope of 1.5% or as specified in the contract documents.

4 Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

MAXIMUM PIPE DIAMETERS	
Precast Structure	Cast-in-place Structure
30"	36"

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	———	7	4'-8"	See Insert
4t2	4	Top	———	4	4'-6"	12"
4t3	4	Top	———	10	1'-10"	6"
4b1	4	Base	———	6	4'-6"	11"
4b2	4	Base	———	6	4'-6"	11"
4i1	4	Insert	———	4	Boxout Length minus 8"	See Plan
4w1	4	Walls	———	16	Wall Height minus 4"	14"
4w2	4	Walls	———	Varies	4'-8"	12"
4w3	4	Walls	———	Varies	4'-8"	12"

SUDAS | IOWADOT | REVISION 4 04-21-20

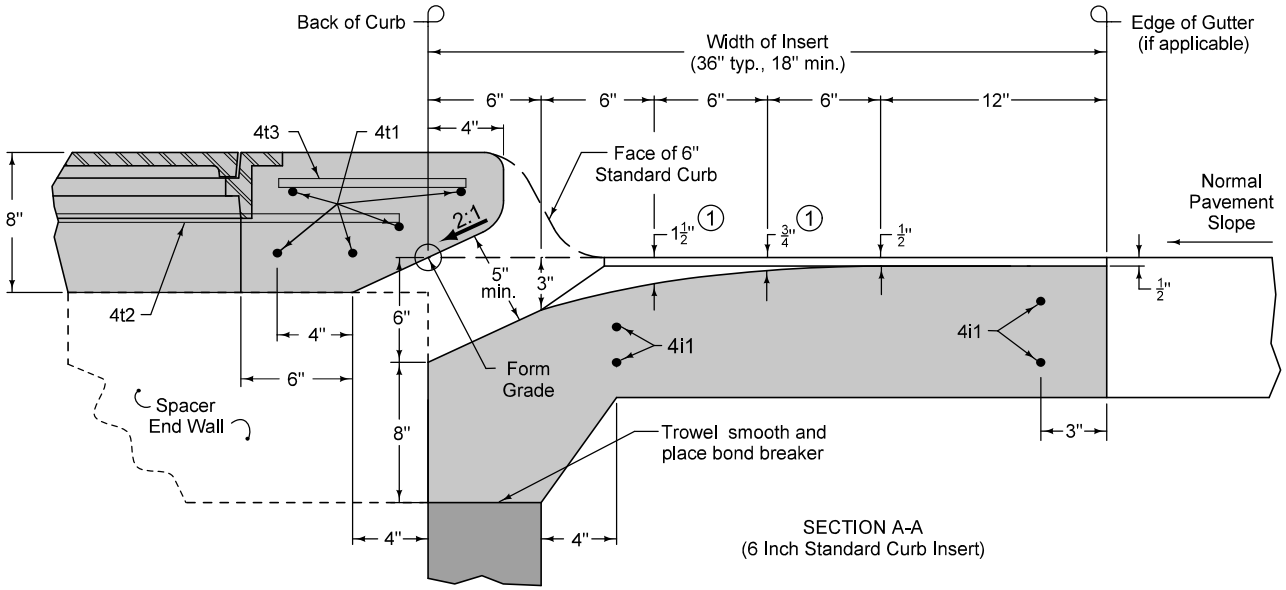
FIGURE 6010.508 | STANDARD ROAD PLAN | SW-508 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

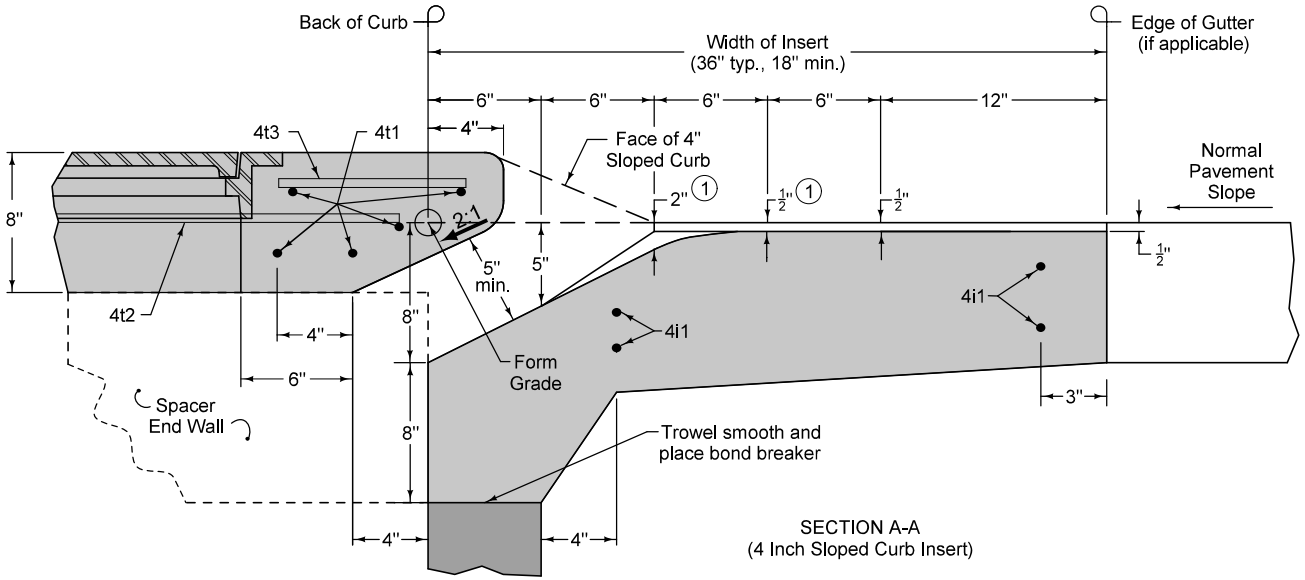
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, LARGE BOX

FIGURE 6010.508 | SHEET 2 OF 2



SECTION A-A
(6 Inch Standard Curb Insert)



SECTION A-A
(4 Inch Sloped Curb Insert)

(1) Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by $\frac{1}{4}$ inch.

SUDAS	IOWA DOT	REVISION 6	04-21-20
FIGURE 6010.509	STANDARD ROAD PLAN	SW-509	SHEET 1 of 3

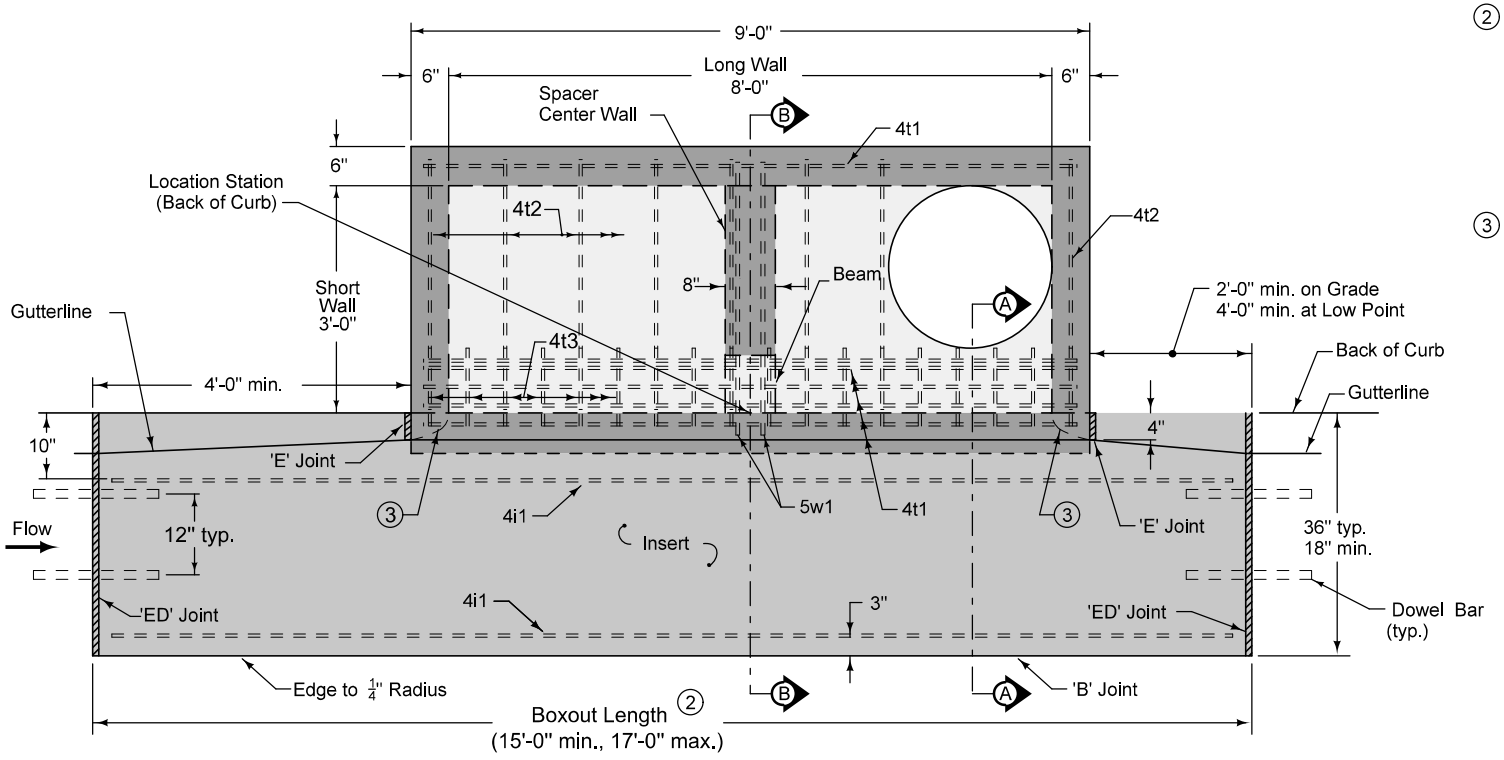
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.509 | SHEET 1 OF 3



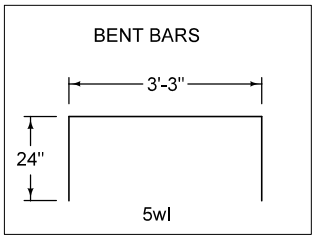
PLAN

2 Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

3 Rounded shaping at inlet.

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4b1	4	Base	——	9	3'-6"	12"
4b2	4	Base	——	5	8'-6"	10"
4i1	4	Insert	——	4	Boxout Length minus 8"	See Insert
4t1	4	Top	——	6	8'-6"	See Plan
4t2	4	Top	——	8	3'-6"	12"
4t3	4	Top	——	18	10"	6"
4w1	4	Walls	——	22	Wall Height minus 4"	13"
4w2	4	Long Walls	——	Varies	4'-8"	12"
4w3	4	Short Walls	——	Varies	3'-8"	12"
5w1	5	Beam	⌐¬	2	7'-3"	4"



SUDAS | IOWA DOT

REVISION 6 04-21-20

FIGURE 6010.509 | STANDARD ROAD PLAN | SW-509

SHEET 2 of 3

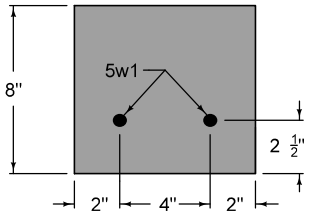
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

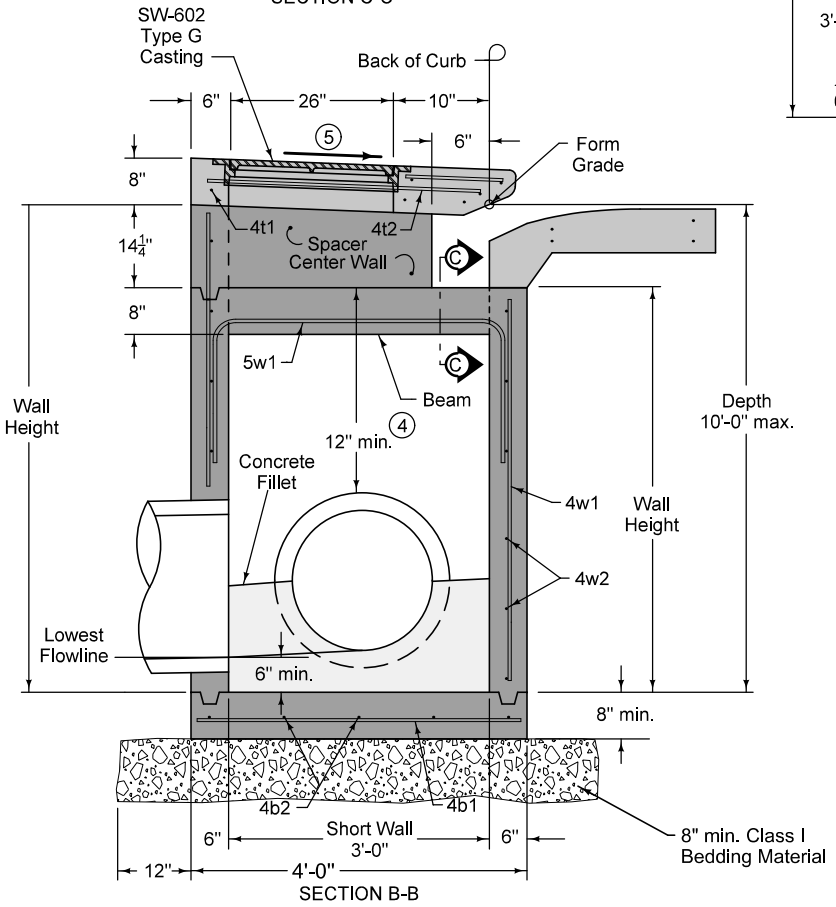
Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

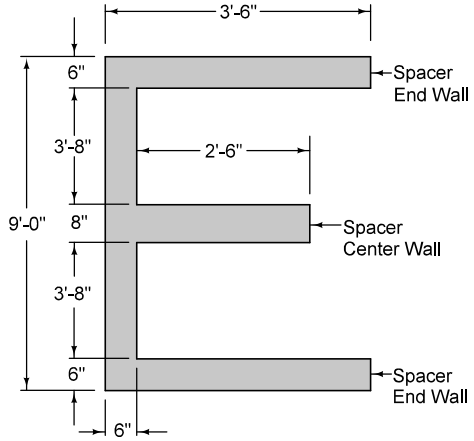
FIGURE 6010.509 SHEET 2 OF 3



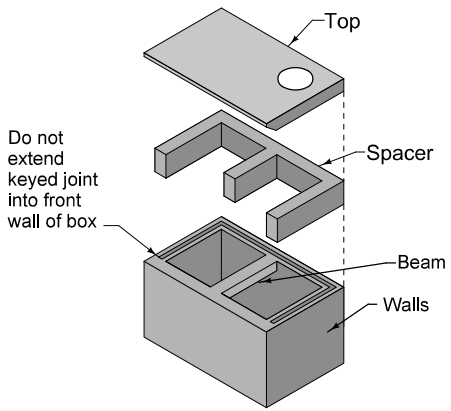
SECTION C-C



SECTION B-B



PLAN
(SPACER)



ISOMETRIC
(Refer to SECTION B-B for
alignment of Top with Spacer)

(4) 12 inch minimum wall height above all pipes.

(5) Slope of 1.5% or as specified in the contract documents.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	24"	30"
Long Wall	60"	66"

SUDAS | IOWA DOT | REVISION 6 04-21-20

FIGURE 6010.509 | STANDARD ROAD PLAN | SW-509 | SHEET 3 of 3

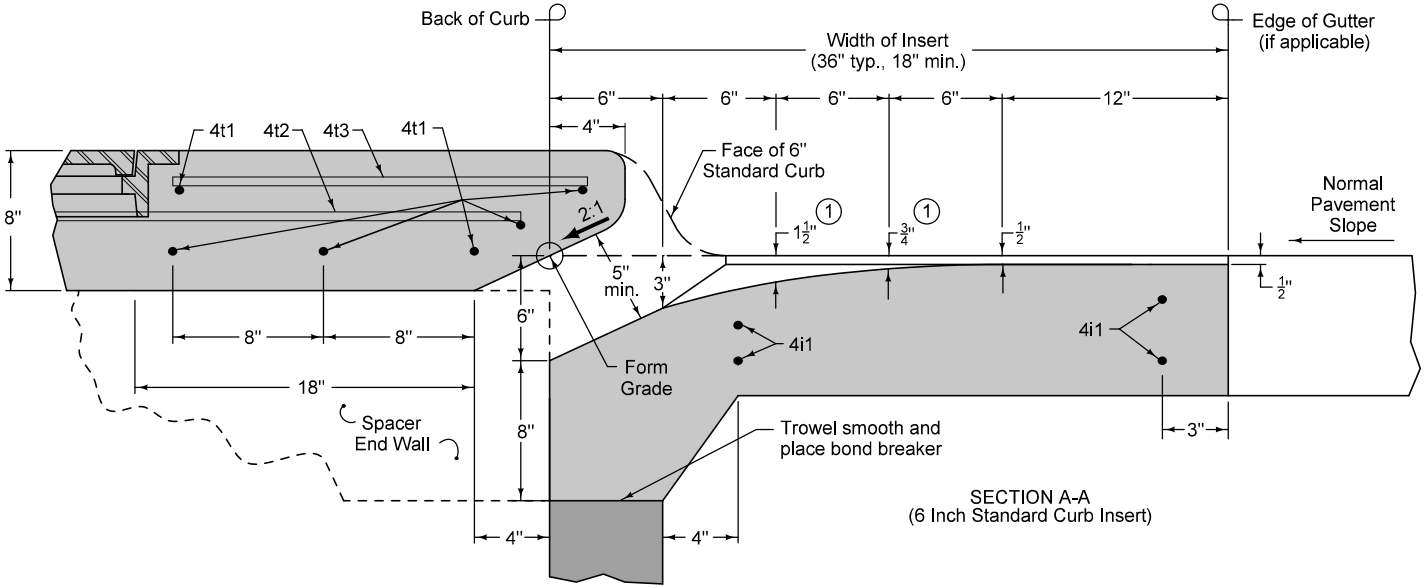
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

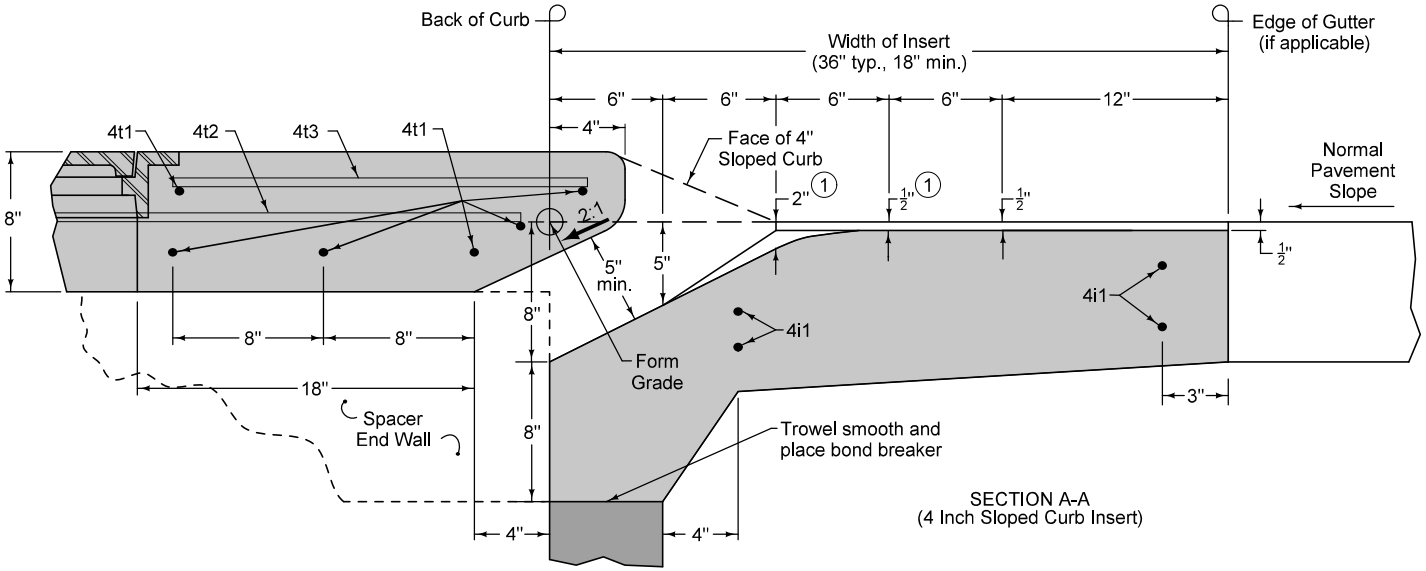
Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.509 SHEET 3 OF 3



SECTION A-A
(6 Inch Standard Curb Insert)



SECTION A-A
(4 Inch Sloped Curb Insert)

① Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by $\frac{1}{4}$ inch.

FIGURE 6010.510 | SHEET 1 OF 3

SUDAS | IOWA DOT

REVISION	
6	04-21-20

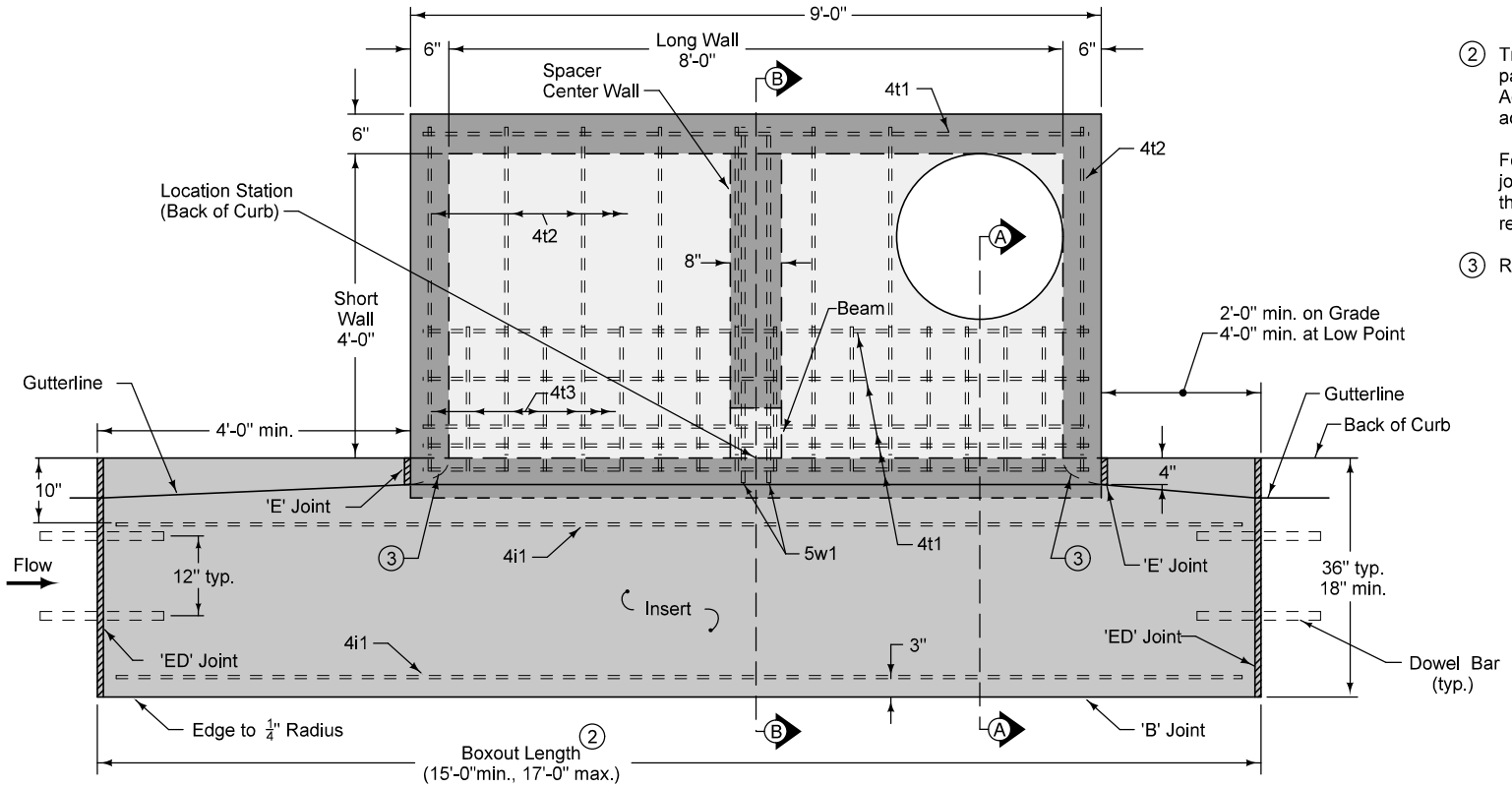
FIGURE 6010.510 | STANDARD ROAD PLAN | SW-510 | SHEET 1 of 3

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX



PLAN

② Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

③ Rounded shaping at inlet.

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4b1	4	Base	——	9	4'-6"	12"
4b2	4	Base	——	6	8'-6"	11"
4i1	4	Insert	——	4	Boxout Length minus 8"	See Insert
4t1	4	Top	——	7	8'-6"	See Plan
4t2	4	Top	——	8	4'-4"	12"
4t3	4	Top	——	18	1'-10"	6"
4w1	4	Walls	——	24	Wall Height minus 4"	13"
4w2	4	Long Walls	——	Varies	4'-8"	12"
4w3	4	Short Walls	——	Varies	8'-8"	12"
5w1	5	Beam	⌐¬	2	8'-3"	4"

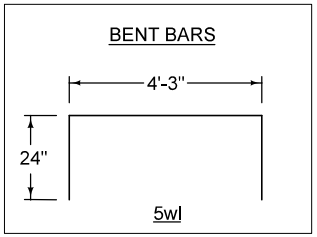


FIGURE 6010.510 SHEET 2 OF 3

SUDAS | IOWA DOT

REVISION 6 04-21-20

SW-510

FIGURE 6010.510 | STANDARD ROAD PLAN

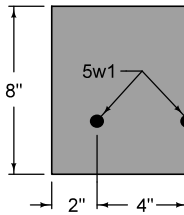
SHEET 2 of 3

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

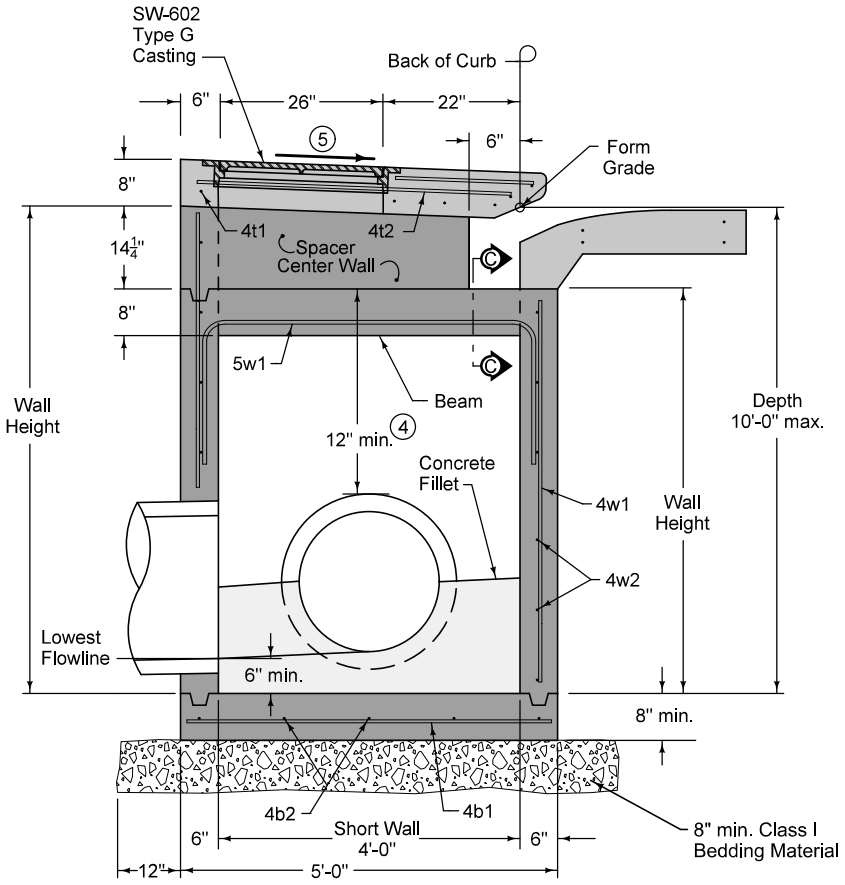
Paul D. Wigand
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

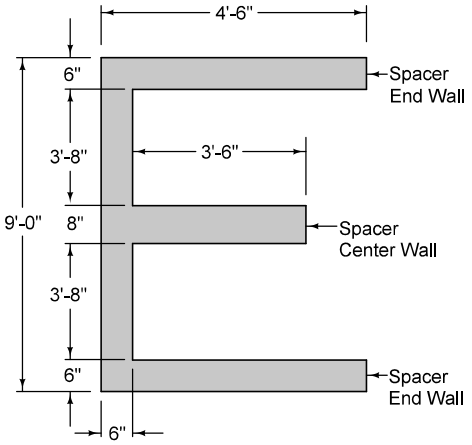
DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX



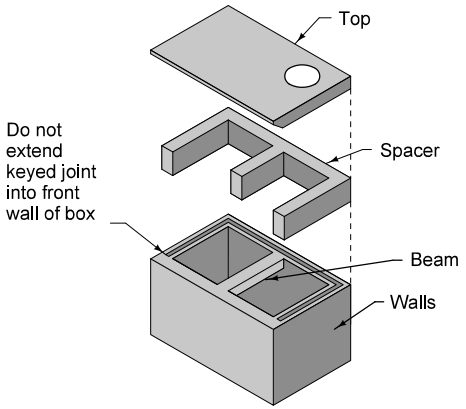
SECTION C-C



SECTION B-B



PLAN
(SPACER)



ISOMETRIC
(Refer to Section B-B
for alignment of Top
with Spacer)

④ 12 inch minimum wall height above all pipes.

⑤ Slope of 1.5% or as specified in the contract documents.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	30"	36"
Long Wall	60"	66"

SUDAS | IOWADOT | REVISION 6 04-21-20

FIGURE 6010.510 | STANDARD ROAD PLAN | SW-510 | SHEET 3 of 3

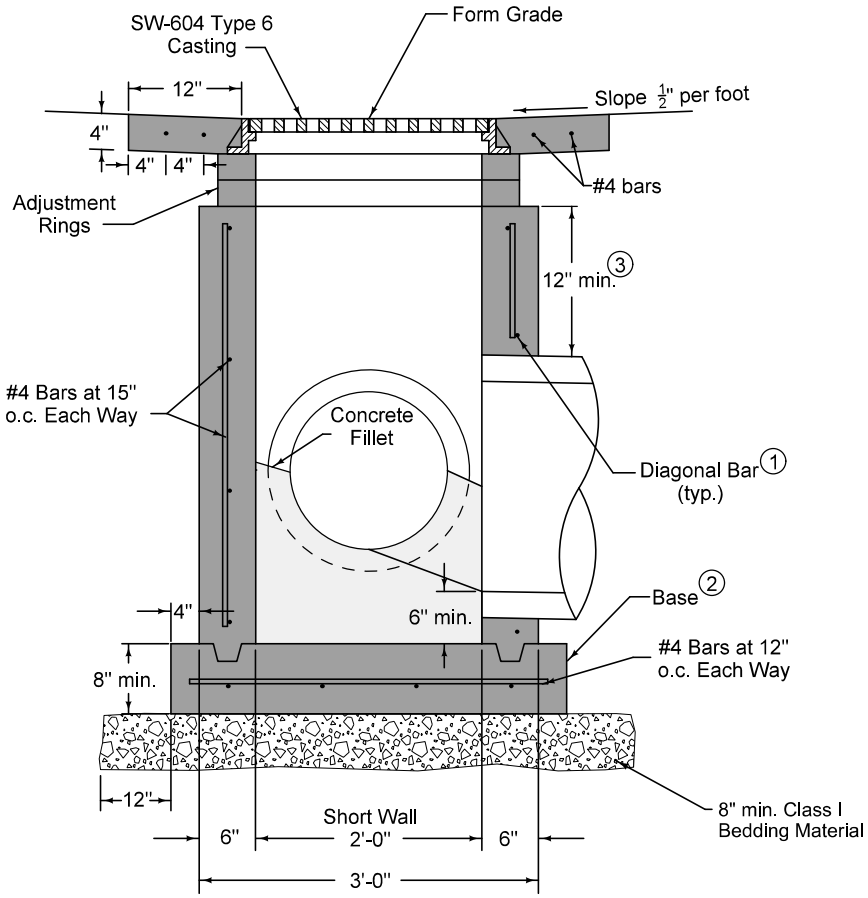
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

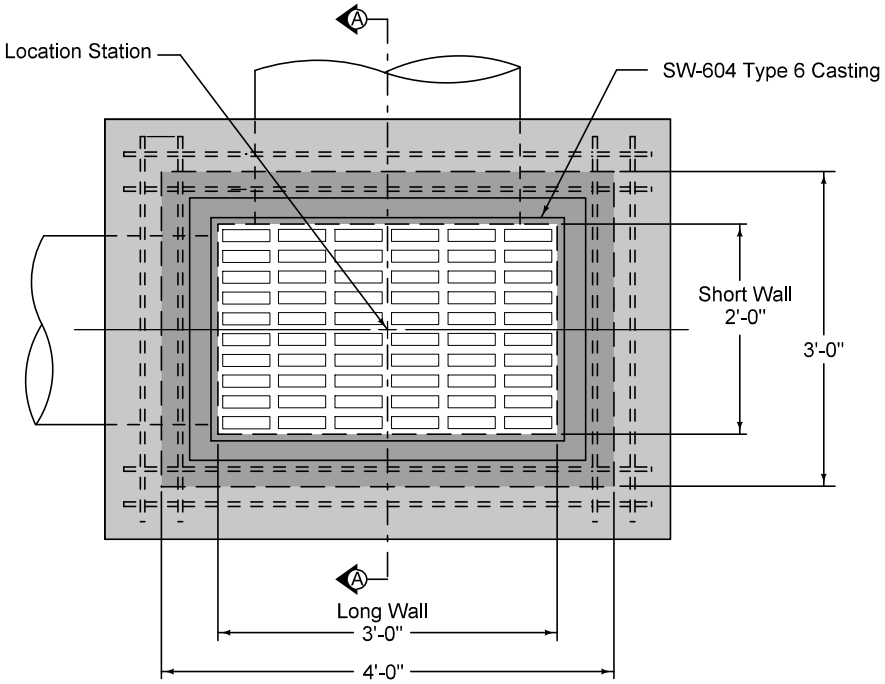
DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX

FIGURE 6010.510 | SHEET 3 OF 3



SECTION A-A

1. Install four #4 diagonal bars at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.



PLAN

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	15"	18"
Long Wall	24"	30"

FIGURE 6010.511 | SHEET 1 OF 1

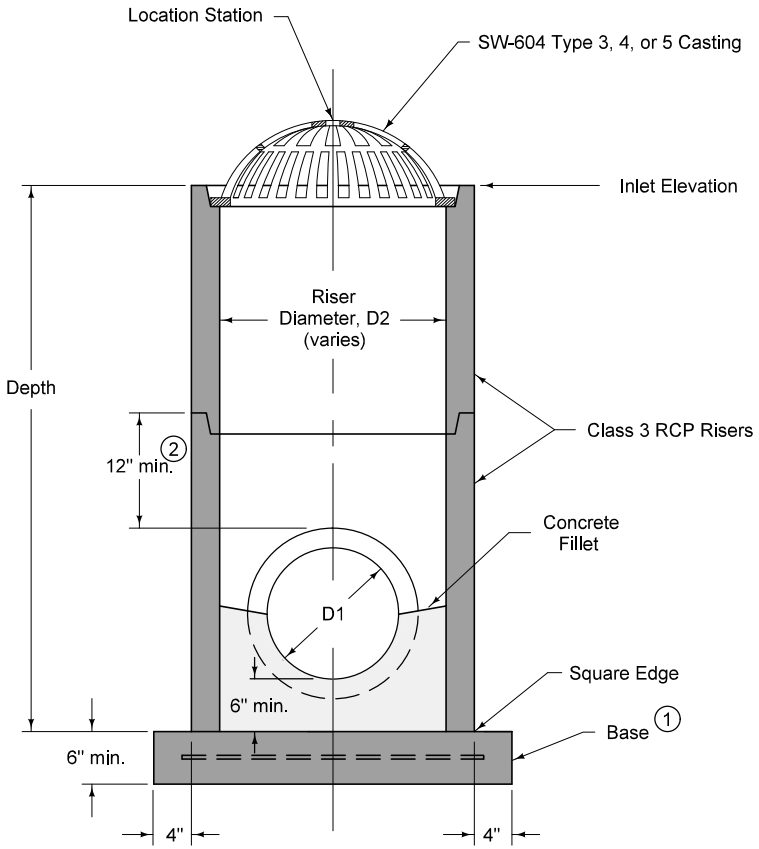
SUDAS | IOWA DOT | REVISION 2 | 04-21-20

FIGURE 6010.511 | STANDARD ROAD PLAN | SW-511 | SHEET 1 of 1

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

RECTANGULAR AREA INTAKE



TYPICAL SECTION

CASE 1

1. Precast (shown) or cast-in-place base:
   - Precast: 6 inch thick concrete with #6 welded wire mesh on 4 inch centers (WWF 4" x 4"). Center mesh vertically within base.
   - Cast-in-place: 8 inch thick non-reinforced concrete.
2. 12 inch minimum riser height above all pipes.

INTAKE SIZE - CASE 1	
Outlet Pipe Diameter, D1	Minimum Riser Diameter, D2
12"	18"
15"	24"
18"	24"
21"	30"
24"	30"
27"	36"

SUDAS | IOWA DOT

REVISION 4 04-21-20

FIGURE 6010.512 | STANDARD ROAD PLAN | SW-512

SHEET 1 of 2

REVISIONS: Changed 1 to I on Bedding Material

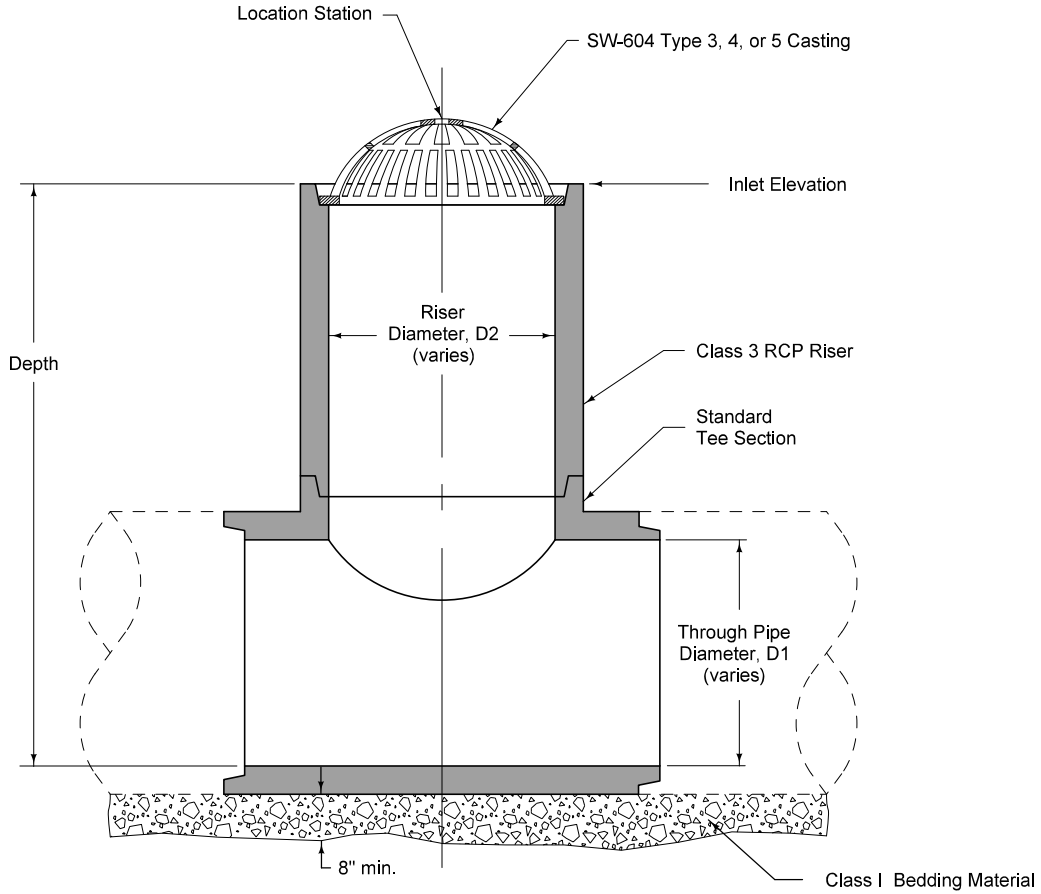
Paul D. Wigard
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

CIRCULAR AREA INTAKE

FIGURE 6010.512 | SHEET 1 OF 2

③ Minimum riser diameter is 18 inches.



TYPICAL SECTION

CASE 2

INTAKE SIZE - CASE 2	
Through Pipe Diameter, D1	Maximum ③ Riser Diameter, D2
18"	18"
21"	18"
24"	24"
27"	24"
30"	30"
36" or more	36"

SUDAS | IOWA DOT | REVISION 4 04-21-20

FIGURE 6010.512 | STANDARD ROAD PLAN | SW-512 | SHEET 2 of 2

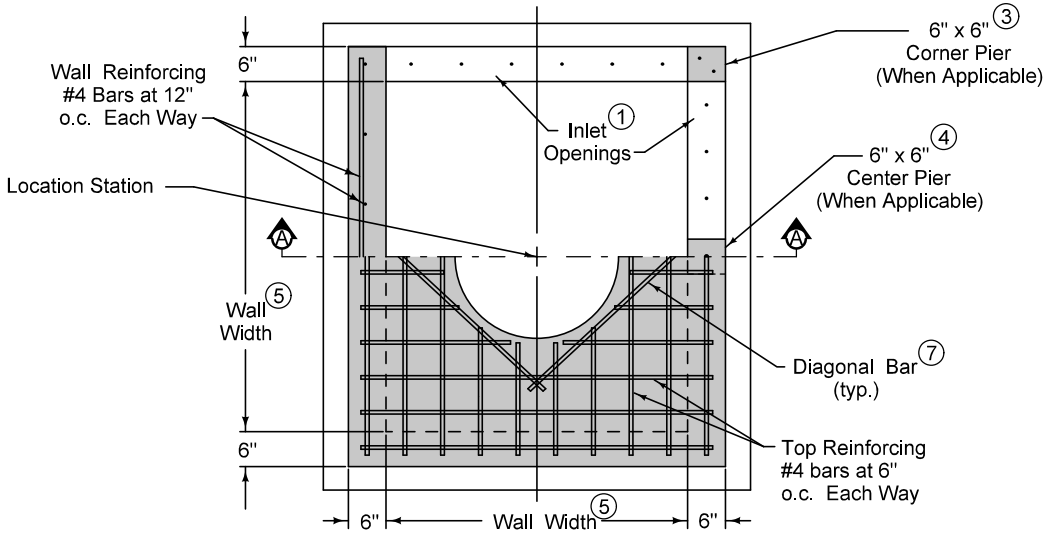
REVISIONS: Changed 1 to I on Bedding Material.

Paul D. Wigand
SUDAS DIRECTOR

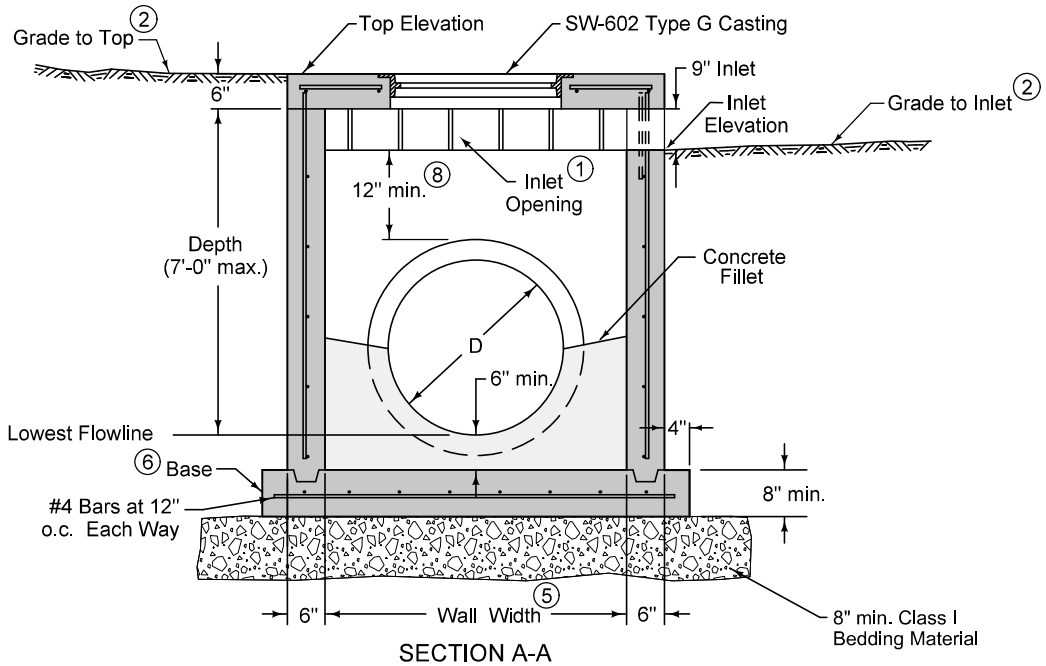
Stuart Nicholson
DESIGN METHODS ENGINEER

CIRCULAR AREA INTAKE

FIGURE 6010.512 SHEET 2 OF 2



PLAN



SECTION A-A

Structure may be built with openings on any or all sides. Provide openings and orientation as specified in the contract documents.

Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.

① Construct inlet openings with 15 inch #4 epoxy coated bars at 8 inches on center. Embed bars a minimum of 3 inches into walls and top at all openings.

② Grade to inlet elevation on open sides. Grade to top elevation on closed sides.

③ Corner pier required between openings of two adjacent walls. Extend wall reinforcing vertically through pier. Install one additional 15 inch #4 bar in pier.

④ Center pier required at center of any inlet opening with length of 5 feet or greater. Extend wall reinforcing vertically through pier. Install one additional 15 inch #4 bar in pier.

⑤ Wall widths vary with pipe diameter. Provide 6 inches of wall width (minimum) each side of pipe opening. Minimum wall width is 36 inches. Maximum wall width is 72 inches.

⑥ Cast-in-place base shown. If base is precast integral with walls, the footprint of base is not required to extend beyond the outer edge of the walls.

⑦ Install four #4 diagonal bars at all pipe openings.

⑧ 12 inch minimum wall height above all pipes.

SUDAS	IOWADOT	REVISION 3	04-20-21
FIGURE 6010.513	STANDARD ROAD PLAN	SW-513	
		SHEET 1 of 1	

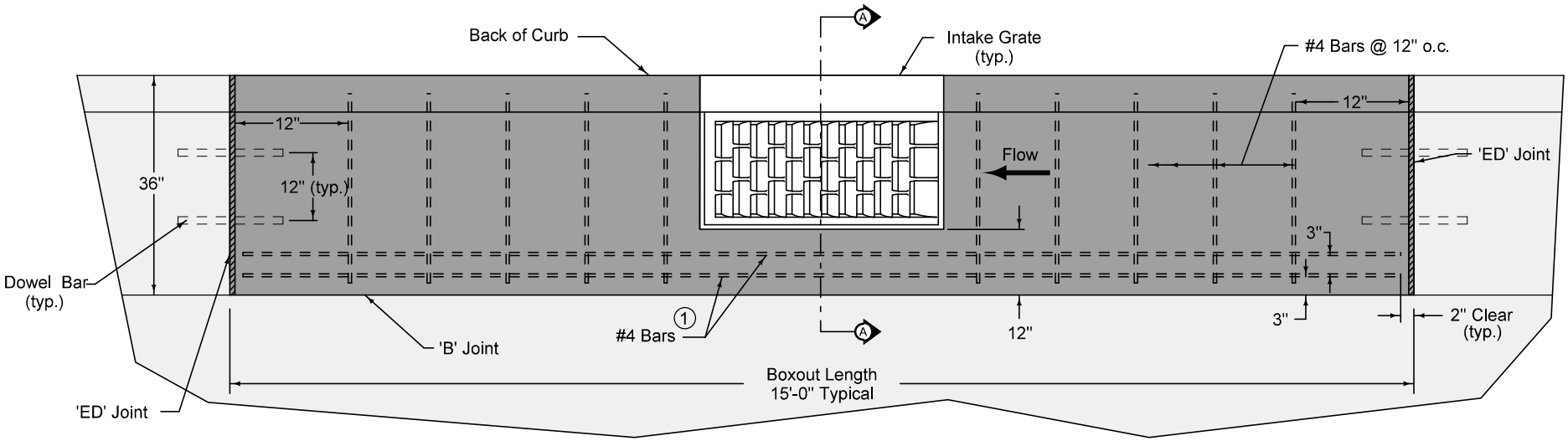
REVISIONS: Modified circle notes 1, 3, 4 and 8.

Paul D. Wigand
SUDAS DIRECTOR

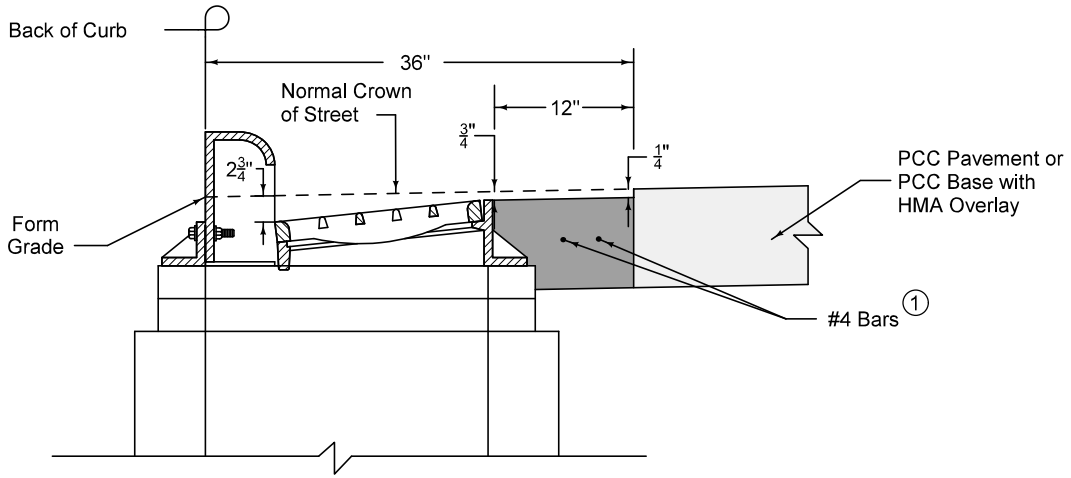
Stuart Nicholson
DESIGN METHODS ENGINEER

OPEN-SIDED AREA INTAKE

FIGURE 6010.513 SHEET 1 OF 1



BOXOUT IN PCC PAVEMENT AND PCC BASE WITH HMA OVERLAY



SECTION A-A

Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing concrete pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the boxout.

(1) Center bars vertically within slab.

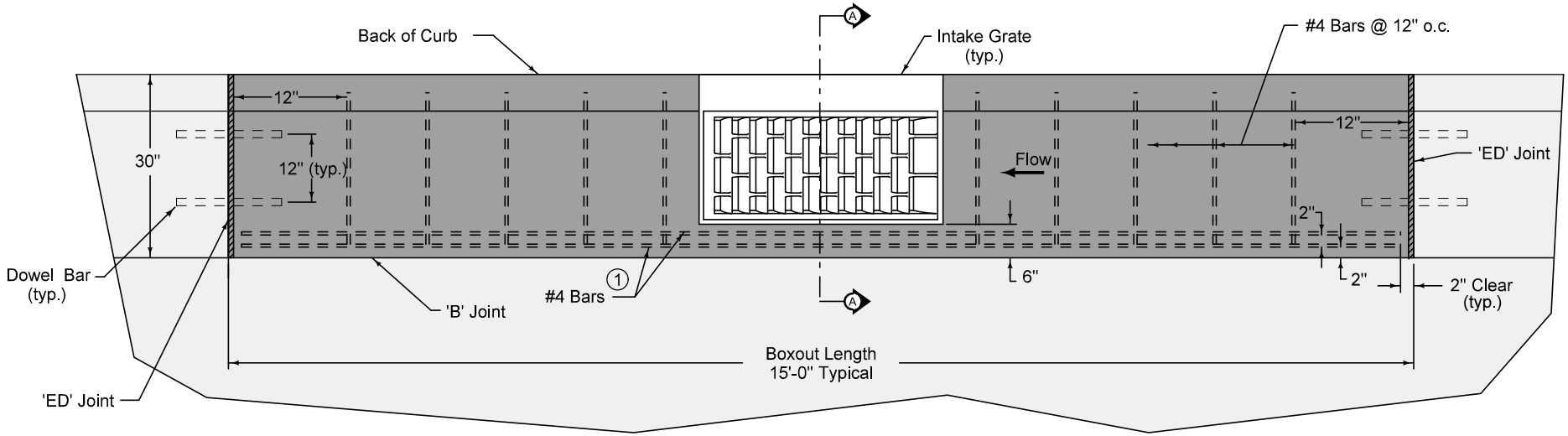
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.514	STANDARD ROAD PLAN	SW-514
		SHEET 1 of 3

REVISIONS: Added dimension to back of grate. Updated line work and Iowa DOT and SUDAS logo.

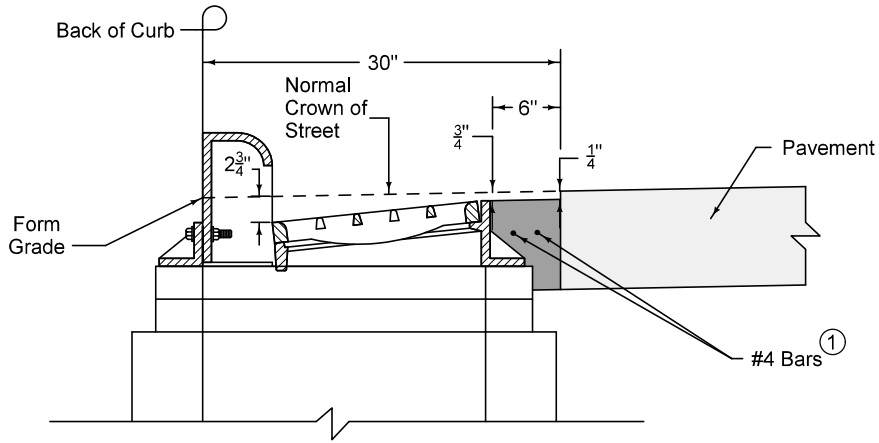
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

BOXOUT FOR GRATE INTAKES

FIGURE 6010.514 SHEET 1 OF 3



BOXOUT IN PCC CURB AND GUTTER



SECTION A-A

1 Center bars vertically within slab.

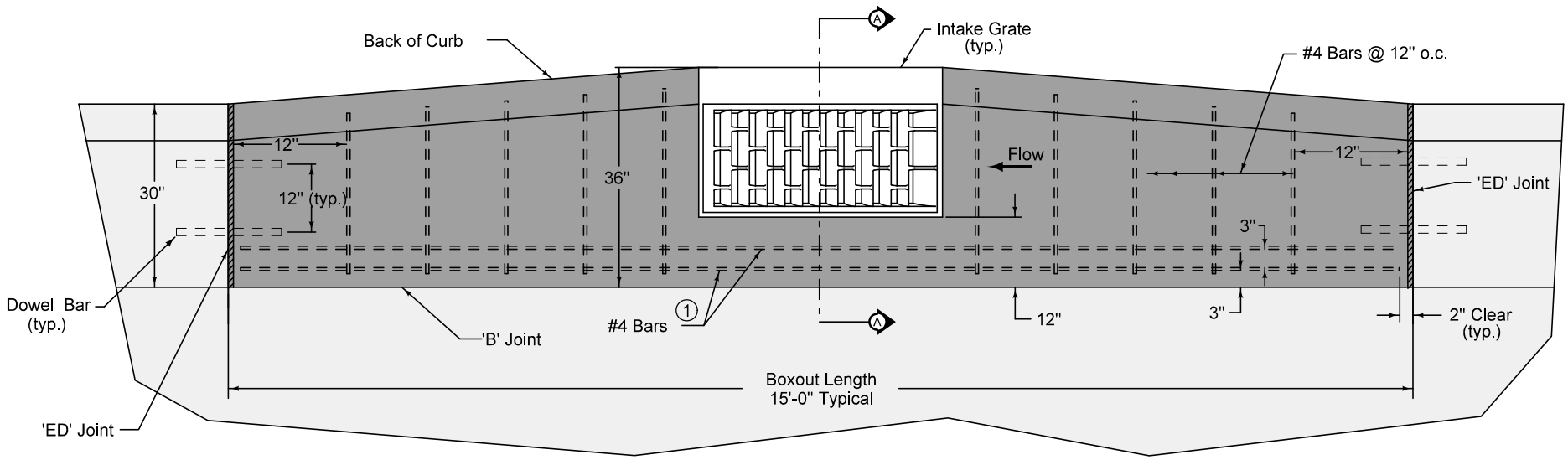
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.514	STANDARD ROAD PLAN	SW-514
		SHEET 2 of 3

REVISIONS: Added dimension to back of grate. Updated line work and Iowa DOT and SUDAS logo.

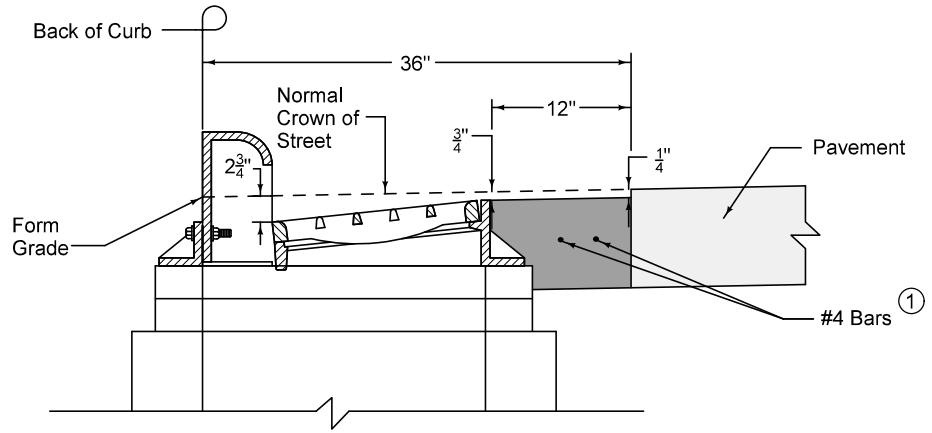
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

BOXOUT FOR GRATE INTAKES

FIGURE 6010.514 SHEET 2 OF 3



ALTERNATE BOXOUT IN PCC CURB AND GUTTER



SECTION A-A

Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjacent joint spacing may need to be field adjusted to fit boxouts.

For retrofit intakes, match existing concrete pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the boxout.

(1) Center bars vertically within slab.

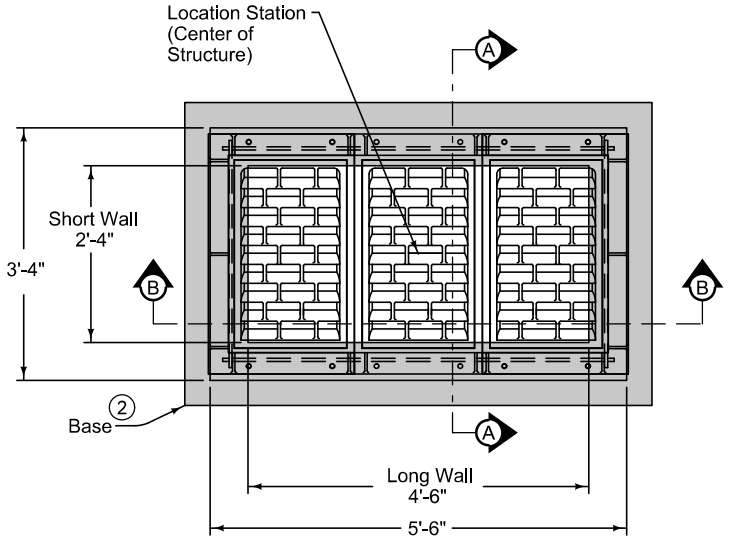
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.514	STANDARD ROAD PLAN	SW-514
		SHEET 3 of 3

REVISIONS: Added dimension to back of grate. Updated line work and Iowa DOT and SUDAS logo.

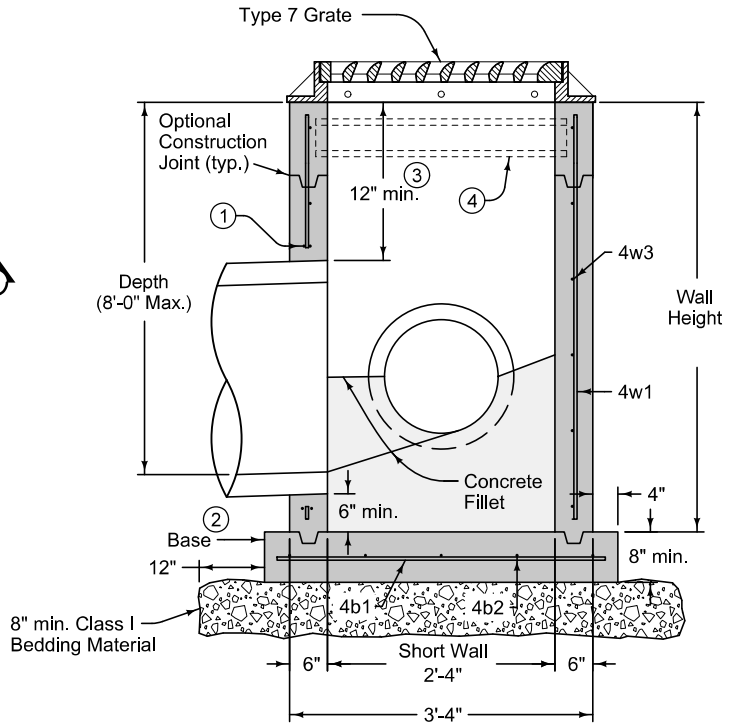
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

BOXOUT FOR GRATE INTAKES

FIGURE 6010.514 SHEET 3 OF 3



PLAN



SECTION A-A

1. Provide two #4 hoop bars at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. If required by casting manufacturer, provide support beam under all frame joints. Modify structure walls as required to provide pocket for beam.

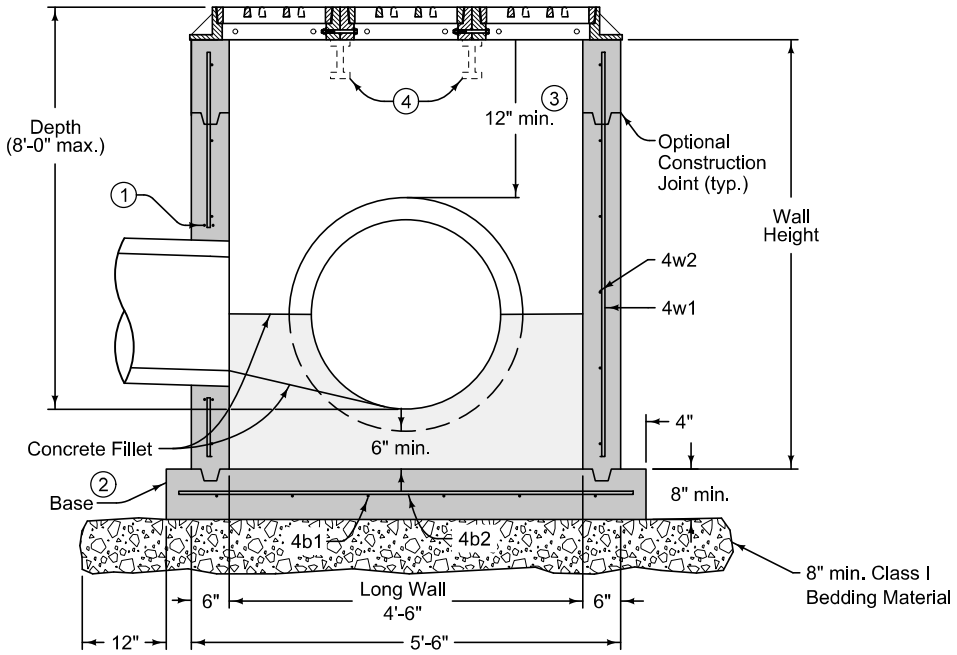
FIGURE 6010.515 | SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION: New 04-21-20
FIGURE 6010.515	STANDARD ROAD PLAN	SW-515
		SHEET 1 of 2

REVISIONS: New.

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TRIPLE RECTANGULAR AREA INTAKE



SECTION B-B

1. Provide two #4 hoop bars at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. If required by casting manufacturer, provide support beam under all frame joints. Modify structure walls as required to provide pocket for beam.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	18"	21"
Long Wall	36"	42"

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4b1	4	Base	——	6	3'-6"	12"
4b2	4	Base	——	4	5'-8"	12"
4w1	4	Walls	——	20	Wall Height minus 4"	12"
4w2	4	Short Wall	——	Varies	3'-0"	12"
4w3	4	Long Wall	——	Varies	5'-2"	12"

SUDAS | IOWADOT

REVISION: New 04-21-20

FIGURE 6010.515 | STANDARD ROAD PLAN | SW-515

SHEET 2 of 2

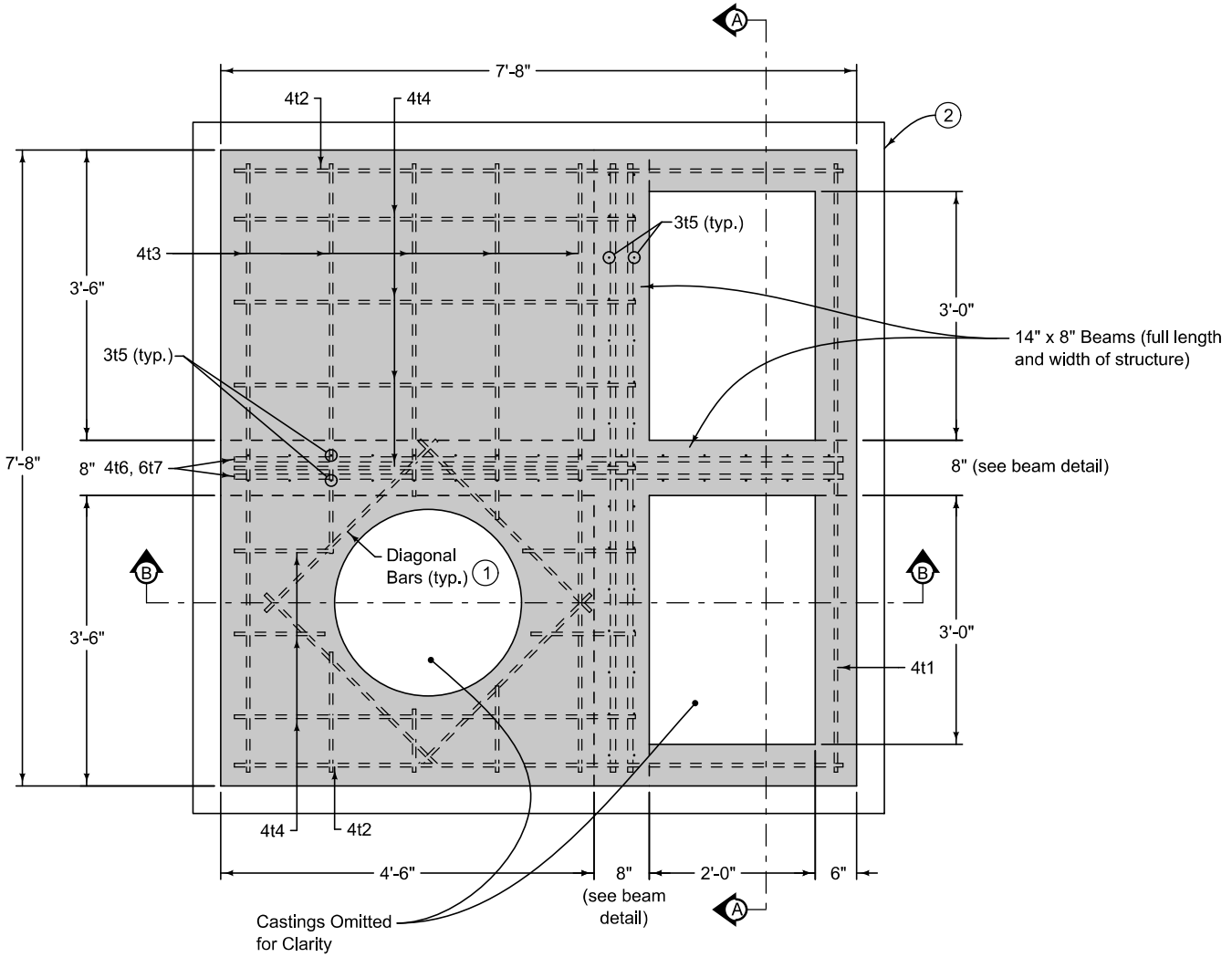
REVISIONS: New.

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SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

TRIPLE RECTANGULAR AREA INTAKE

FIGURE 6010.515 | SHEET 2 OF 2



PLAN

Maximum pipe diameters are set based on maximum structure depth of 6 feet-6 inches.

Refer to SW-514 for boxout details.

(1) Install four #4 diagonal bars at manhole opening and at all pipe openings.

(2) Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

MAXIMUM PIPE DIAMETERS	
Wall	Max. Dia.
Front/Back	36"
Sides	42"

FIGURE 6010.516 | SHEET 1 OF 3

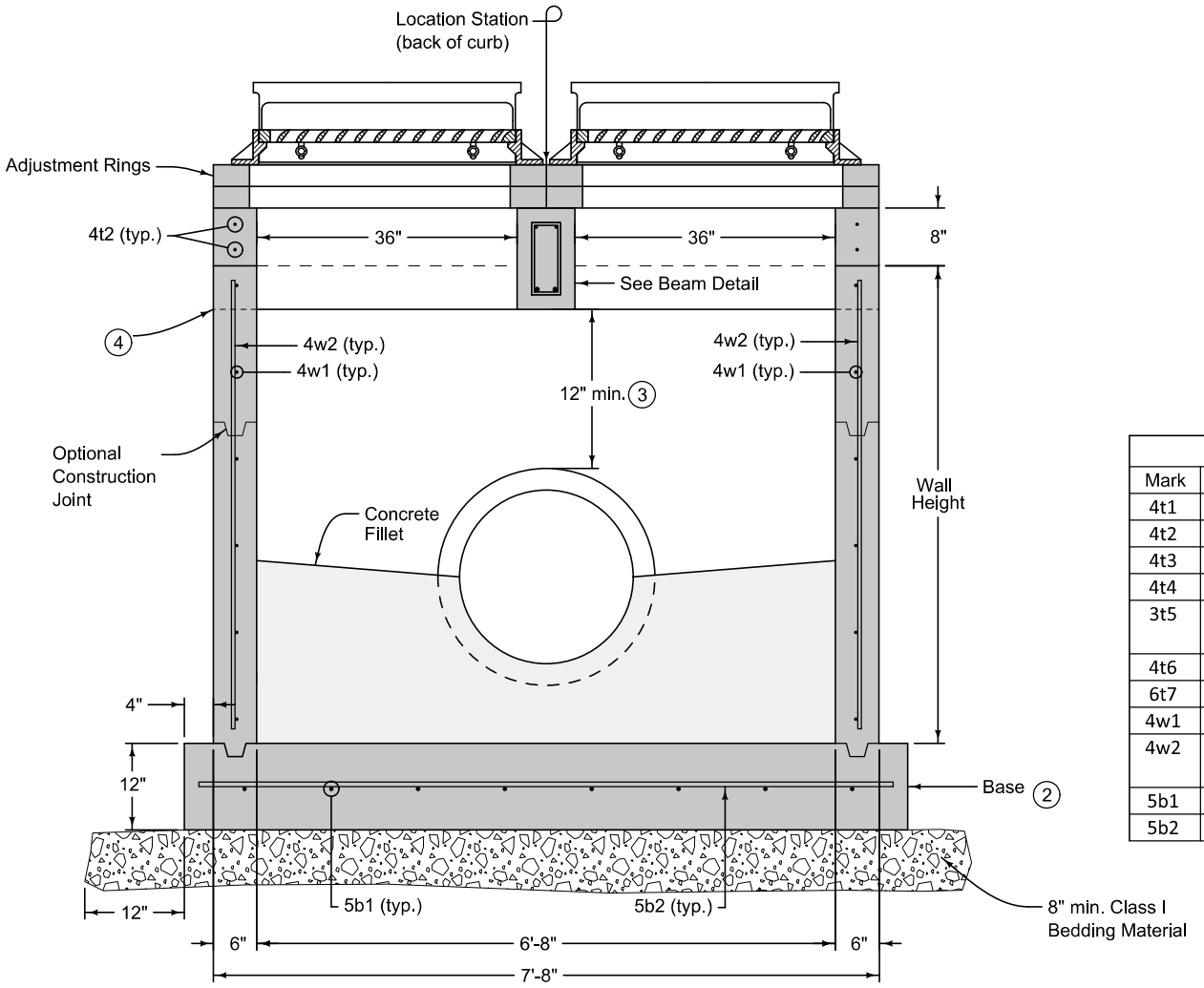
SUDAS | IOWADOT | REVISION: New 4-16-24

FIGURE 6010.516 | STANDARD ROAD PLAN | SW-516 | SHEET 1 of 3

REVISIONS: New.

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LARGE WELL DOUBLE GRATE INTAKE WITH MANHOLE



SECTION A-A

1. Install four #4 diagonal bars at manhole opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. Form pockets in the wall to receive integral beams in the top.

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	2	7'-4''	See Detail
4t2	4	Top	——	4	7'-4''	See Detail
4t3	4	Top	——	10	7'-4"	12''
4t4	4	Top	——	14	4'-2''	12''
3t5	3	Top	▯	30	3'-1"	6"
4t6	4	Top	——	4	7'-4"	See Detail
6t7	6	Top	——	4	7'-4"	See Detail
4w1	4	Walls	——	Varies	7'-4"	12''
4w2	4	Walls	——	32	Wall Height minus 4''	12"
5b1	5	Base	——	9	7'-10''	12''
5b2	5	Base	——	9	7'-10"	12''

SUDAS | IOWA DOT

REVISION: New 4-16-24

FIGURE 6010.516 | STANDARD ROAD PLAN | SW-516

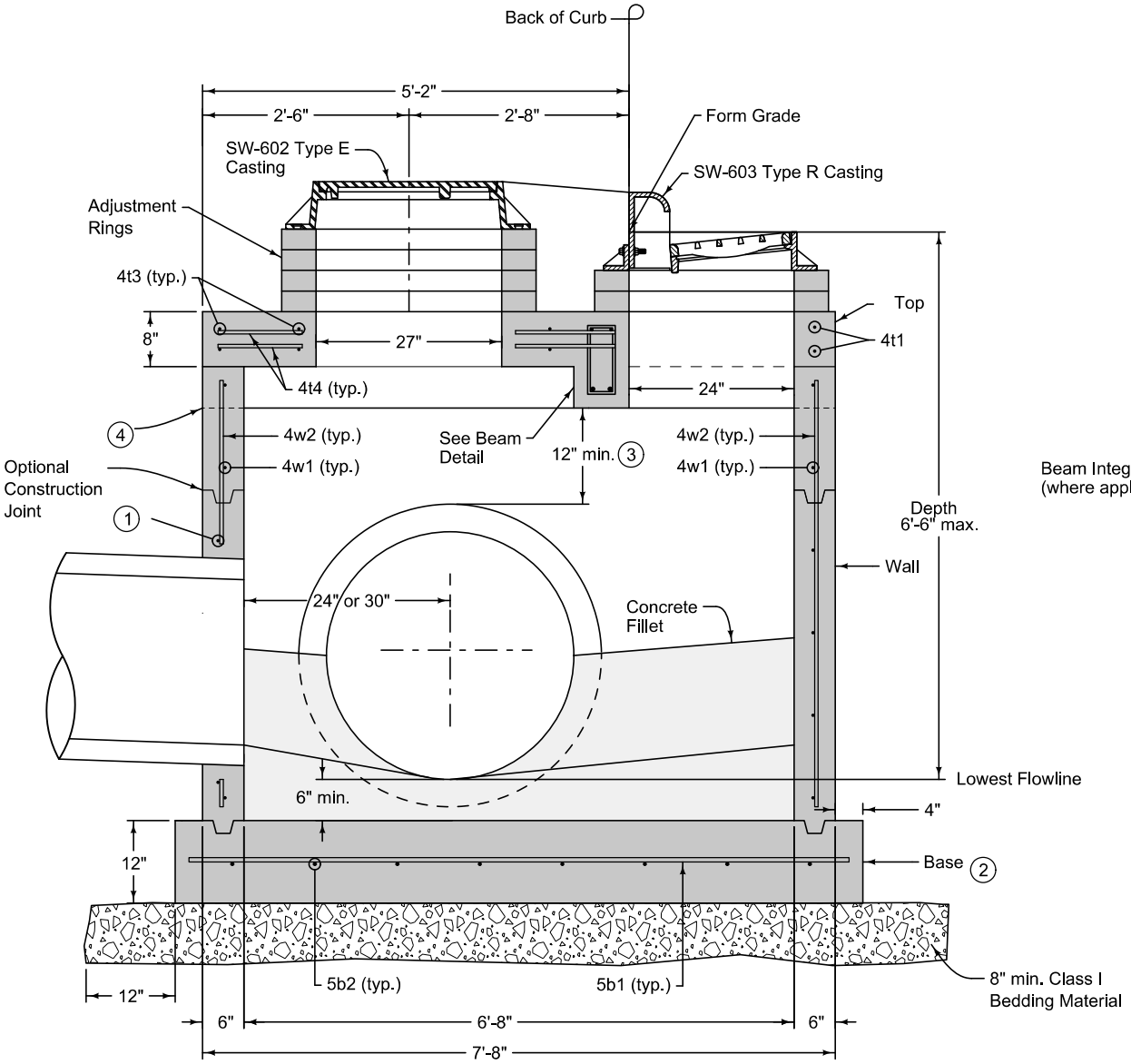
SHEET 2 of 3

REVISIONS: New.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

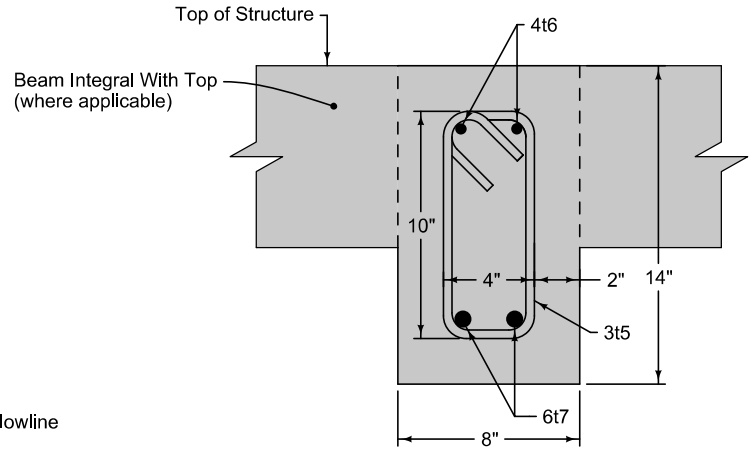
LARGE WELL DOUBLE GRATE INTAKE WITH MANHOLE

FIGURE 6010.516 SHEET 2 OF 3



SECTION B-B

1. Install four #4 diagonal bars at manhole opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. Form pockets in the wall to receive integral beams in the top.



BEAM DETAIL

FIGURE 6010.516 | SHEET 3 OF 3

SUDAS | IOWADOT

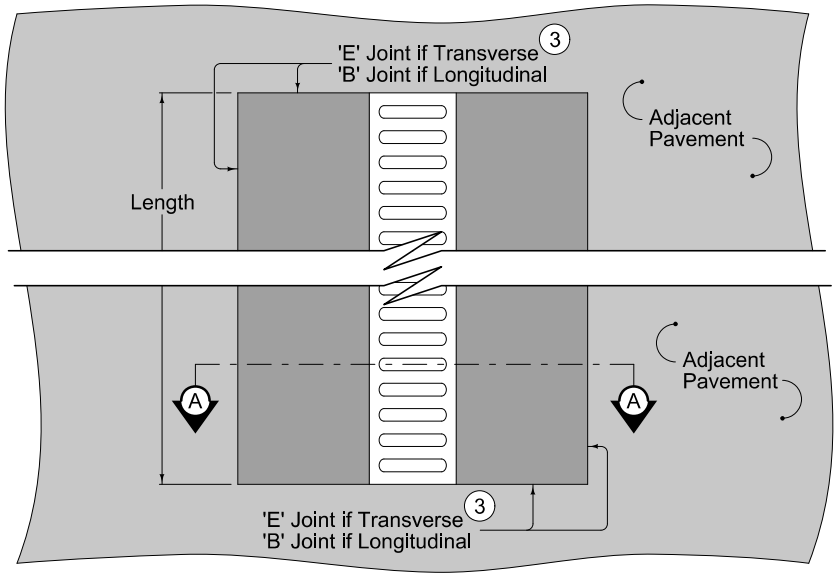
REVISION	
New	4-16-24

FIGURE 6010.516 | STANDARD ROAD PLAN | SW-516 | SHEET 3 of 3

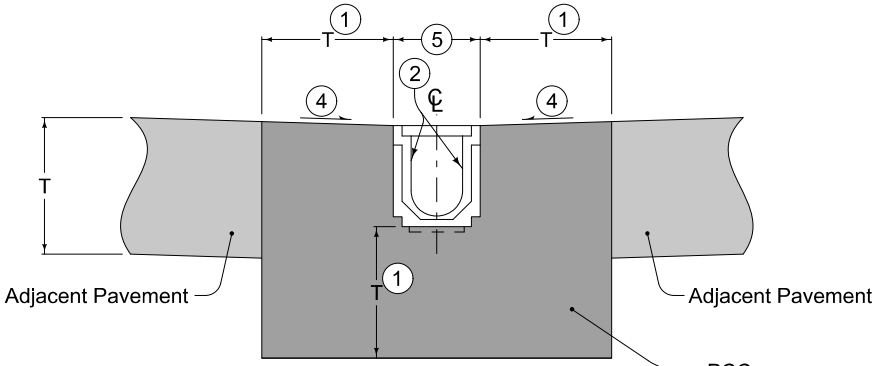
REVISIONS: New.

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LARGE WELL DOUBLE GRATE INTAKE WITH MANHOLE



PLAN



SECTION A-A

1. 6 inches or same as thickness of adjacent pavement, whichever is greater.
2. Linear Trench Drain.
3. For joint details, see PV-101.
4. Slope same as adjacent pavement.
5. Width as determined by manufacturer. Minimum 6 inches.

SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 6010.521	STANDARD ROAD PLAN	SW-521
		SHEET 1 of 2

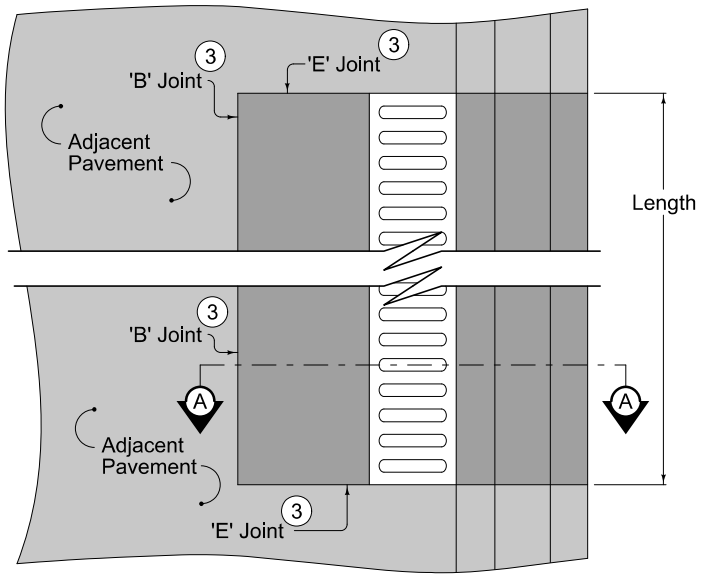
REVISIONS: Converted to joint standard. Modified circle note 1.

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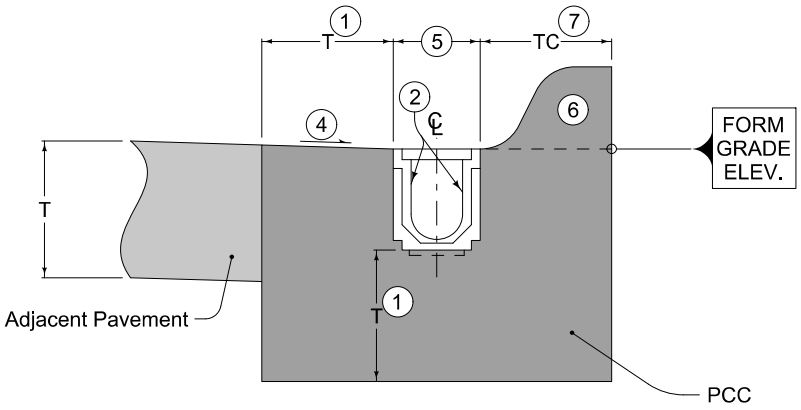
DESIGN METHODS ENGINEER

LINEAR TRENCH DRAIN

FIGURE 6010.521 | SHEET 1 OF 2



PLAN



SECTION A-A

1. 6 inches or same as thickness of adjacent pavement, whichever is greater.
2. Linear Trench Drain.
3. For joint details, see PV-101.
4. Slope same as adjacent pavement.
5. Width as determined by manufacturer. Minimum 6 inches.
6. Standard or sloped curb. For curb details, see PV-102.
7. Minimum thickness same as thickness of adjacent pavement or curb width, whichever is greater.

FIGURE 6010.521 | SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 2 | 04-21-20

FIGURE 6010.521 | STANDARD ROAD PLAN | SW-521 | SHEET 2 of 2

REVISIONS: Converted to joint standard. Modified circle note 1.

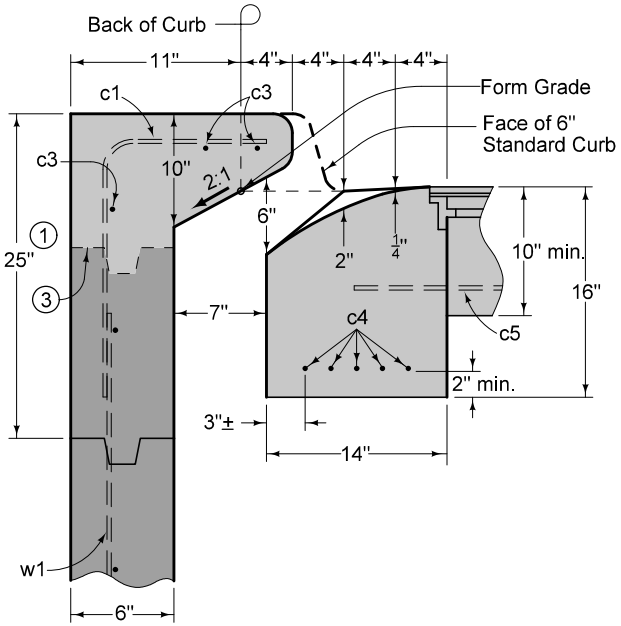
Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

LINEAR TRENCH DRAIN

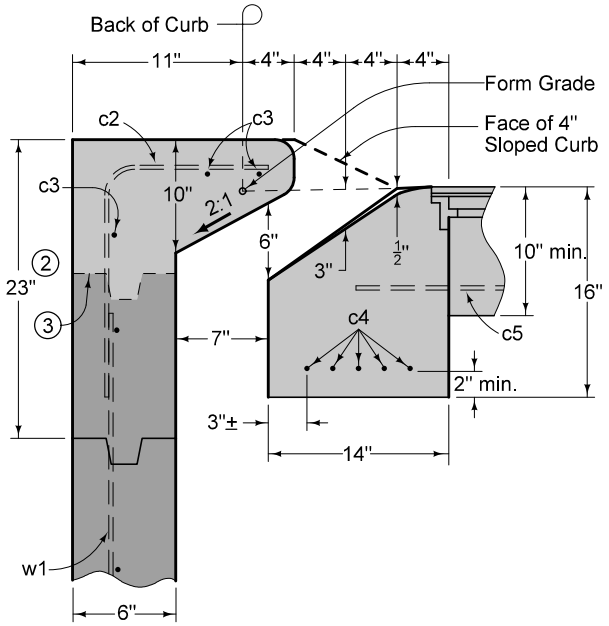
(1) 39 inches when attaching the SW-542 extension unit.

(2) 37 inches when attaching the SW-542 extension unit.

(3) Additional keyed construction joint when attaching the SW-542 extension unit.



INSERT
(6 Inch Standard Curb)



INSERT
(4 Inch Sloped Curb)

FIGURE 6010.541 | SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 5 04-21-20
FIGURE 6010.541	STANDARD ROAD PLAN	SW-541
		SHEET 1 of 2

REVISIONS: Changed wall walls to 6 inch reinforced. Modified TYPICAL SECTION and c1 and c2 bar lengths. Added note 4. Added Class I bedding material.

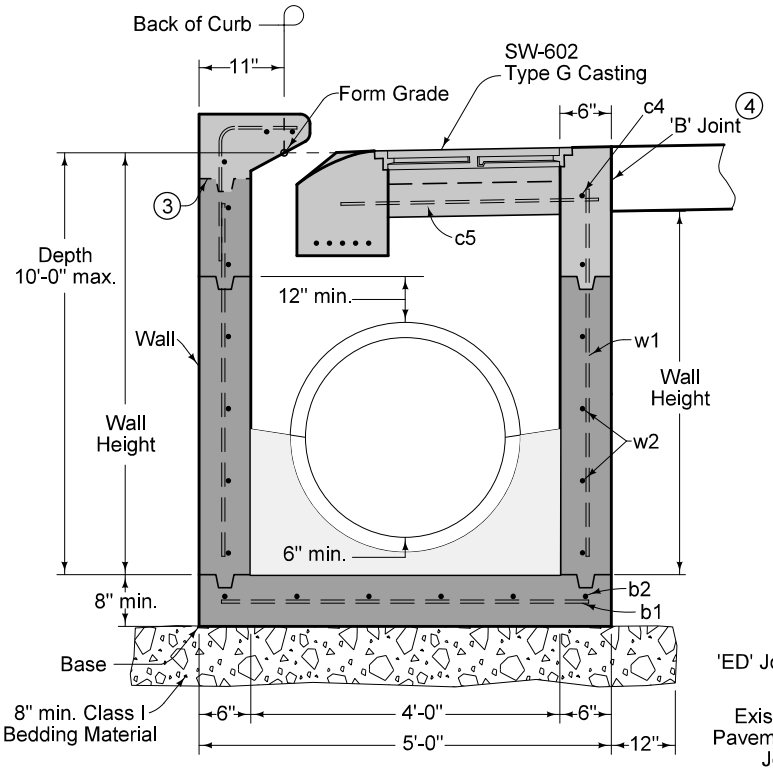
Paul D. Wigand — SUDAS DIRECTOR
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OPEN-THROAT CURB INTAKE UNDER PAVEMENT

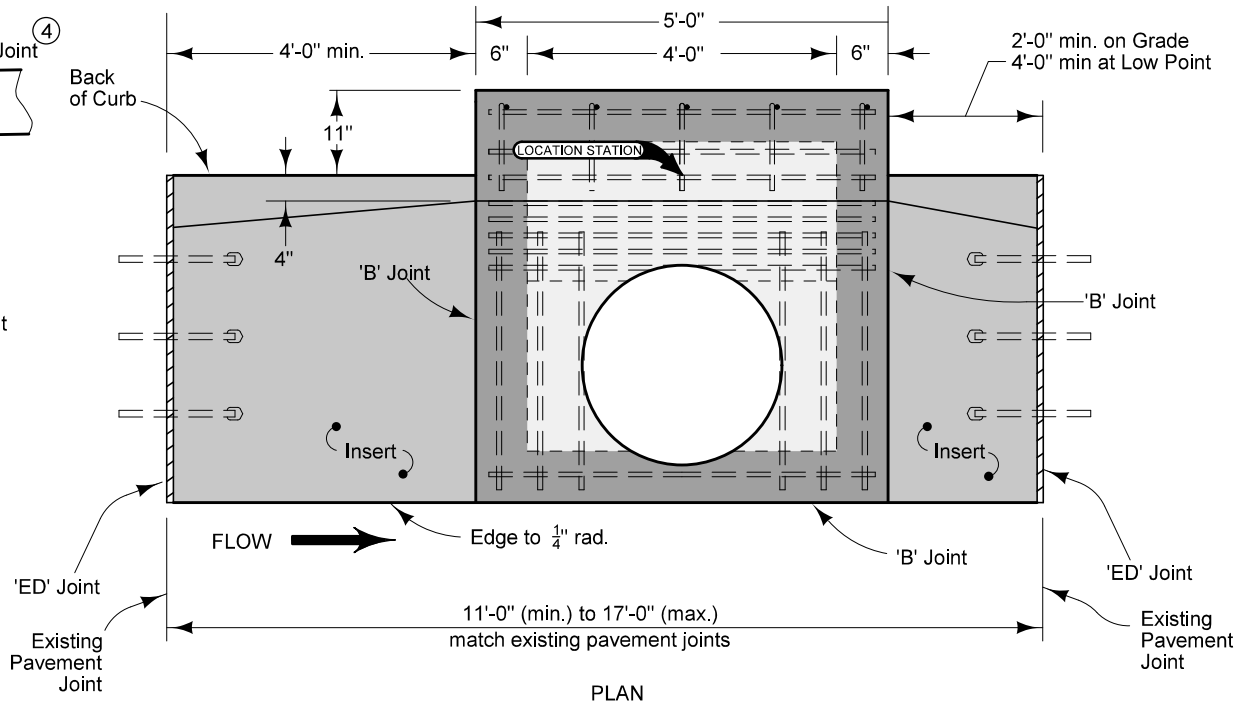
For joint details, refer to PV-101.

③ Additional keyed construction joint when attaching the SW-542 extension unit.

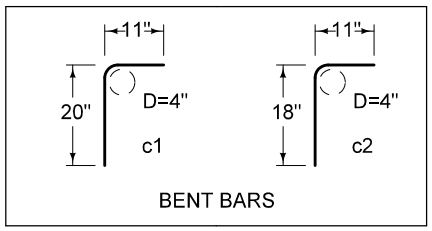
④ Top of well flush with pavement.



TYPICAL SECTION



PLAN



BENT BARS

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
b1	4	Base	——	4'-6"	11"
b2	4	Base	——	4'-6"	11"
w1	4	Wall	——	Wall Height minus 4"	14"
w2	4	Wall	——	4'-8"	12"
c1	4	Top	⌜	2'-7"	14"
c2	4	Top	⌜	2'-5"	14"
c3	4	Top	——	4'-8"	See Detail
c4	4	Top	——	4'-8"	See Detail
c5	4	Top	——	3'-2"	See Detail

MAXIMUM PIPE DIAMETER	
Precast	30"
Cast-in-Place	36"

FIGURE 6010.541 | SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 5 04-21-20

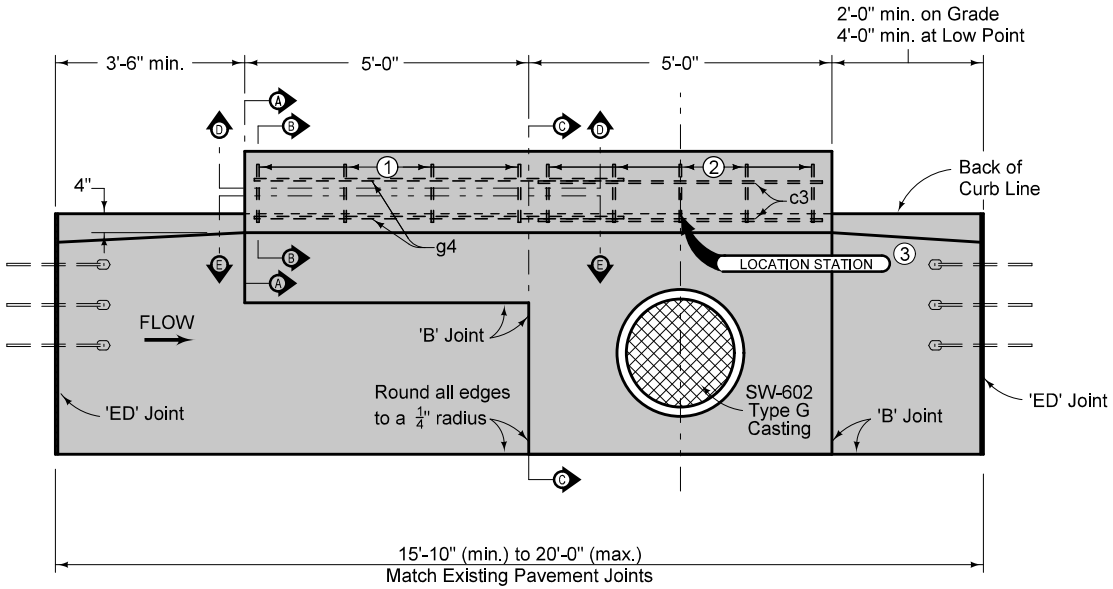
FIGURE 6010.541 | STANDARD ROAD PLAN | SW-541 | SHEET 2 of 2

REVISIONS: Changed wall walls to 6 Inch reinforced. Modified TYPICAL SECTION and c1 and c2 bar lengths. Added note 4. Added Class I bedding material.

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Stuart Nicholson
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OPEN-THROAT CURB INTAKE UNDER PAVEMENT



PLAN
(SW-542 EXTENSION AND SW-541 INTAKE)

Extension unit may be used on either or both sides of SW-541 intakes. Details are similar when extension unit is on the opposite side.

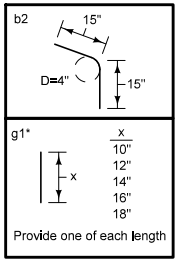
① g3 for 6 inch standard curb; g5 for 4 inch sloped curb.

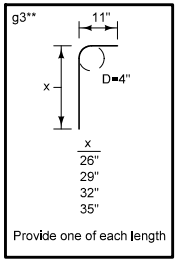
② c1 for 6 inch standard curb; c2 for 4 inch sloped curb. See SW-541 for reinforcing.

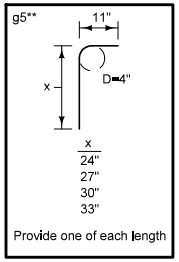
③ The location station is where the centerline of intake meets the back of the curb line.

Placing sequence: 1. Base; 2. Walls and Extension; 3. Top; 4. Insert

REINFORCING BAR LIST							
BAR	SIZE	LOCATION	SHAPE	NO.	LENGTH	WEIGHT	SPACING
b2	4	Intake Wall	⌐	3	2'-6"	5.0	9"
f1	4	Bottom	—	3	4'-9"	9.5	9"
f2	4	Bottom	—	4	1'-7"	4.2	18"
g1	4	Wall	—	5	Varies*	Varies*	12"
g2	4	Wall	—	1	4'-8"	3.1	-
g3	4	Top	⌐	4	Varies**	Varies**	18"
g4	4	Top	—	3	6'-4"	12.7	-
g5	4	Top	⌐	4	Varies**	Varies**	18"







SUDAS IOWA DOT

REVISION	
5	10-20-20

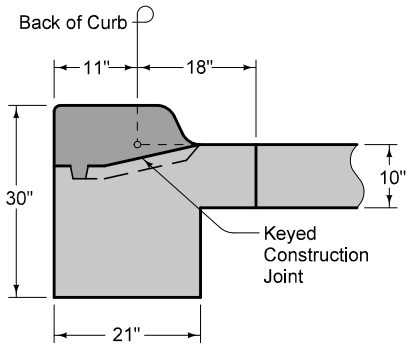
FIGURE 6010.542 | STANDARD ROAD PLAN | SW-542 | SHEET 1 of 4

REVISIONS: Removed Interim from standard.

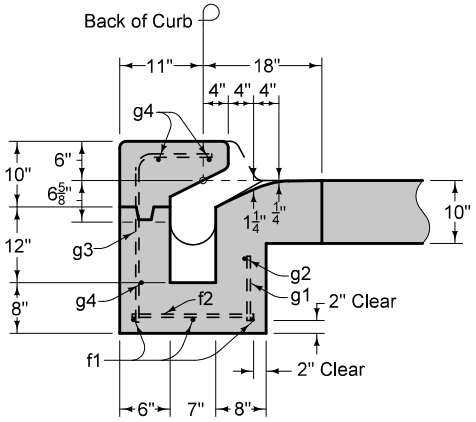
Paul D. Wigard, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

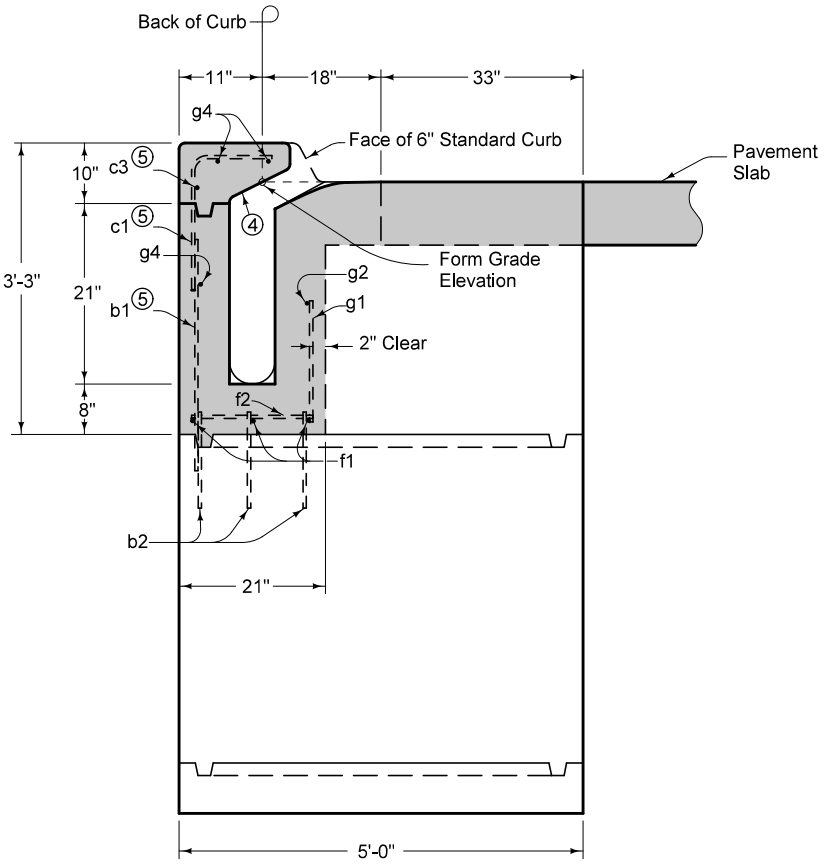
FIGURE 6010.542 | SHEET 1 OF 4



SECTION A-A



SECTION B-B



SECTION C-C

④ 2:1 Slope (Horizontal:Vertical)

⑤ See SW-541 for reinforcing.

6 INCH STANDARD CURB

FIGURE 6010.542 SHEET 2 OF 4

SUDAS IOWADOT

REVISION	
5	10-20-20

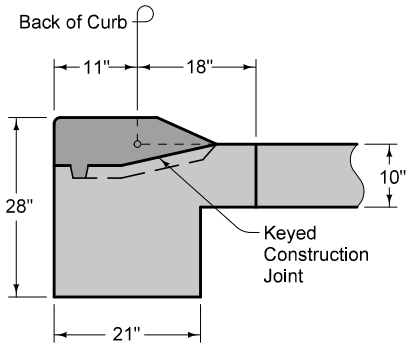
FIGURE 6010.542 | STANDARD ROAD PLAN | SW-542 | SHEET 2 of 4

REVISIONS: Removed Interim from standard.

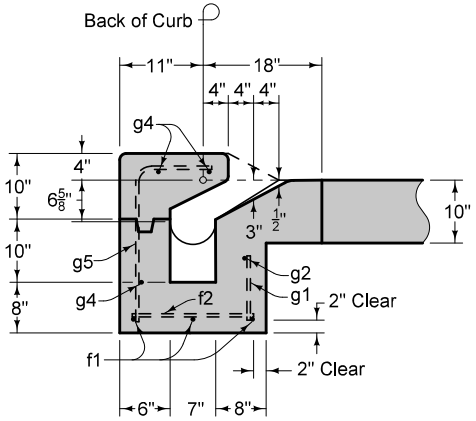
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Stuart Nicholson
DESIGN METHODS ENGINEER

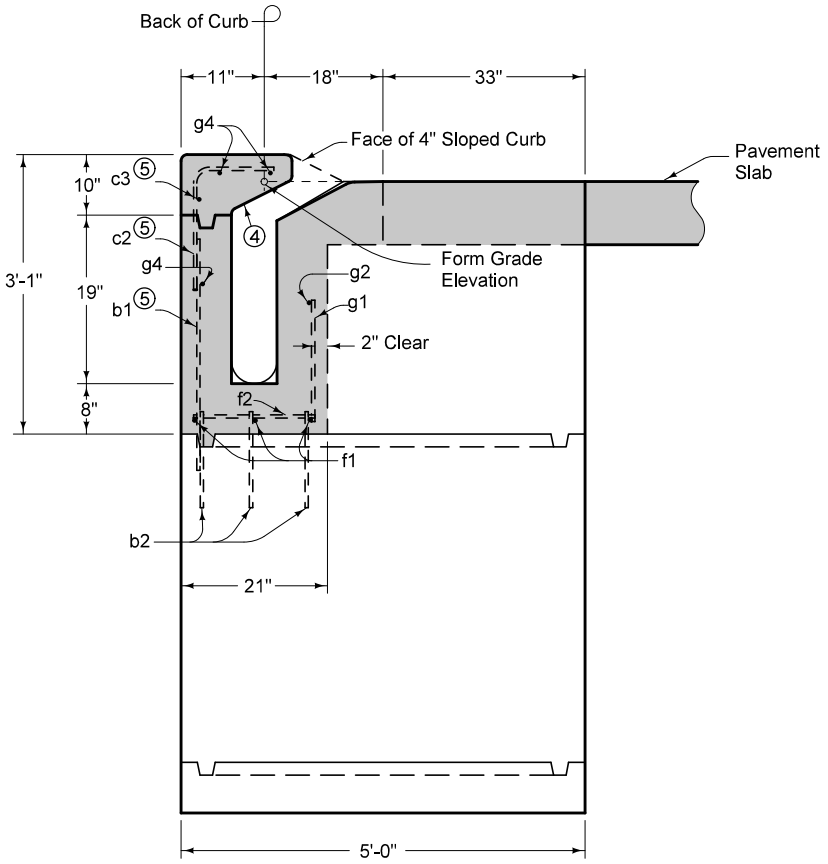
EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT



SECTION A-A



SECTION B-B



SECTION C-C

④ 2:1 Slope (Horizontal:Vertical)

⑤ See SW-541 for reinforcing.

4 INCH SLOPED CURB

FIGURE 6010.542 SHEET 3 OF 4

SUDAS IOWA DOT

REVISION	
5	10-20-20

FIGURE 6010.542 | STANDARD ROAD PLAN

SW-542

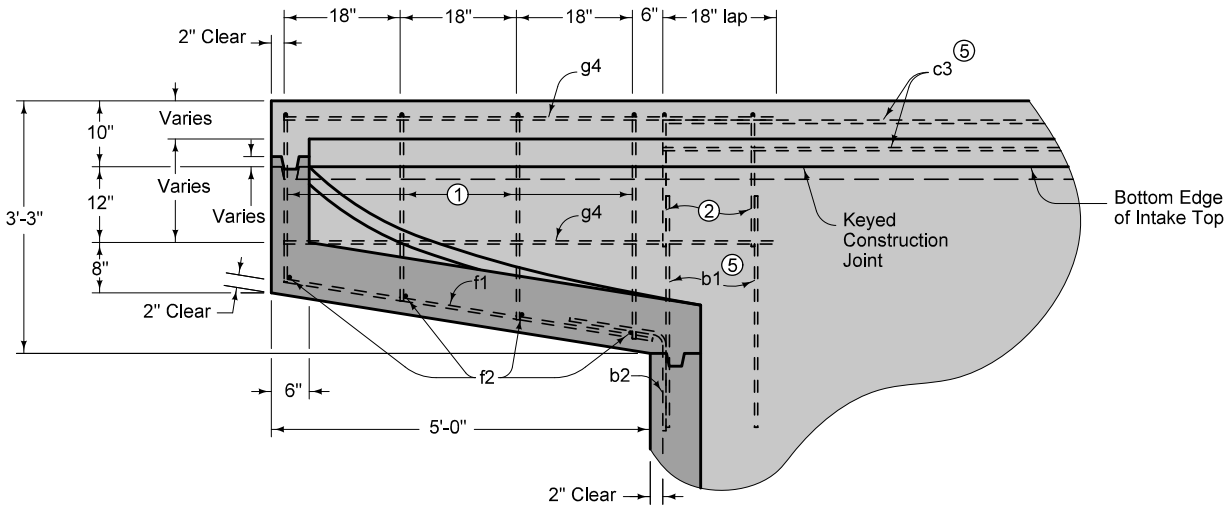
SHEET 3 of 4

REVISIONS: Removed Interim from standard.

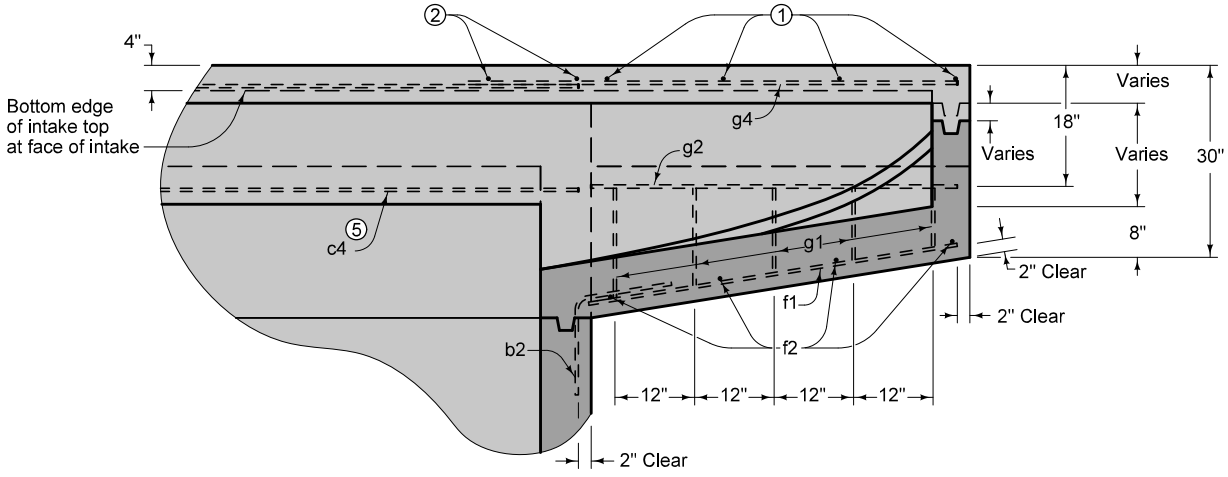
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SUDAS DIRECTOR

DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT



SECTION D-D



SECTION E-E

① g3 for 6 inch standard curb; g5 for 4 inch sloped curb.

② c1 for 6 inch standard curb; c2 for 4 inch sloped curb. See SW-541 for reinforcing.

⑤ See SW-541 for reinforcing.

FIGURE 6010.542 SHEET 4 OF 4

SUDAS IOWADOT

REVISION	
5	10-20-20

FIGURE 6010.542 | STANDARD ROAD PLAN

SW-542

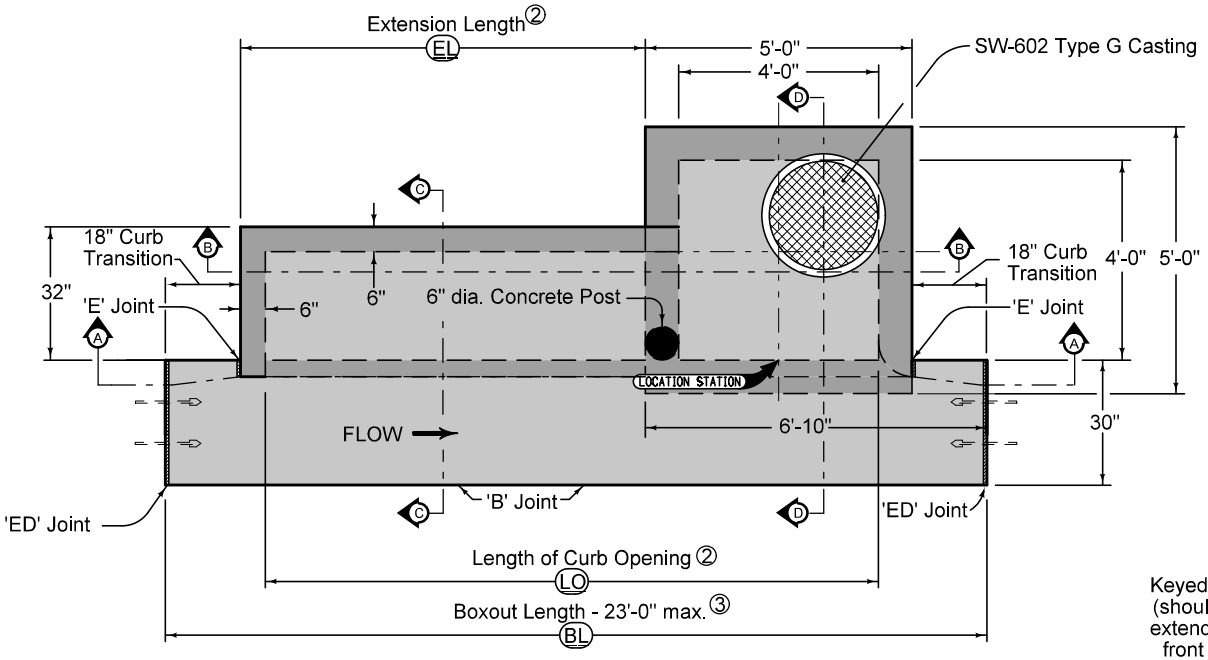
SHEET 4 of 4

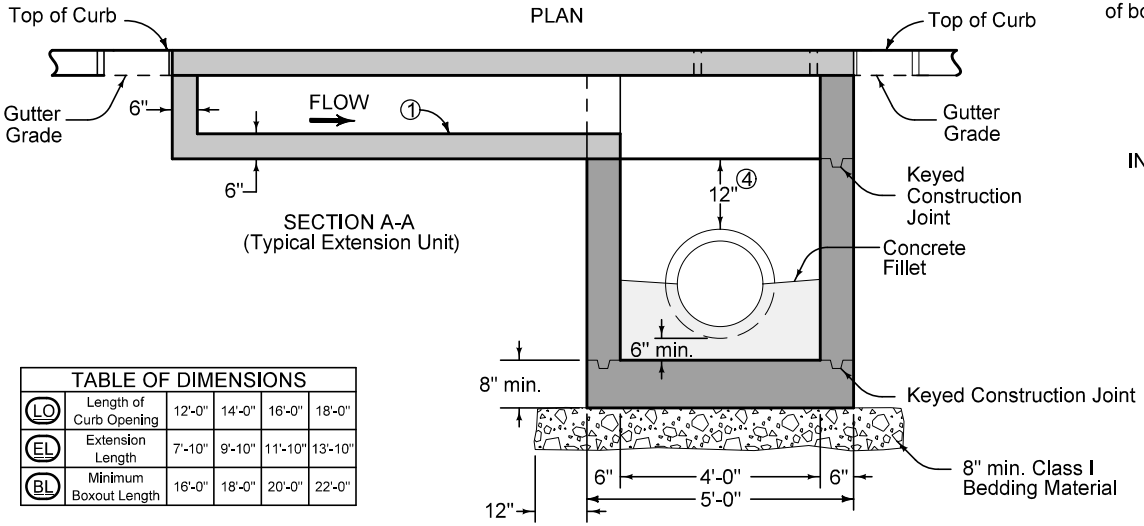
REVISIONS: Removed Interim from standard.

Paul D. Wigant
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

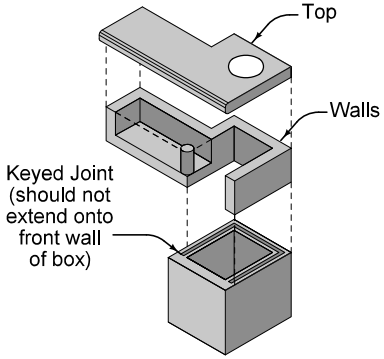




SECTION A-A
(Typical Extension Unit)

SECTION B-B
(Typical Intake Well)

TABLE OF DIMENSIONS					
LO	Length of Curb Opening	12'-0"	14'-0"	16'-0"	18'-0"
EL	Extension Length	7'-10"	9'-10"	11'-10"	13'-10"
BL	Minimum Boxout Length	16'-0"	18'-0"	20'-0"	22'-0"



ISOMETRIC
INTAKE WELL, WALLS AND TOP

Extension unit may be used on either or both sides of intake. Details are similar when extension unit is on the opposite side. For joint details, refer to PV-101.

① Match gutter slope. Drain to well.

② Other lengths of opening may be constructed by varying the length of the extension and the rebar.

③ Includes 2 inches for 'ED' Joints.

④ 12 inch minimum wall height above all pipes.

MAXIMUM PIPE DIAMETERS	
Precast Structure	Cast-in-place Structure
30"	36"

FIGURE 6010.545 SHEET 1 OF 4

SUDAS | IOWA DOT

REVISION 6 04-19-22

FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545

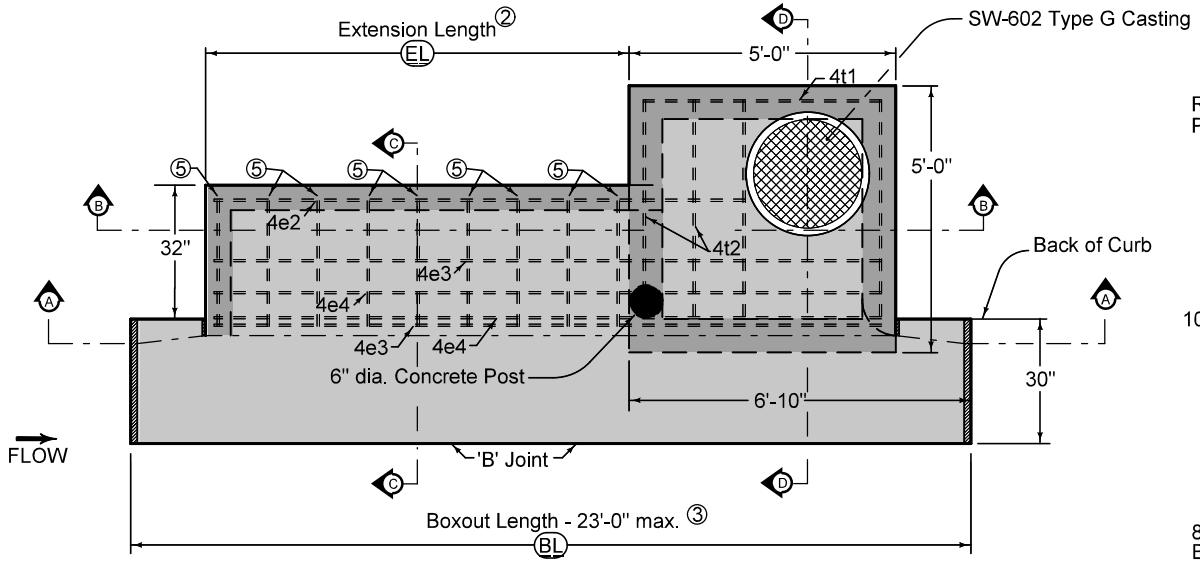
SHEET 1 of 4

REVISIONS: Clarified labeling of rebar.

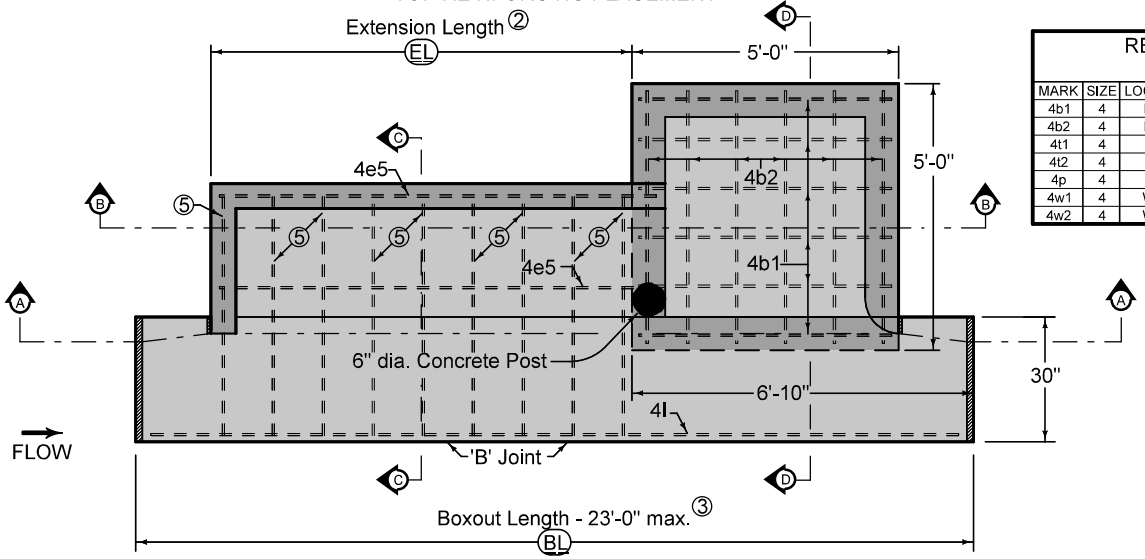
Paul D. Wigard
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

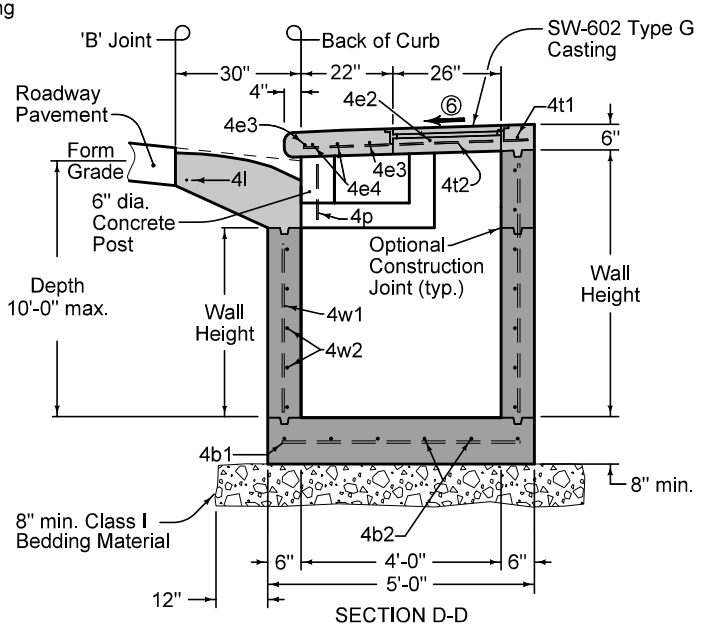
SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING



PLAN
TOP REINFORCING PLACEMENT



PLAN
BOTTOM REINFORCING PLACEMENT



SECTION D-D

REINFORCING BAR LIST
Intake Well

MARK	SIZE	LOCATION	NO.	LENGTH	SPACING
4b1	4	Base	6	4'-6"	11"
4b2	4	Base	6	4'-6"	11"
4t1	4	Top	1	4'-8"	12"
4t2	4	Top	4	4'-3"	See Detail
4p	4	Post	1	13"	
4w1	4	Walls	16	Wall Height minus 4"	14"
4w2	4	Walls	Varies	4'-8"	12"

② Other lengths of opening may be constructed by varying the length of the extension and the rebar.

③ Includes 2 inches for 'ED' Joints.

⑤ 4e1 or 4e6. See Sheets 3 and 4.

⑥ Slope of 1.5% or as specified in the contract documents.

SUDAS | IOWADOT

REVISION
6 | 04-19-22

FIGURE 6010.545 | STANDARD ROAD PLAN

SW-545

SHEET 2 of 4

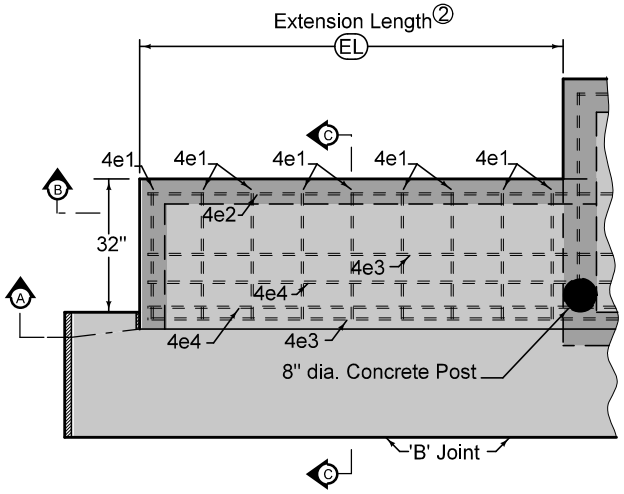
REVISIONS: Clarified labeling of rebar.

Paul D. Wigand
SUDAS DIRECTOR

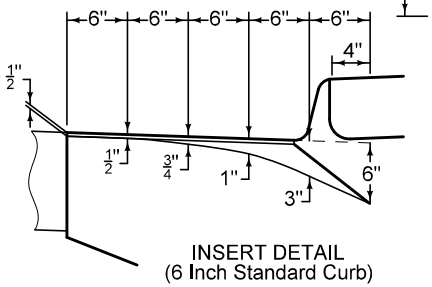
Steven Nichols
DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

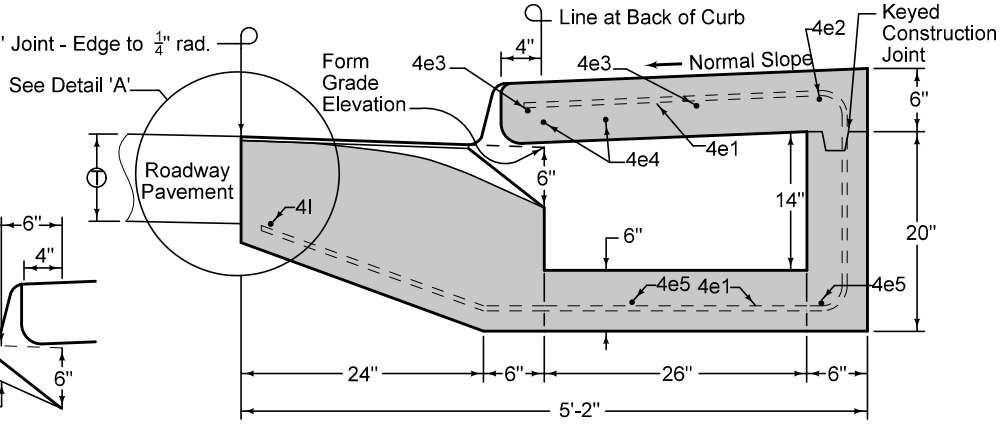
FIGURE 6010.545 SHEET 2 OF 4



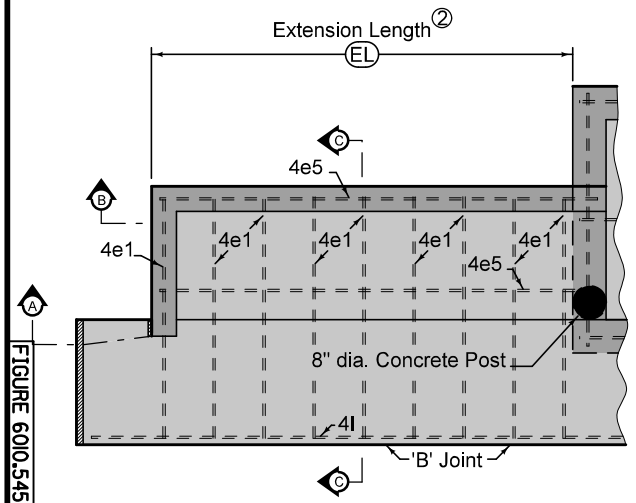
PLAN
TOP OF EXTENSION REINFORCING PLACEMENT



INSERT DETAIL
(6 Inch Standard Curb)



SECTION C-C
(6 Inch Standard Curb)



PLAN
BOTTOM OF EXTENSION REINFORCING PLACEMENT

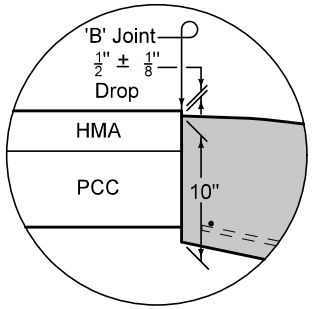
REINFORCING BAR LIST (LO) = 12'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	9	9'-5½"	56.9	12"
4e2	4	Top	1	10'-0"	6.7	
4e3	4	Top	2	12'-9"	17.0	15½"
4e4	4	Top	2	12'-9"	17.0	6"
4e5	4	Base	2	8'-2"	10.9	22"
4l*	4	Insert	1	15'-10"	10.6	
* With 16'-6" Boxout.				Total	119.1 lbs.	

REINFORCING BAR LIST (LO) = 14'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	11	9'-5½"	69.5	12"
4e2	4	Top	1	12'-0"	8.0	
4e3	4	Top	2	14'-9"	19.7	15½"
4e4	4	Top	2	14'-9"	19.7	6"
4e5	4	Base	2	10'-2"	13.6	22"
4l*	4	Insert	1	17'-10"	11.9	
* With 18'-6" Boxout.				Total	142.4 lbs.	

REINFORCING BAR LIST (LO) = 16'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	13	9'-5½"	82.1	12"
4e2	4	Top	1	14'-0"	9.3	
4e3	4	Top	2	16'-9"	22.4	15½"
4e4	4	Top	2	16'-9"	22.4	6"
4e5	4	Base	2	12'-2"	16.2	22"
4l*	4	Insert	1	19'-10"	13.2	
* With 20'-6" Boxout.				Total	165.6 lbs.	

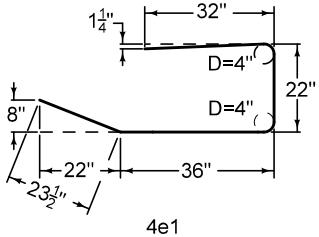
REINFORCING BAR LIST (LO) = 18'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	15	9'-5½"	94.8	12"
4e2	4	Top	1	16'-0"	10.7	
4e3	4	Top	2	18'-9"	25	15½"
4e4	4	Top	2	18'-9"	25	6"
4e5	4	Base	2	14'-2"	18.9	22"
4l*	4	Insert	1	21'-10"	14.6	
* With 22'-6" Boxout.				Total	189.0 lbs.	

6 INCH STANDARD CURB



DETAIL 'A'
Use when adjacent pavement is HMA or composite.

BENT BAR DETAILS



4e1

NOTE: ALL DIMENSIONS ARE OUT TO OUT
D = PIN DIAMETER

② Other lengths of opening may be constructed by varying the length of the extension and the rebar.

SUDAS | IOWADOT | REVISION 6 04-19-22

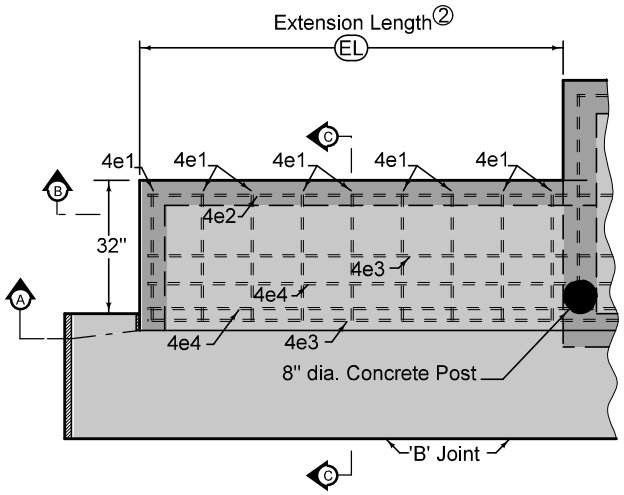
FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545 | SHEET 3 of 4

REVISIONS: Clarified labeling of rebar.

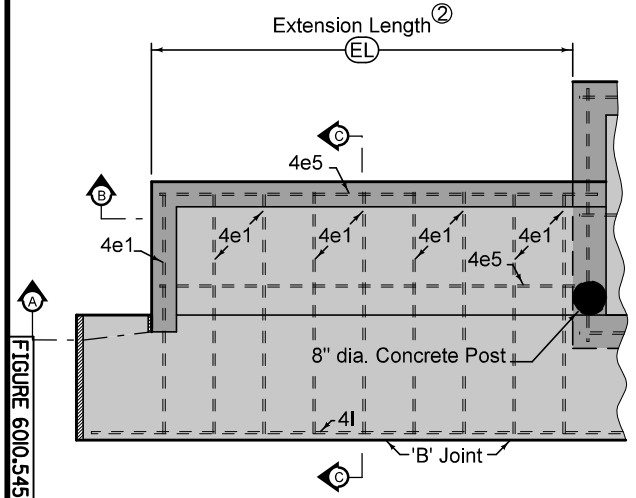
Paul D. Wigard, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

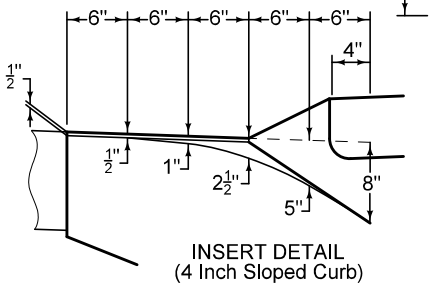
FIGURE 6010.545 | SHEET 3 OF 4



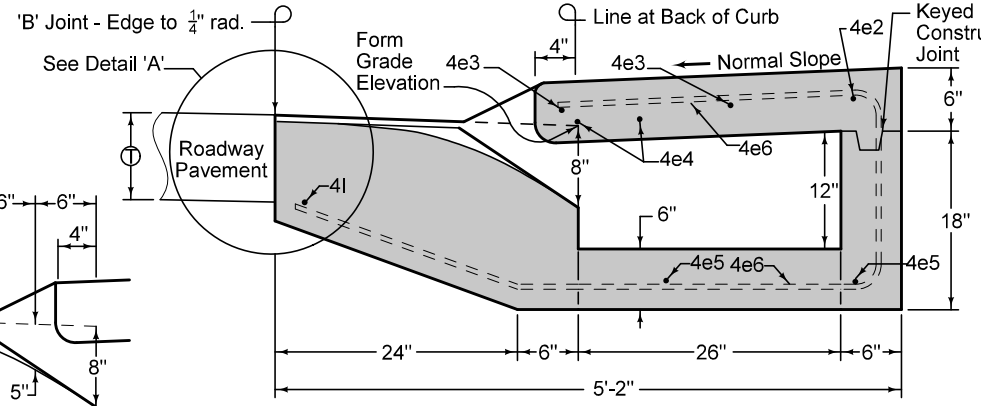
PLAN
TOP OF EXTENSION REINFORCING PLACEMENT



PLAN
BOTTOM OF EXTENSION REINFORCING PLACEMENT



INSERT DETAIL
(4 Inch Sloped Curb)



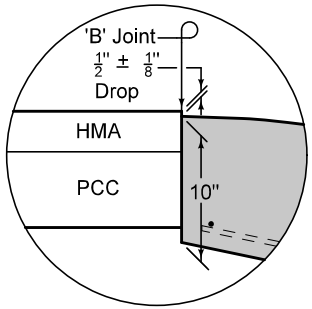
SECTION C-C
(4 Inch Sloped Curb)

REINFORCING BAR LIST (LO) = 12'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	10'-0"	6.7	
4e3	4	Top	2	12'-9"	17.0	15½"
4e4	4	Top	2	12'-9"	17.0	6"
4e5	4	Base	2	8'-2"	10.9	22"
4e6	4	Top/Base	9	9'-3½"	56.9	12"
4l*	4	Insert	1	15'-10"	10.6	
* With 16'-6" Boxout.				Total	119.0 lbs.	

REINFORCING BAR LIST (LO) = 14'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	12'-0"	8.0	
4e3	4	Top	2	14'-9"	19.7	15½"
4e4	4	Top	2	14'-9"	19.7	6"
4e5	4	Base	2	10'-2"	13.6	22"
4e6	4	Top/Base	11	9'-3½"	69.5	12"
4l*	4	Insert	1	17'-10"	11.9	
* With 18'-6" Boxout.				Total	142.3 lbs.	

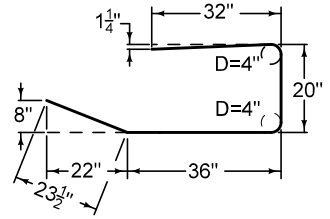
REINFORCING BAR LIST (LO) = 16'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	14'-0"	9.3	
4e3	4	Top	2	16'-9"	22.4	15½"
4e4	4	Top	2	16'-9"	22.4	6"
4e5	4	Base	2	12'-2"	16.2	22"
4e6	4	Top/Base	13	9'-3½"	82.1	12"
4l*	4	Insert	1	19'-10"	13.2	
* With 20'-6" Boxout.				Total	165.5 lbs.	

REINFORCING BAR LIST (LO) = 18'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	16'-0"	10.7	
4e3	4	Top	2	18'-9"	25	15½"
4e4	4	Top	2	18'-9"	25	6"
4e5	4	Base	2	14'-2"	18.9	22"
4e6	4	Top/Base	15	9'-3½"	94.8	12"
4l*	4	Insert	1	21'-10"	14.6	
* With 22'-6" Boxout.				Total	188.9 lbs.	



DETAIL 'A'
Use when adjacent pavement is HMA or composite.

BENT BAR DETAILS



4e6

NOTE: ALL DIMENSIONS ARE OUT TO OUT
D = PIN DIAMETER

② Other lengths of opening may be constructed by varying the length of the extension and the rebar.

4 INCH SLOPED CURB

SUDAS | IOWADOT

REVISION 6 04-19-22

FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545

SHEET 4 of 4

REVISIONS: Clarified labeling of rebar.

Paul D. Wigand, SUDAS DIRECTOR
Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

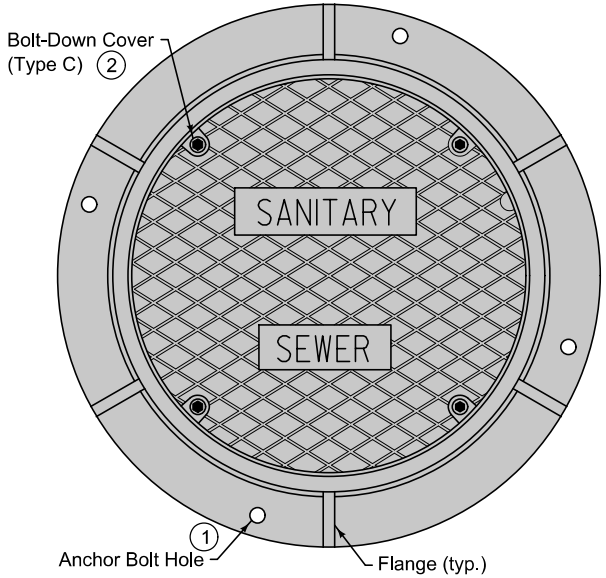
FIGURE 6010.545 SHEET 4 OF 4

TYPE A

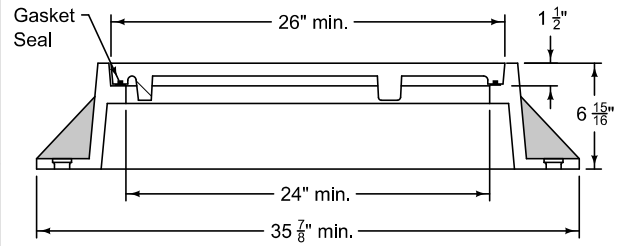
Two-piece fixed casting

TYPE C

Two-piece fixed casting with bolt-down cover (2)



PLAN



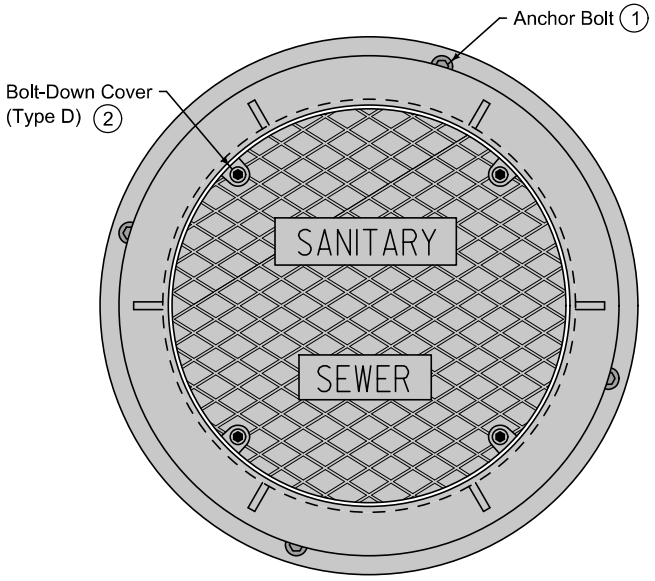
TYPICAL SECTION

TYPE B: HMA

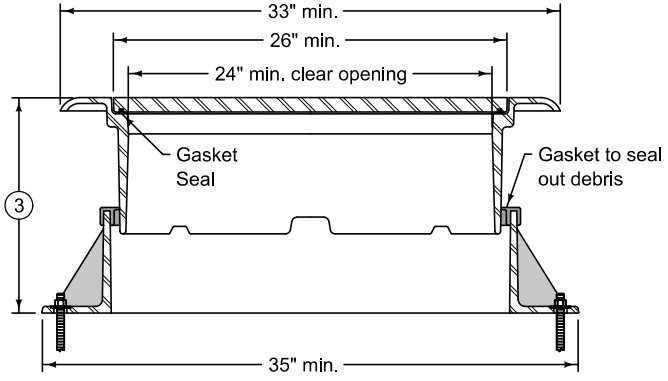
Three-piece floating casting for use in HMA paving

TYPE D: HMA

Three-piece floating casting with bolt-down cover for use in HMA paving (2)



PLAN



TYPICAL SECTION

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one concealed pickhole.

(1) Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.

(2) If specified, furnish bolt down frame and cover with four 1/2 inch minimum diameter stainless steel, hex nut, recessed cap screws. Secure cover with screws, washers, and rubber gasket seals.

(3) Casting height varies. Minimum adjustment range of 4 inches.

SUDAS	IOWA DOT	REVISION 4	04-21-20
FIGURE 6010.601	STANDARD ROAD PLAN	SW-601	SHEET 1 of 2

REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigard
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

CASTINGS FOR SANITARY SEWER MANHOLES

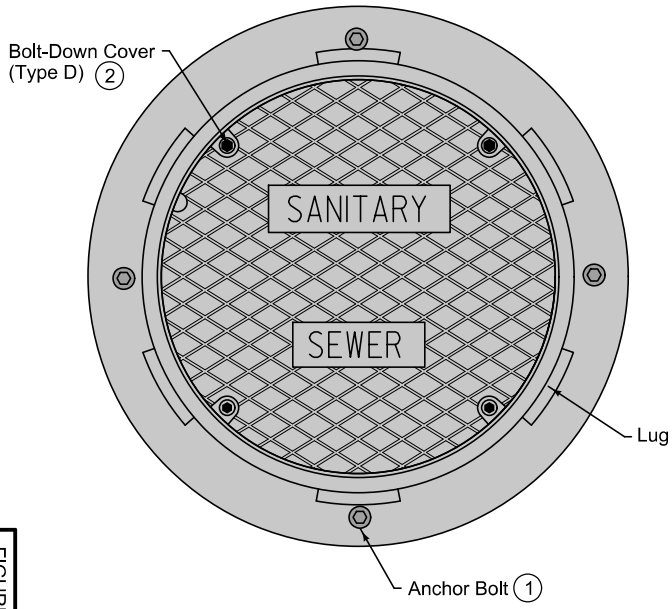
FIGURE 6010.601 | SHEET 1 OF 2

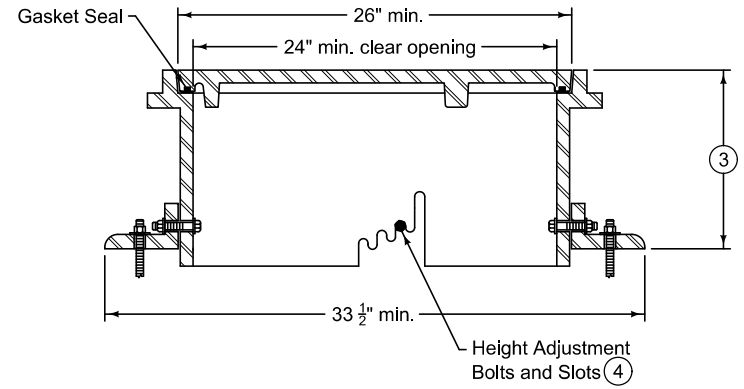
TYPE B: PCC

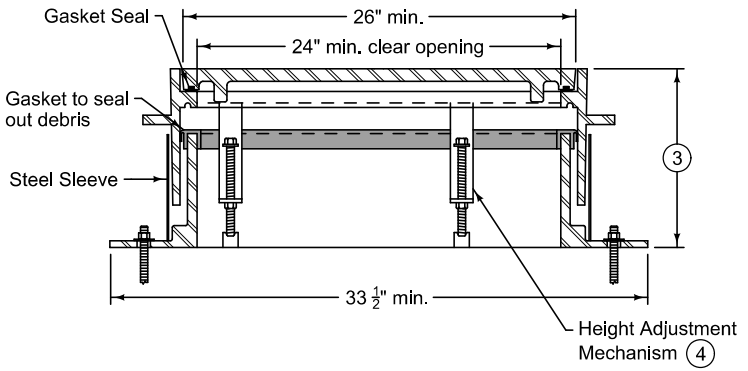
Three-piece floating casting for use in PCC paving and PCC boxouts

TYPE D: PCC

Three-piece floating casting with bolt-down cover for use in PCC paving and PCC boxouts







TYPICAL SECTION 5

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one concealed pickhole.

1. Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.
2. If specified, furnish bolt down frame and cover with four 1/2 inch minimum diameter stainless steel, hex nut, recessed cap screws. Secure cover with screws, washers, and rubber gasket seals.
3. Casting height varies. Minimum adjustment range of 4 inches.
4. Set casting at proper grade using the adjustment slots or adjustment mechanism. Remove bolts or mechanism upon completion of paving.
5. Height adjustment method may vary; two options are shown.

SUDAS	IOWADOT	REVISION 4	04-21-20
FIGURE 6010.601	STANDARD ROAD PLAN	SW-601	SHEET 2 of 2

REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigand
SUDAS DIRECTOR

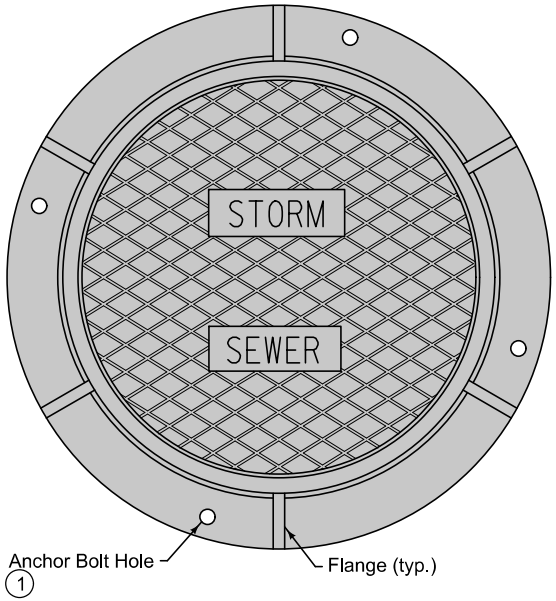
Stuart Nicholson
DESIGN METHODS ENGINEER

CASTINGS FOR SANITARY SEWER MANHOLES

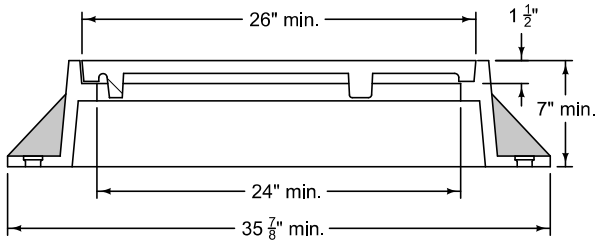
FIGURE 6010.601 | SHEET 2 OF 2

TYPE E

Two-piece fixed casting



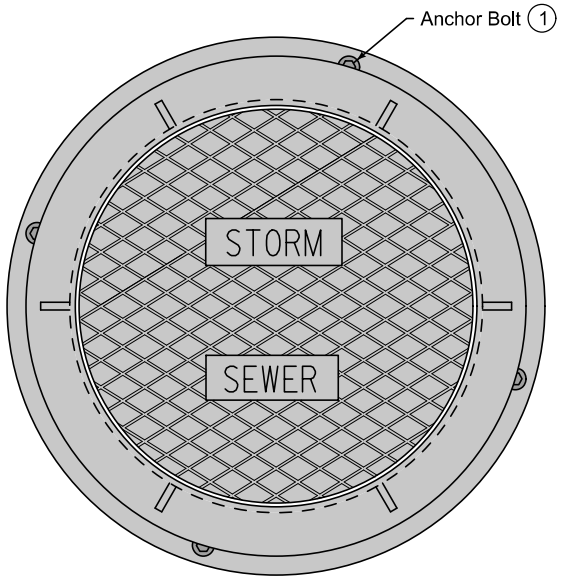
PLAN



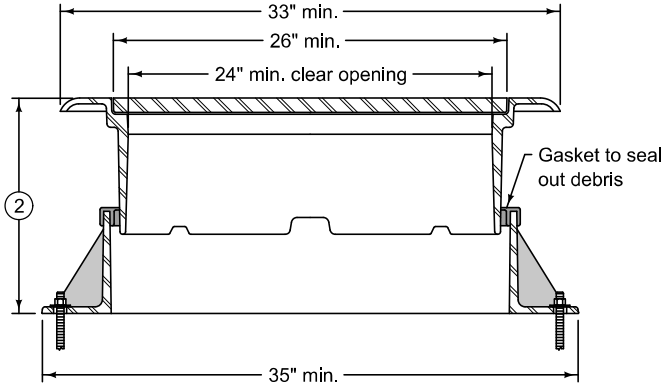
TYPICAL SECTION

TYPE F: HMA

Three-piece floating casting for use in HMA paving



PLAN



TYPICAL SECTION

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one pickhole.

(1) Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.

(2) Casting height varies. Minimum adjustment range of 4 inches.

FIGURE 6010.602 | SHEET 1 OF 3

SUDAS | IOWADOT | REVISION 4 | 04-21-20

FIGURE 6010.602 | STANDARD ROAD PLAN | SW-602 | SHEET 1 of 3

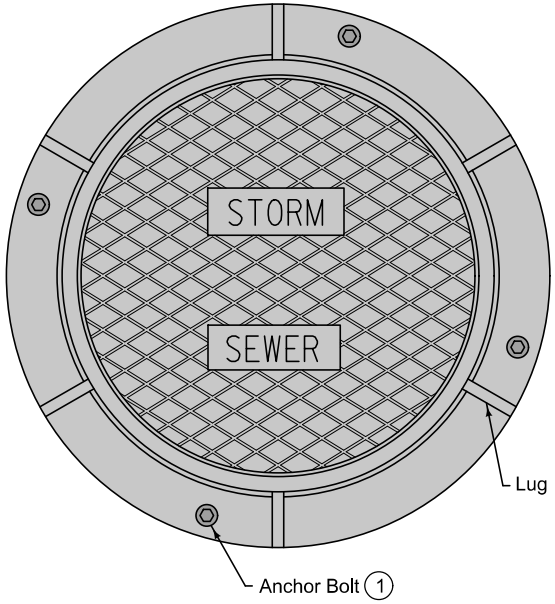
REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigand, SUDAS DIRECTOR
Stuart Nicholson, DESIGN METHODS ENGINEER

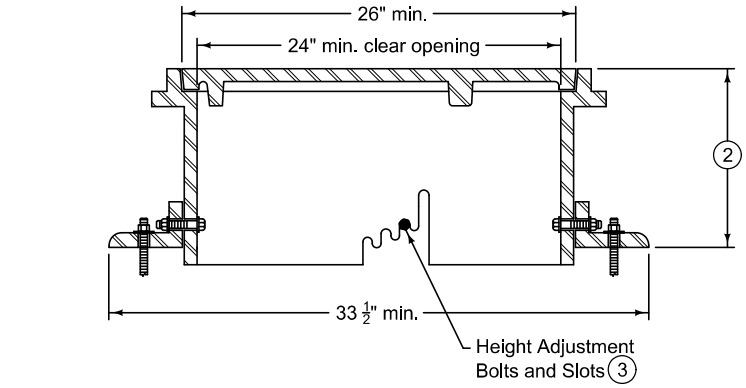
CASTINGS FOR STORM SEWER MANHOLES

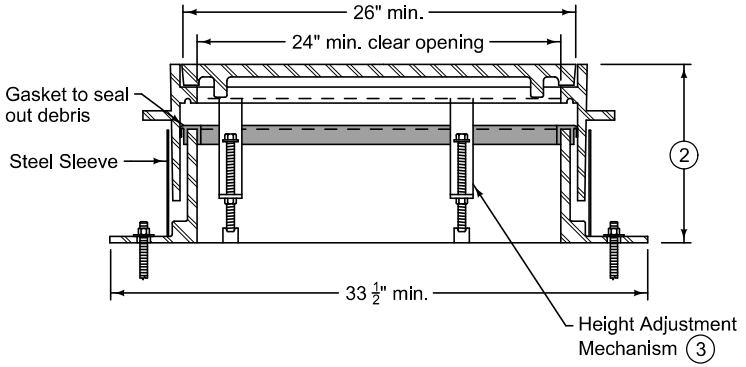
TYPE F: PCC

Three-piece floating casting for use in PCC paving and PCC boxouts



PLAN





TYPICAL SECTION (4)

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one pickhole.

(1) Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.

(2) Casting height varies. Minimum adjustment range of 4 inches.

(3) Set casting at proper grade using the adjustment slots or adjustment mechanism. Remove bolts or mechanism upon completion of paving.

(4) Height adjustment method may vary; two options are shown.

FIGURE 6010.602 | SHEET 2 OF 3

SUDAS	IOWA DOT	REVISION 4	04-21-20
FIGURE 6010.602	STANDARD ROAD PLAN	SW-602	SHEET 2 of 3

REVISIONS: Add option for 3-piece HMA casting

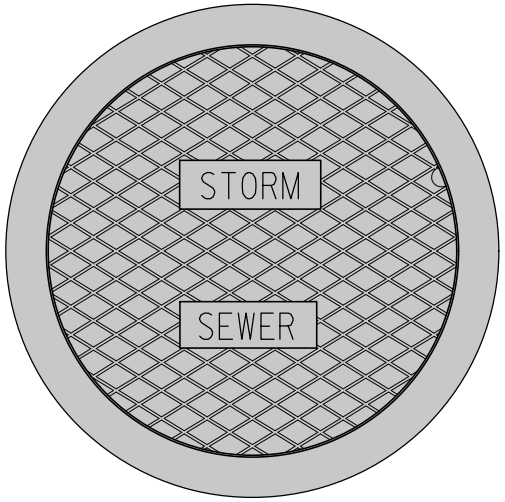
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

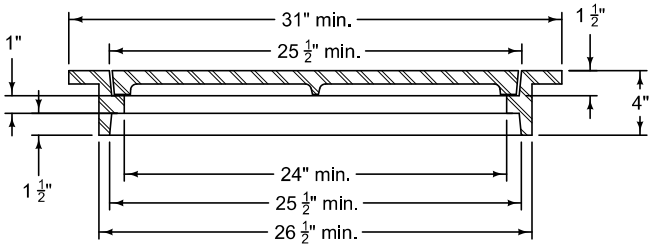
CASTINGS FOR STORM SEWER MANHOLES

TYPE G

Two piece fixed casting



PLAN



TYPICAL SECTION

Cover Notes:
Roughness pattern and text style may vary.
Minimum one pickhole.

SUDAS	IOWA DOT	REVISION 4 04-21-20
FIGURE 6010.602	STANDARD ROAD PLAN	SW-602 SHEET 3 of 3

REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigand — SUDAS DIRECTOR
Stuart Nicholson — DESIGN METHODS ENGINEER

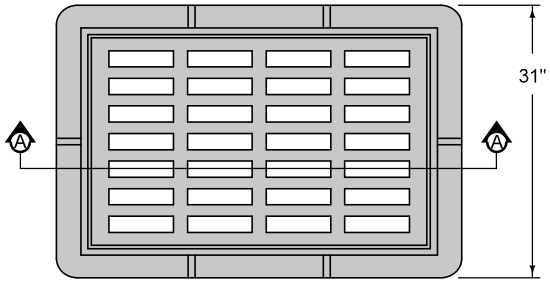
CASTINGS FOR STORM SEWER MANHOLES

FIGURE 6010.602 | SHEET 3 OF 3

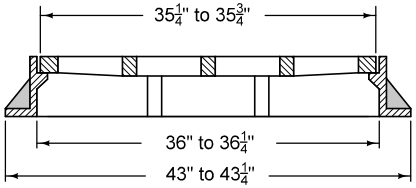
TYPE Q (1)

Driveway Grate

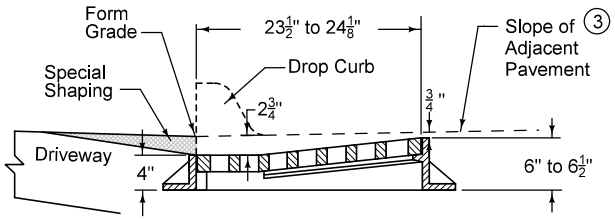
(Minimum open area 370 in^2)



PLAN



SECTION A-A

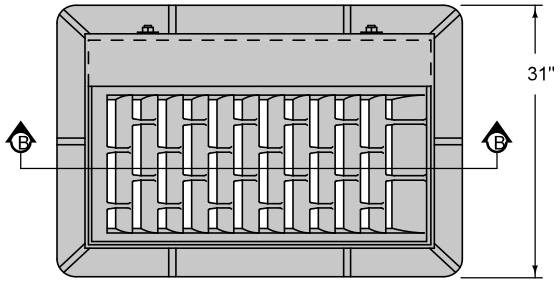


TYPICAL SECTION

TYPE R (2)

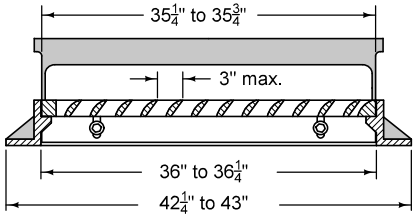
Curb Inlet Grade

(Minimum open area 180 in^2)

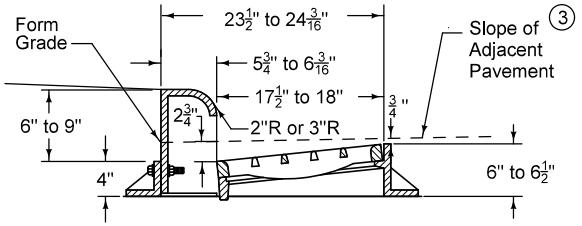


PLAN

Flow



SECTION B-B



TYPICAL SECTION

1. For use at curb drops for driveways. Use only when specified in the contract documents.
2. Provide bicycle-safe vane-style grate. At low points, grates with vanes facing both directions of flow are allowed.
3. For details of boxout pavement, refer to SW-514.

SUDAS	IOWA DOT	REVISION 6 10-16-18
FIGURE 6010.603	STANDARD ROAD PLAN	SW-603
		SHEET 1 of 2

REVISIONS: Corrected typo on page two that said SHEET 1 of 2.

Paul D. Wigant — SUDAS DIRECTOR

Brian Smith — DESIGN METHODS ENGINEER

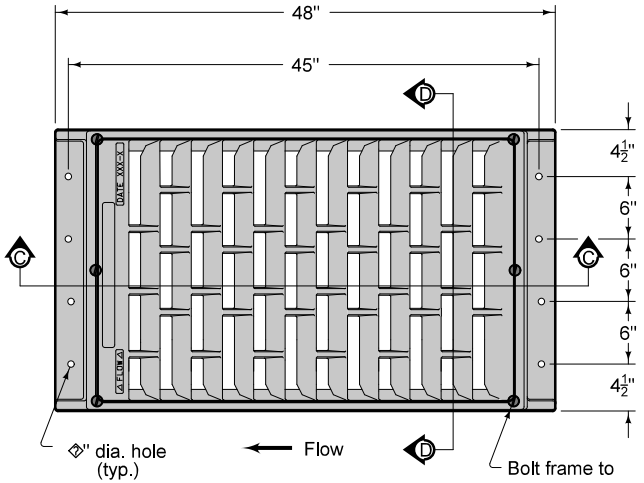
CASTINGS FOR GRATE INTAKES

FIGURE 6010.603 SHEET 1 OF 2

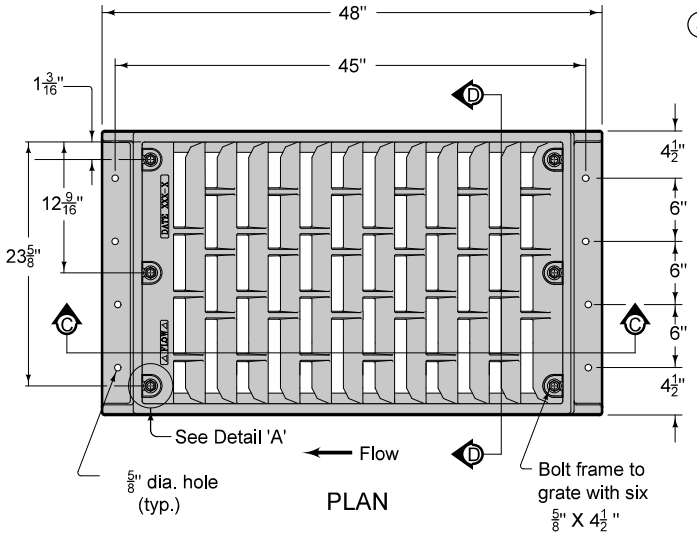
TYPE S ②④

Barrier Intake Grate

(Minimum open area 300 in^2)



PLAN

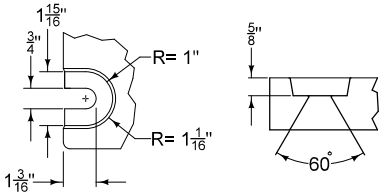


PLAN

② Provide bicycle-safe vane-style grate. At low points, grates with vanes facing both directions of flow are allowed. The Contractor has the choice of which Type S Grate to use.

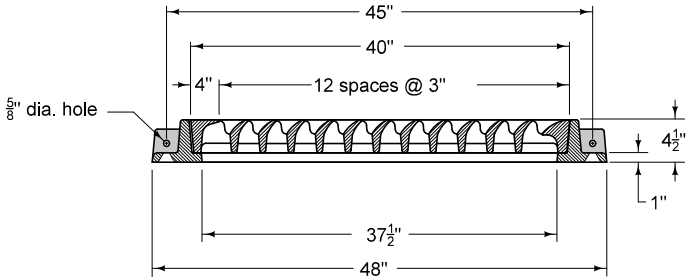
④ Use ductile iron frame castings meeting the requirements of ASTM A 536.

Frame minimum weight = 220 lbs.
Grate minimum weight = 340 lbs.

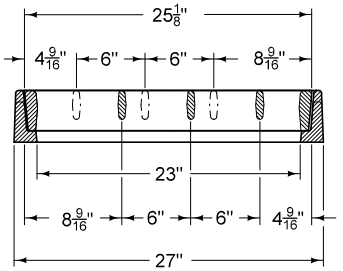


DETAIL'A'

Bolt Slot Detail



SECTION C-C



SECTION D-D

SUDAS	IOWADOT	REVISION 6 10-16-18
FIGURE 6010.603	STANDARD ROAD PLAN	SW-603 SHEET 2 of 2

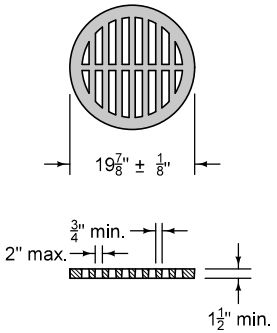
REVISIONS: Corrected typo on page two that said SHEET 1 of 2.

Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

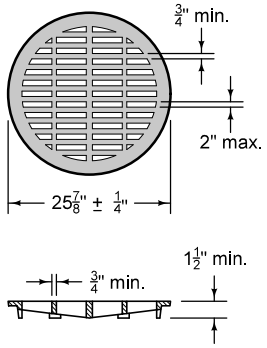
CASTINGS FOR GRATE INTAKES

FIGURE 6010.603 SHEET 2 OF 2

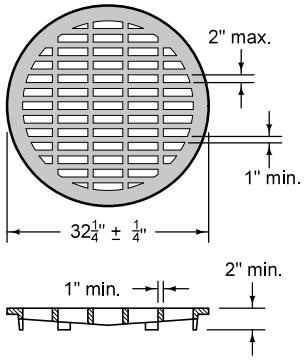
TYPE 4



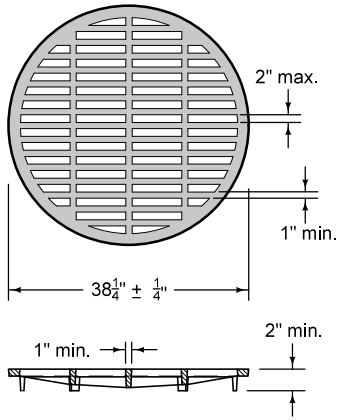
TYPE 4A
For Placement on 18" RCP



TYPE 4B
For Placement on 24" RCP

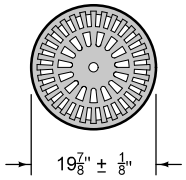


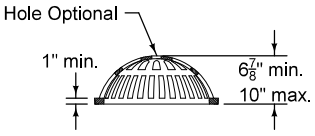
TYPE 4C
For Placement on 30" RCP



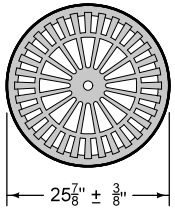
TYPE 4D
For Placement on 36" RCP

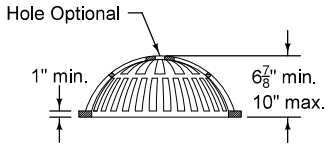
TYPE 3
(Light Duty)





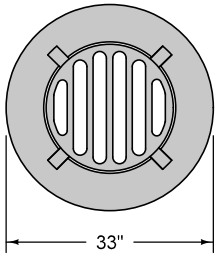
TYPE 3A
For Placement on 18" RCP





TYPE 3B
For Placement on 24" RCP

TYPE 5
(Light Duty)
For Placement on 24" to 30" RCP



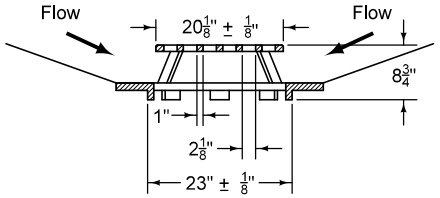


FIGURE 6010.604 SHEET 1 OF 2

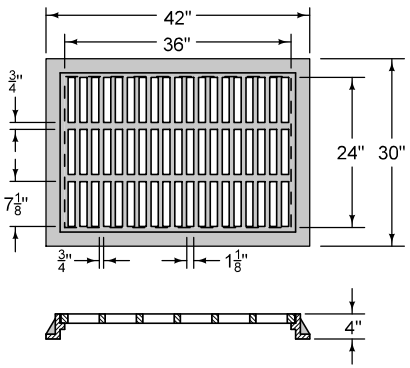
SUDAS	IOWA DOT	REVISION 3 04-21-20
FIGURE 6010.604	STANDARD ROAD PLAN	SW-604
		SHEET 1 of 2

REVISIONS: Added Type 7 casting. Modified circle notes.

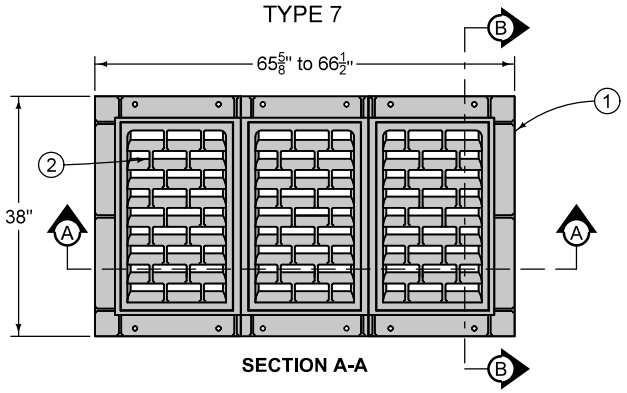
Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

CASTINGS FOR AREA INTAKES

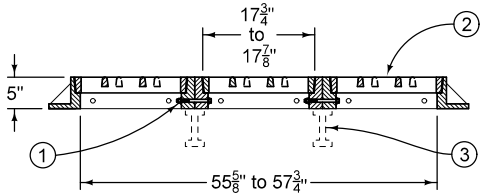
TYPE 6



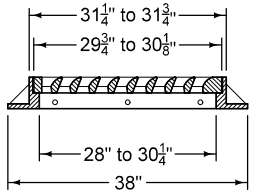
TYPE 7



SECTION A-A



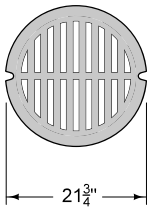
SECTION A-A

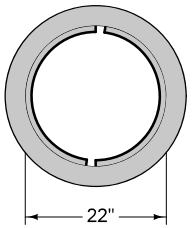


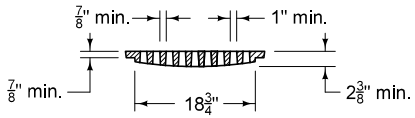
SECTION B-B

TYPE 9

(Light Duty)

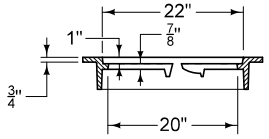






GRATE (4)

Minimum Weight = 85 lbs.



FRAME

Minimum Weight = 75 lbs.

(1) Frame provided in three segments (two ends and one center). Bolt segments together as specified by the casting manufacturer.

(2) Provide bicycle safe, vane style grates with a minimum open area of 4 square feet. At low points, grates with vanes facing both directions will be allowed.

(3) If required by casting manufacturer, provide support beam under all frame joints. Modify structure walls as required to provide pocket for beam.

(4) Cast grate without locking lugs so it may be used in an inverted position.

SUDAS	IOWADOT	REVISION 3 04-21-20
FIGURE 6010.604	STANDARD ROAD PLAN	SW-604
		SHEET 2 of 2

REVISIONS: Added Type 7 casting. Modified circle notes.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

CASTINGS FOR AREA INTAKES

FIGURE 6010.604 SHEET 2 OF 2

REHABILITATION OF EXISTING MANHOLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

Rehabilitation of existing manholes.

1.02 DESCRIPTION OF WORK

Rehabilitate existing manholes to waterproof and to prevent inflow and infiltration, to prevent corrosion, or to reestablish the structural integrity of the manhole. Includes construction of structural liners, protective liners, and infiltration barriers.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Concrete mix design, if required by the Engineer.

B. Catalog cuts of all mortar mixes, sealants, and liners.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Infiltration Barriers:

1. **Rubber Chimney Seal:**
   - **a. Measurement:** Each rubber chimney seal installed on an existing manhole will be counted.
   - **b. Payment:** Payment will be made at the unit price for each chimney seal.
   - **c. Includes:** Unit price includes, but is not limited to, all necessary compression or expansion bands and extension sleeves as necessary to complete chimney seal.

2. **Molded Shield:**
   - **a. Measurement:** Each molded shield installed on an existing manhole will be counted.
   - **b. Payment:** Payment will be made at the unit price for each molded shield.
   - **c. Includes:** Unit price includes, but is not limited to, sealant.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. **Urethane Chimney Seal:**
   a. **Measurement:** Each urethane chimney seal installed on an existing manhole will be counted.
   b. **Payment:** Payment will be at the unit price for each urethane chimney seal.
   c. **Includes:** Unit price includes, but is not limited to, preparing the surface of the manhole and furnishing and applying primer and urethane chimney seal according to the manufacturer's requirements.

B. In-Situ Manhole Replacement, Cast-in-place Concrete:

1. **Measurement:** The vertical dimension of in-situ manhole replacement will be measured in feet from the lowest flowline to the top of the rim.

2. **Payment:** Payment will be at the unit price per vertical foot.

3. **Includes:** Unit price includes, but is not limited to, handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, and testing the manhole upon completion.

C. In-Situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner:

1. **Measurement:** The vertical dimension of in-situ manhole replacement with plastic liner will be measured in feet from the lowest flowline to the top of the rim.

2. **Payment:** Payment will be at the unit price per vertical foot.

3. **Includes:** Unit price includes, but is not limited to, handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, sealing at the frame and cover, sealing pipe penetrations as recommended by the manufacturer, and testing the manhole upon completion.

D. Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal:

1. **Measurement:** The vertical dimension of manhole lining will be measured for depth in feet from the bottom of the lining to the top of the lining for each liner thickness specified.

2. **Payment:** Payment will be at the unit price per vertical foot for each liner thickness.

3. **Includes:** Unit price includes, but is not limited to, the handling of sewer flows during lining operations as required to properly complete the installation, and replacement of the existing casting with a new casting.

PART 2 - PRODUCTS

2.01 INFILTRATION BARRIER

A. Rubber Chimney Seal: Comply with Section 6010, 2.11 for external and internal rubber chimney seals.

B. Molded Shield: Comply with Section 6010, 2.11 for molded shields.

C. Heat Shrink Sleeve: Comply with Section 6010, 2.11 for heat shrink sleeves.

D. Urethane Chimney Seal: Comply with the following table for the physical properties.

Table 6020.01: Physical Properties

Property	ASTM Test Method	Acceptable Value
Elongation	D 412	800%, minimum
Tensile Strength	D 412	1150 psi, minimum
Adhesive Strength	D 903	175 lb/in, minimum
Pressure Resistance	C 1244	2 minutes

2.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE

A. Forming System: Provide an internal forming system capable of forming a new and structurally independent manhole wall within the existing manhole, with the specified thickness and conforming to the general shape of the existing manhole.

B. Concrete: Comply with Section 7010, 2.01, A.

C. Plastic Liner: When specified, provide a PVC or PE plastic liner resistant to degradation by sulfuric acid. Use a liner capable of being attached to the exterior of the forming system during erection of the forms. Use a plastic liner with a ribbed or studded exterior surface suitable for anchoring to the newly formed interior wall.

D. Casting: Provide new casting. Comply with Section 6010, 2.10.

2.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL

A. Cementitious Lining:

1. Use a high-strength, high-build, corrosion-resistant mortar, based on Portland cement fortified with micro silica. Mixed mortar is to have a paste-like consistency that may be sprayed, cast, pumped, or gravity-flowed into any area 1/2 inch and larger.

2.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL (Continued)

2. Comply with the following table for physical properties.

Table 6020.02: Physical Properties

Property	Value
Unit Weight	102 to 130 pcf
Set Time at 70° F ASTM C 403 Initial Set / Final Set	240 minutes / 480 minutes
Modulus of Elasticity ASTM C 469 24 hours / 28 days	180,000 psi min. / 1,150,000 psi min.
Flexural Strength ASTM C 293 24 hours / 28 days	650 psi min. / 800 psi min.
Compressive Strength ASTM C 109 24 hours / 28 days	3,000 psi / 10,000 psi
Tensile Strength ASTM C 307	600 psi
Shear Bond ASTM C 882	>1,000 psi
Shrinkage ASTM C 157	None
Chloride Permeability ASTM C 1202	<550 Coulombs

3. Use a lining containing a liquid admixture for the prevention of micro-biologically induced corrosion.

B. Corrosion-Resistant Epoxy Lining:

1. Use a two-component 100% solids epoxy formulated for use in sewer systems.

2. Comply with the following table for physical properties.

Table 6020.03: Physical Properties

Property	Value
Dry Time	4-6 hours at 75° F; 50% Relative Humidity
Compressive Strength ASTM D 695	15,000 psi min.
Flexural Strength ASTM D 790	11,000 psi min.
Tensile Strength ASTM D 638	4,500 psi min.
Hardness ASTM D 2240	68 to 90 Shore D
Ultimate Elongation ASTM D 638	3.5 to 5.5 %
Adhesion ASTM D 7234	Substrate Failure

C. Casting: Provide new casting. Comply with Section 6010, 2.10.

PART 3 - EXECUTION

3.01 INFILTRATION BARRIER

A. Rubber Chimney Seal: Comply with Section 6010, 3.01.

B. Molded Shield: Comply with Section 6010, 3.01.

C. Urethane Chimney Seal: Use only when specified in the contract documents.

1. Prepare the surface according to the manufacturer's recommendations, including sandblasting, pressure washing, sealing leaks or gaps, and drying the surface.

2. Apply primer, prepare product, and brush-apply the seal to a minimum thickness of 175 mils, covering 2 inches above the bottom of the frame and the entire adjustment ring area to 3 inches below the bottom adjustment ring.

3.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE

A. Preparation: Prepare according to the forming system manufacturer's recommendations, including the following:

1. Clean the existing surface to remove loose material and debris.

2. Remove existing steps that might interfere with the erection of the forms.

3. Control infiltration that may affect placement of concrete.

B. Installation: Install and test according to the forming system manufacturer's recommendations, including the following:

1. Place pipe extensions through the structure to maintain flow during installation.

2. Erect forms inside the manhole. Secure the assembled internal forms to prevent shifting and to provide sufficient stiffness and strength to prevent collapse.

3. Install a plastic liner when specified.

4. Seal the forms at the bottom of the manhole to ensure the concrete does not enter the sewer.

5. Carefully place concrete between the forms and the existing manhole walls. Place concrete from the bottom up to prevent segregation of concrete.

6. Consolidate concrete as required to fill all pockets, seams, and cracks within the existing manhole wall.

7. Remove the forms when the concrete has cured sufficiently.

8. Weld and test joints if a plastic liner is installed.

9. Apply a sealing strip around the circumference of the invert top where it meets the vertical wall and around all pipe penetrations to form a waterstop.

10. Overlay the invert top with concrete or high-strength mortar. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

3.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE (Continued)

11. Apply an epoxy lining to the invert top. Apply clean sand to the epoxy to create a non-slip surface.

12. Seal the plastic liner to the manhole casting and existing pipe stubs as recommended by the manufacturer.

13. Install new casting.

3.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL

A. Surface Preparation: Prepare according to the manufacturer's recommendations, including the following:

1. Wash the interior with a high-pressure washer.

2. Plug active leaks with the appropriate sealing material.

B. Mortar Application: Apply according to the manufacturer's recommendations, including the following:

1. Apply with a rotating centrifugal casting applicator, beginning at the bottom of the manhole.

2. Retrieve the applicator head at the manufacturer's recommended speed to achieve the desired thickness.

3. Apply to the full required thickness utilizing multiple passes as necessary. Minimize the time between passes so subsequent passes are cast against fresh mortar.

4. Verify thickness with a wet gauge at several locations to ensure proper depth.

5. Hand-apply high-strength mortar to the invert surface. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

C. Epoxy Seal Application: Seal according to the manufacturer's recommendations, including the following:

1. Apply with a rotating centrifugal casting applicator or airless sprayer onto the fresh mortar liner.

2. If the epoxy seal is applied more than 24 hours after application of the mortar liner, or if the mortar liner is contaminated, clean the liner and then apply the epoxy.

D. Finishing: Install a new casting.

3.04 CLEANING, INSPECTION, AND TESTING

Comply with Section 6030 for in-situ manhole replacement and centrifugally cast mortar lined rehabilitation.

END OF SECTION

CLEANING, INSPECTION, AND TESTING OF STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cleaning, inspecting, and testing sanitary sewer manholes.

B. Cleaning and inspecting storm sewer manholes, intakes, and other utility structures.

1.02 DESCRIPTION OF WORK

A. Clean, inspect, and test sanitary sewer manholes.

B. Clean and inspect storm sewer manholes, intakes, and other utility structures.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Notify the Engineer at least 24 hours prior to performing testing.

B. The Engineer must be present to review testing procedures and record results.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

Cleaning, inspection, and testing of structures are incidental to construction of structures and will not be paid for separately.

PART 2 - PRODUCTS

None.

PART 3 - EXECUTION

3.01 CLEANING

A. Clean all manholes, intakes, and structures by removing sheeting, bracing, shoring, forms, soil sediment, concrete waste, and other debris.

B. Do not discharge soil sediment or debris to drainage channels or existing storm sewer or sanitary sewer system.

3.02 VISUAL INSPECTION

A. Examine structure for:

1. Damage.
2. Slipped forms.
3. Indication of displacement of reinforcement.
4. Porous areas or voids.
5. Proper placement of seals, gaskets, and embedments.

B. Verify that the structure is set to true line, grade, and plumb.

C. Verify structure dimensions and thicknesses.

3.03 REPAIR

Comply with Section 6010 for repairs.

3.04 SANITARY SEWER MANHOLE TESTING

A. General:

1. Use vacuum testing for sanitary sewer manholes, unless exfiltration testing is specified in the contract documents.
2. Conduct the final test after manhole construction is complete, all repairs and connections have been made, and the invert has been installed.

B. Vacuum Test:

1. Applicable only for new manholes isolated from connecting sewer lines.
2. Use manufactured vacuum test equipment meeting the Engineer's approval. Follow the equipment manufacturer's recommended procedures throughout, unless directed otherwise by the Engineer or these specifications.
3. Use extreme care and follow safety precautions during testing operations. Keep personnel clear of manholes during testing.
4. Seal all openings except manhole top access using pneumatic plugs rated for test pressures. Install plugs according to the test equipment manufacturer's recommendations.
5. Brace pipe inverts if backfill material has not been placed around connecting pipes.

3.04 SANITARY SEWER MANHOLE TESTING (Continued)

6. Install the vacuum tester head assembly on the manhole top access, and inflate the seal.

7. Evacuate the manhole to 5 psi or 10 inches mercury (Hg). Close the isolation valve and start the test. Record the starting time.

8. Maintain a vacuum in the manhole for the time indicated in the following table for the diameter and depth of manhole being tested.

9. Test failure is indicated by vacuum loss greater than 0.5 psi or 1 inch mercury (Hg) within the minimum test time indicated in the table below for the depth and diameter of the manhole being tested.

Table 6030.01: Minimum Vacuum Test Times for Various Manhole Diameters

Depth (feet)	Diameter (inches)				
	48	54	60	66	72
	Time (seconds)				
8	20	23	26	29	33
10	25	29	33	36	41
12	30	35	39	43	49
14	35	41	46	51	57
16	40	46	52	58	67
18	45	52	59	65	73
20	50	53	65	72	81
22	55	64	72	79	89
24	59	64	78	87	97
26	64	75	85	94	105
28	69	81	91	101	113
30	74	87	98	108	121

C. Exfiltration Test:

1. Testing may be performed in conjunction with sanitary sewer line testing. Comply with Section 4060.

2. Do not test by this method if water may potentially freeze during the test.

3. Plug the manhole inlet and outlet.

4. Fill the manhole with water to 2 feet above the outside top of the connecting pipe. If ground water is present, fill the manhole to no less than 2 feet nor more than 5 feet above the ground water level. Do not fill above the top of the standard barrel sections.

5. Mark the water level.

6. Allow water to stand in the manhole for 1 hour, then refill to the original water level and begin the test.

7. Determine the allowable drop in water level by using the equation given in Section 4060, 3.03. After 1 hour, measure the drop in water level.

8. Test failure is indicated by water loss greater than the maximum allowable calculated exfiltration.

3.05 TEST FAILURE

If testing fails, reseal the openings, repair the manhole, and retest. An alternate test method complying with these specifications may be used for a retest if desired.

END OF SECTION

Insert tab here called

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PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

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A. Pavement

B. Curb and Gutter

1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of full depth PCC pavement and curb and gutter.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Two weeks prior to commencing any PCC pavement placement, submit a paving mix design for each different source of aggregate to be used for review and approval by the Engineer. Submit mixes or mix designs approved by the Iowa Department of Transportation or an independent testing laboratory.

B. Maturity curves for paving mixes and maturity reading results.

C. Submit all testing and certifications according to Section 7010, 3.07.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Aggregate Storage: Comply with Iowa DOT Article 2301.02, C.

B. Cement and Fly Ash: Comply with Iowa DOT Article 2301.02, C.

C. Admixtures: Store in suitable weather tight enclosures which will preserve quality.

D. Reinforcing Steel: Store off ground on timbers or other supports.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Complete elements of the work that can affect line and grade in advance of other open cut construction unless noted on plans.

1.07 SPECIAL REQUIREMENTS

None

1.08 MEASUREMENT AND PAYMENT

A. PCC Pavement:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of PCC pavement.

3. **Includes:** Unit price includes, but is not limited to, final trimming of subgrade or subbase, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection (excluding cold weather protection; see Section 7010, 1.08, N), safety fencing, concrete for rigid headers, boxouts for fixtures, pavement smoothness testing, and quality control for stringless paving.

B. Air Content Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement subject to a unit price reduction for air content deficiency according to Section 7010, 3.07.

2. **Payment:** Payment will be at the reduced unit price according to Table 7010.03 for each thickness of PCC pavement. If there is an air content deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

C. Pavement Smoothness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement subject to a unit price reduction for pavement smoothness according to Section 7010, 3.07.

2. **Payment:** Payment will be at the reduced unit price according to Table 7010.04 for each thickness of PCC pavement. If there is a pavement smoothness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

D. PCC Pavement Thickness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement that has deficient pavement thickness as determined in Table 7010.05.

2. **Payment:** Payment will be at the percentage of the unit price indicated in Table 7010.05 for each different thickness of PCC pavement. If there is a pavement thickness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

E. Curb and Gutter:

1. **Measurement:** Measurement will be in linear feet measured along the face of the curb for each different width and thickness of curb and gutter.

2. **Payment:** Payment will be at the unit price per linear feet of curb and gutter.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection (excluding cold weather protection; see Section 7010, 1.08, N), and boxouts for fixtures.

1.08 MEASUREMENT AND PAYMENT (Continued)

F. Beam Curb:

1. **Measurement:** Measurement will be in linear feet measured along the face of the curb.

2. **Payment:** Payment will be at the unit price per linear feet of beam curb.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection (excluding cold weather protection; see Section 7010, 1.08, N), and boxouts for fixtures.

G. Concrete Median:

1. **Measurement:** Measurement will be in square yards of concrete median. When the curb is integral with the pavement, the width will be measured from back of curb to back of curb.

2. **Payment:** Payment will be at the unit price per square yard of concrete median.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection (excluding cold weather protection; see Section 7010, 1.08, N), and boxouts for fixtures.

H. PCC Railroad Crossing Approach:

1. **Measurement:** Measurement will be in square yards of railroad crossing approach.

2. **Payment:** Payment will be at the unit price per square yard of railroad crossing approach.

3. **Includes:** Unit price includes, but is not limited to, excavation for modified subbase and subdrain, furnishing and installing subdrain, furnishing and installing subdrain outlet or connection to storm sewer, furnishing and installing porous backfill material, furnishing and placing modified subbase material, furnishing and installing reinforcing steel and tie bars, furnishing and placing concrete, furnishing, placing, and compacting asphalt.

I. PCC Pavement Samples and Testing:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for PCC pavement samples and testing.

3. **Includes:** Lump sum price includes, but is not limited to, certified plant inspection, pavement thickness cores, pavement smoothness measurement (when required by the contract documents), and maturity testing.

J. Granular Surfacing: Comply with Section 7030 for granular surfacing material placed at intersecting roads, driveways, and turnouts.

K. PCC Pavement Widening:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement widening. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement widening area.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. **Payment:** Payment will be at the unit price per square yard for each thickness of PCC pavement widening.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection (excluding cold weather protection; see Section 7010, 1.08, N), safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness.

L. Pavement Removal: Comply with Section 7040.

M. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

N. PCC Cold Weather Protection:

1. **Measurement:** When cold weather protection is required and authorized by the Engineer, measurement will be in square yards of the area of PCC pavement to be protected. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price of $2.50 per square yard. Payment will be limited to protection necessary only within the contract period and with prior authorization of the work by the Engineer. No price modifications will be made for quantity underruns or overruns for this item. Cold weather protection necessary after the completion date, after all calendar days have passed, or after all working days have been used is incidental to the work regardless if a quantity was included in the contract.

3. **Includes:** Unit price includes, but is not limited to, all labor, materials, and equipment to install and remove all required protection.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: Meet the requirements of Iowa DOT Section 4101 and Materials I.M. 401, including Type I and Type II cements and blended hydraulic cements Type 1P, Type 1S, Type 1T, and Type 1L.

B. Supplementary Cementitious Materials (SCM):

1. **Fly Ash:** Comply with Iowa DOT Section 4108.

2. **Ground Granulated Blast Furnace Slag (GGBFS):** Comply with Iowa DOT Section 4108.

3. **Limestone:** Comply with Iowa DOT Materials I.M. 401.

C. Fine Aggregate for Concrete:

1. Meet the requirements of Iowa DOT Section 4110 and Materials I.M. 409, Source Approvals for Aggregates.

2. Comply with the following gradation:

Sieve Size	Percent Passing
3/8”	100
No. 4	90 to 100
No. 8	70 to 100
No. 30	10 to 60
No. 200	0 to 1.5
Iowa DOT Article 4109.02, Gradation No. 1 in the Aggregate Gradation Table.	

3. The Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

D. Coarse Aggregate for Concrete:

1. Crushed stone particles with Class 2 durability complying with Iowa DOT Section 4115 and Materials I.M. 409, Source Approvals for Aggregates.

2. Comply with one of the following gradations:

Sieve Size	Gradation No. 3 Percent Passing	Gradation No. 4 Percent Passing	Gradation No. 5 Percent Passing
1 1/2”	100	100	-----
1”	95 to 100	50 to 100	100
3/4”	-----	30 to 100	90 to 100
1/2”	25 to 60	20 to 75	-----
3/8”	-----	5 to 55	20 to 55
No. 4	0 to 10	0 to 10	0 to 10
No. 8	0 to 5	0 to 5	0 to 5
No. 200	0 to 1.5	0 to 1.5	0 to 1.5
Iowa DOT Article 4109.02, Gradation No. 3, 4, and 5 in the Aggregate Gradation Table.			

3. The Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

2.01 MATERIALS (Continued)

E. Intermediate Aggregate for Concrete: Use if specified in contract documents.

1. Meet the requirements of Iowa DOT Section 4112 and Materials I.M. 409, Source Approvals for Aggregates.

2. For crushed limestone or dolomite, meet the durability class required for the coarse aggregate. When gravel durability is lower than the coarse aggregate durability requirements, pea gravel is not to exceed 15% of the total aggregate mix.

3. Comply with the following aggregate gradation:

Sieve Size	Percent Passing
1/2”	95 to 100
3/8”	-----
No. 4	-----
No. 8	0 to 10
Iowa DOT Article 4109.02, Gradation No. 2 in the Aggregate Gradation Table	

4. The Engineer may authorize a change in gradation subject to materials locally available at the time of construction.

F. Water Requirements: Comply with Iowa DOT Section 4102. Potable water obtained from a municipal supply, suitable for drinking, may be accepted without testing.

G. Admixtures: Meet Iowa DOT Materials I.M. 403 and the requirements for the liquid admixtures shown below. Other admixtures may be used subject to the approval of the Engineer.

1. Air Entrainment Admixture: Comply with Iowa DOT Section 4103.

2. Retarding and Water Reducing Admixtures: Comply with Iowa DOT Section 4103.

3. Accelerating admixtures (calcium chloride): Comply with Iowa DOT Article 2529.02.

H. Bars: Comply with Iowa DOT Section 4151 for metallic tie bars and dowel bars or Iowa DOT Section 4156 for glass fiber reinforced polymer dowel bars. Meet the tie bar requirements for bar mats. All metallic bars must be epoxy coated.

I. Expansion Tubes: Comply with Iowa DOT Section 4191.

J. Metal Keyways: Comply with Iowa DOT Section 4191.

K. Supports for Bars: Comply with Iowa DOT Materials I.M. 451.01.

L. Joint Fillers and Sealers:

1. Joint Sealers: Comply with Iowa DOT Article 4136.02.

2. Preformed Expansion Joint Fillers and Sealers: Use the following types of preformed materials for filling expansion joints that comply with Iowa DOT Article 4136.03. When the type is not specified, use a resilient filler.

- Resilient filler
- Flexible foam expansion joint filler
- Tire buffings expansion joint filler
- Elastomeric joint seals

2.01 MATERIALS (Continued)

M. Liquid Curing Compound: Comply with Iowa DOT Section 4105.

N. Covering:

1. Burlap: Comply with Iowa DOT Section 4104.

2. Plastic Film: Comply with Iowa DOT Section 4106.

3. Insulating Cover: Comply with Iowa DOT Section 4106.

O. Grout Systems: Use polymer grouts that comply with Iowa DOT Materials I.M. 491.11.

2.02 CONCRETE MIXES

A. Mix Design:

1. Comply with Iowa DOT Class C or Class M mix meeting the requirements of Materials I.M. 529. If higher durability mixes are specified, use C-SUD or CV-SUD mixes.

2. Ensure compatibility of all material combinations. If the concrete materials are not producing a workable concrete mixture, a change in the material may be required. Changes will be at no additional cost to the Contracting Authority.

B. Consistency and Workability:

1. Slump:
a. Use an amount of mixing water that will produce workable concrete of uniform consistency. Unless specifically modified by the Engineer, ensure slump, measured according to Iowa DOT Materials I.M. 317, is no less than 1/2 inch or no more than 2 1/2 inches for machine finish and no less than 1/2 inch and no more than 4 inches for hand finish. When a water reducing admixture is used, the maximum slump may be increased to 5 inches.
b. If it is not possible to produce concrete having the required consistency without exceeding the maximum allowable water to cement ratio specified, the cement content may be increased or water reducing admixture may be added. Obtain the Engineer's approval. Do not exceed the maximum water to cement ratio. Additional cement or water reducer will be added with no additional cost to the Contracting Authority.
c. The basic absolute volume of water per unit volume of concrete is based on average conditions. If material characteristics require that the total quantity of water used to secure the required consistency reduces the batch yield (computed on the basis of absolute volumes of the batch quantities used) by more than 2.0%, the Engineer may adjust the proportions to correct the yield. This adjustment will not be a basis for adjustment of the contract unit price.

2. Air Content: Use an approved air entraining agent.
a. For machine-placed pavement, use a target air content of 8% with a tolerance of plus or minus 2% when measured on the grade just prior to consolidation, as determined by Iowa DOT Materials I.M. 318. The target air content may be adjusted by the Engineer based on random tests of the consolidated concrete behind the paving machine. These additional tests will be used to consider the need for a target value change and will not be used in the acceptance decision.
b. For hand-placed pavement, use a target content for hand finish of 7% with a tolerance of plus or minus 1.5% when measured on the grade and just prior to consolidation, as determined by Iowa DOT Materials I.M. 318.

2.02 CONCRETE MIXES (Continued)

C. Use of Fly Ash and Ground Granulated Blast Furnace Slag (GGBFS) as Supplementary Cementitious Materials:

1. Mix proportions for the various mixes using fly ash and GGBFS are included in Iowa DOT Materials I.M. 529. The maximum allowable fly ash substitution rate is 20%. Do not use a GGBFS substitution rate of more than 35% by weight (mass). The total supplementary cementitious material substitution rate is not to exceed 40%.

2. If C-SUD or CV-SUD mixes are specified, the maximum allowable Class F fly ash substitution rate is 25% and the maximum Class C fly ash substitution rate is 35%. The maximum combination rate is 20% Class C fly ash and 20% GGBFS.

3. When Type IP, IT, or IS cement is used in the concrete mixture, only fly ash substitution will be allowed. Between October 16 and March 15, use of Type IL cement with fly ash and GGBFS or Type IP, IS, or IT cement with fly ash will be allowed only when maturity method is used to determine time of opening. Transport, store, haul, and batch fly ash and GGBFS in such a manner to keep it dry.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Batching and Mixing Equipment:

1. General:

a. Weighing and Proportioning Equipment: Comply with Iowa DOT Article 2001.20.

b. Mixing Equipment: Comply with Iowa DOT Article 2001.21.

c. Material Bins: Involves any structure in which materials are stored. Each part of any bin, including foundations and supports, must be adequate to withstand any stress to which it might be subjected to while in use.

2. Batching:

a. Ensure the batching plant is Iowa DOT calibrated and approved. Provide copy of current calibrations and approvals.

b. Coordinate the batch plant operation and batch trucks with the paving operation in order to ensure a steady supply of materials.

c. Operate the batch plant and trucks to minimize dust, noise, or truck nuisances.

3. Mixing:

a. Construction or Stationary Mixer:

1) Ensure the concrete is uniform in composition and consistency. If this condition is not produced because of the size of the batch, the size of the batch may be reduced or the mixing time increased, or both, until this result is obtained. If non-uniform, corrective action must be taken.

2) Ensure the methods of delivering and handling the concrete are such that objectionable segregation or damage to the concrete will not occur, and they will facilitate placing with a minimum of handling.

b. Ready Mixed Concrete:

1) Ensure the concrete is uniform in composition and consistency. If non-uniform, concrete producers must take corrective action.

2) Ready mixed concrete is defined as concrete proportioned in a central plant and mixed in a stationary mixer for transportation in trucks without agitation, proportioned at a central plant, and only partially mixed in a stationary mixer for transportation and finish mixing in a transit mixer, or proportioned at a central plant, and then mixed in a transit mixer prior to or during transit.

3) When necessary to add additional mixing water at the site of placement, mix the batch at least an additional 30 revolutions of the drum at mixing speed.

4) Ensure each vehicle in which concrete will be delivered is capable of discharging concrete having a slump not over 2 inches at an overall rate for its entire load of not less than 1.25 cubic yards per minute. Ensure the concrete is delivered at a rate sufficient to maintain a sustained rate of progress of not less than 100 feet per hour for the width and depth of pavement to be placed.

c. All Methods: Identify each truck load by a plant charge ticket showing plant name, contractor, project data, quantity, class, time batched, and water added at site.

B. Concrete Delivery Equipment:

1. General:

a. In handling concrete from the mixer to the place of deposit, take care to avoid segregation.

b. When concrete is deposited through a chute, slope the chute to allow concrete to flow slowly without segregation. Place the delivery point of the chute as close as possible to the point of deposit. Keep chutes and spouts clean. Thoroughly flush them with water before and after each run. Discharge the water outside the paving area in an approved concrete washout area.

c. Provide alternate plan for concrete delivery in event of equipment failure.

d. Take concrete samples from material placed on the subgrade or subbase.

3.01 EQUIPMENT (Continued)

2. Concrete Transfer Equipment:

a. Utilize placers, conveyors, buckets, or buggies designed specifically for transporting concrete.
b. Do not allow concrete to free fall into or out of transfer equipment.
c. Meet the requirements of Section 7010, 2.02, B, 2 for air entrainment of the concrete mix and testing for compliance.

3. Concrete Pumps:

a. Do not pump concrete through aluminum conduit or tubing.
b. Use the concrete pump to deliver the material as close to horizontal as possible, keep restrictions and drops to a minimum, and avoid free fall.
c. Meet the requirements of Section 7010, 2.02, B, 2 for air entrainment of the concrete mix and testing for compliance.
d. Sample the first load after pumping a minimum of 3 cubic yards. Sample after each significant change in boom angle.
e. Sample before and after the pump to determine if any changes in the slump and other significant mixture characteristics occur.
f. When sampling at the end of the placement line, take care to ensure that the sample is representative of the concrete being placed from the pipeline. Note: Changes to the placement rate or boom configuration can result in changes in the concrete properties. Typically, the vertical position of the boom results in the greatest potential for air loss while the horizontal position of the boom has the least potential. Location of pumping equipment should be determined so that it is possible to maintain a consistent, low boom angle as much as possible during placement.
g. If air test shows that air entrainment is outside of the allowed range, follow procedure as outlined in Section 7010, 3.07, B.
h. Leaks in the line or pump hydraulics, which would allow air to be added to the concrete, are prohibited.

C. Concrete Placement Equipment:

1. Consolidating and Finishing Equipment:

a. Use a paving machine that meets all of the following:
   1) Is designed for the specific purpose of placing, consolidating, and finishing concrete pavement.
   2) Develops vertical edges on the pavement.
   3) Is self propelled and equipped with a means for spreading the concrete to a uniform depth before it enters the throat.
   4) Vibrates the concrete to the full width and depth being placed in a single passage. Use vibrating tubes or arms working in the concrete or a vibrating pan operating on the surface of the concrete.
   5) Produces a surface reasonably free of voids and tears.
   6) When the paver is operated on previously placed concrete, prevent damage to the pavement surface.
   7) For slip form pavers, use a paver equipped with automatic horizontal and vertical grade controls.
b. Hand methods utilizing air screeds and vibrating screeds may be used for short pavement runs, cul-de-sacs, driveways, and some intersections.
c. When allowed by the Engineer, use stringless paving equipment capable of providing the same accuracy necessary to comply with the requirements of Section 7010.
d. Use a laser guided screed that meets all of the following:
   1) Designed for the specific purpose of placing and finishing of concrete pavement using a 3-dimensional surface model.
   2) All equipment for laser guided screed, including the guidance system, will meet the project design model tolerances.

3.01 EQUIPMENT (Continued)

3) Will provide consolidation to full width and full depth of concrete placement. Provide intermediate consolidation by using external hand held vibrators.
4) Produces a surface reasonably free of voids and tears.
5) Provide boom-style screed (drive-in screeds are not allowed) with an auger boom, placement head (water spray mechanism not allowed), guidance equipment, and software to produce 3-dimensional surface.
6) Produces pavement smoothness as specified in Section 7010, 3.07, C.

2. Vibrators for Machine Paving:

a. Consolidate, with a single pass of an approved internal or surface vibrator, the full width and depth of concrete requiring a finishing machine. Operate internal vibrators within a frequency range of 4,000 to 8,000 vibrations per minute. The Engineer may authorize the minimum vibration frequency to be lowered to 3,500 vibrations per minute for particular sections of paving, such as superelevations. Operate surface vibrators within a frequency range of 3,500 to 6,000 vibrations per minute.
b. Avoid operating vibrators in a manner to cause a separation of the mix ingredients, either a downward displacement of large aggregate particles or an accumulation of laitance on the surface of the concrete. When forward motion of the paver is reduced, vibrator frequency may need to be reduced to avoid separation of the mix.
c. If a vibrator fails to operate within the specifications, repair or change the vibrator before the paving begins:
   - The following day, or
   - The same day if the continuous paving that day is stopped at a header or at the end of a session.
d. If two adjacent vibrators fail to operate within the specifications, stop the paving operation and repair or replace the vibrators.
e. Stop vibrators whenever forward motion of the paver is stopped.
f. Set the internal vibrator penetration depth into the concrete pavement to mid slab or as deep as possible while passing above reinforcing steel. Provide an operating position locking device so that no part of the vibrating unit can be lowered to the extent that it will come in contact with reinforcing steel or tie bars while paving.
g. Do not exceed the manufacturer's recommendations for vibrator horizontal spacing. Do not exceed 16 inches from center to center.
h. Mount the longitudinal axis of the vibrator body approximately parallel to the direction of paving. Tilt the trailing end of each vibrator downward to a slope of 10 to 30 degrees below horizontal.
i. Use vibrators that meet or exceed the following specifications at the manufacturer's design frequency of 10,000 vpm:
   1) Amplitude (peak to peak) 0.070 inches.
   2) Centrifugal force 1,200 pounds.

3. Vibrators for Hand Methods: Use a vibration rate between 3,500 to 6,000 vibrations per minute, and use an amplitude sufficient to be perceptible on the surface of the concrete more than 12 inches from the vibrating unit.

4. Hand Finishing Equipment: Provide all finishing tools necessary for proper finishing of the concrete including straightedges for checking and correcting finished concrete surfaces.

5. Forms:

a. Rigid Forms: Steel, minimum thickness of 5 gage, height at least equal to design thickness of pavement with base width at least 6 inches.
   1) Minimum section length of 10 feet, joint connections designed to allow horizontal and vertical adjustment with locking device to hold abutting sections firmly in alignment.
   2) Bracing, support, and staking must prevent deflection or movement of forms.

3.01 EQUIPMENT (Continued)

b. Flexible Forms: Use steel or wood flexible forms for curves with a radius less than 100 feet.
1) Bracing, support, and staking must prevent deflection or movement of forms.
2) Ensure that forms used to shape back of curbs at returns have height at least equal to design thickness of pavement and curb height.
3) Forms must be free from scale and surface irregularities.

6. Curing Equipment: Use pressure sprayer capable of applying a continuous uniform film of curing compound. Use equipment with a shield if wind conditions do not allow proper coverage

7. Concrete Saws: Use power operated concrete saws capable of cutting hardened concrete neatly.

8. Joint Sealing Equipment: Use equipment capable of cleaning the joint and heating and installing sealant in joints according to manufacturer's recommendations.

3.02 PAVEMENT CONSTRUCTION

A. Removal of Pavement: Comply with Section 7040, 3.02.

B. Final Subgrade/Subbase Preparation:

1. General:
a. Meet the requirements of Section 2010 for subgrade construction, subgrade treatment, and subbase construction.
b. Trim the subgrade or subbase to the final grade for placement of concrete.
c. Unless otherwise ordered by the Engineer, the subgrade or subbase, at time of placing concrete for concrete pavement, must be in a uniformly moist but not muddy condition to a depth of not less than 1 inch.

2. Subgrade and Subbase Loading:
a. Travel of concrete delivery trucks on a subgrade or subbase must be approved by the Engineer. In such cases, watering of the subgrade or subbase must be limited to just ahead of the paving machine.
b. Enter and exit from side streets to minimize repetitive loading on the subgrade or subbase by concrete trucks.
c. Do not allow loads in excess of the legal axle load on the completed subgrade or subbase.
d. Partially loaded trucks may be required.
e. If subgrade or subbase failure occurs, coordinate the repair with the Engineer.

3. Paving Suspended:
a. Suspend the paving operation where subgrade or subbase stability has been lost.
b. Do not place concrete on a subgrade or subbase that has become unstable, bears ruts or tire marks of equipment, or that is excessively softened by rain until such subgrade or subbase has been reconsolidated and reshaped to correct the objectionable condition.
c. If necessary, scarify to a minimum depth of 6 inches, aerating, and recompacting at no additional cost to the Contracting Authority. Meet the compaction requirements of Section 2010, 3.06.

4. Maintenance of Subgrade or Subbase: Maintain the completed subgrade or subbase during subsequent construction activities.

3.02 PAVEMENT CONSTRUCTION (Continued)

C. Surface Fixture Adjustment:

1. Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with Section 6010, 3.04 for manhole adjustments and Section 5020, 3.04 for water fixture adjustments.

2. Clean outside of fixture to depth of pavement before concrete placement.

3. Construct boxouts where allowed for later adjustment of fixtures. See Figure 7010.103 for the size and shape of the boxout.

D. Setting of Forms: When forms are used, meet the following requirements.

1. Ensure forms have sufficient strength to support paving operations being used.

2. Set base of forms at or below subgrade elevation with top of forms at pavement surface elevation. With Engineer approval, extra height forms may be used to shape the back of integral curb and edge of pavement; set base at or below subgrade elevation with top of form at top of curb elevation.

3. Place and secure forms to required grade and alignment. Do not vary the top face of the form from a true plane by more than 1/8 inch in 10 feet, and do not vary the vertical face from a true plane by more than 1/4 inch in 10 feet.

4. If the soil supporting the forms is softened by rain or standing water so that the forms are inadequately supported, or if voids occur under the forms, remove forms. Rework subgrade to proper elevation and density, and reinstall forms.

5. Ensure forms are free of latent concrete and coated with release agent before concrete is placed.

E. Bar and Reinforcement Placement: Ensure bars are clean, straight, free from distortion and rust, and are firmly secured in position as specified in the contract documents. Place all bars in approved storage to prevent damage; do not distribute along the work site except as needed to avoid delay in paving.

1. Tie Bars:

a. Place bars prior to vibration. For slip form paving, tie bars may be installed after vibration, provided the concrete is consolidated around the bars. Bars may be supported by approved chairs or may be placed in position by a machine or method approved by the Engineer.

b. Use approved continuous bolsters with runners to support reinforcement for bridge approach sections. Place the supports transversely across the approach and space them longitudinally no greater than 4 feet. For double reinforced approach sections the top layer of reinforcing may be chaired off the bottom layer of reinforcing using approved continuous high chairs with runners, provided they are positioned directly above the continuous bolsters with runners supporting the bottom layer of reinforcing. Hold epoxy coated reinforcing steel in place with epoxy or plastic coated bar supports and epoxy or plastic coated tie wires.

2. Dowel Bar Assemblies:

a. When dowel bar assemblies are required in the contract documents, accurately place these assemblies as shown. To prevent their movement during subsequent concrete paving operations, securely stake or fasten to the base to line and grade.

b. Do not use assemblies that are damaged prior to placement. If assemblies are damaged after placement, replace prior to paving. Ensure horizontal and vertical alignment of the load transfer bars does not exceed 1/4 inch from parallel to line and grade. Place each assembly so the bars are in a horizontal plane at T/2 ± 1/2 inch.

3.02 PAVEMENT CONSTRUCTION (Continued)

c. Check the placement of each assembly and the position of the bars within the assembly using a suitable template or other device approved by the Engineer. If the assembly is found to be placed outside of the above tolerances, correct the placement.
d. Cutting the tie wires of the load transfer assemblies is optional.

3. Bar Mats for Reinforced Pavement:

a. When reinforced pavement is specified, assemble bar mats accordingly and firmly fastened together at all bar intersections.
b. Place, secure, latch, and tie bar mats for a continuous mat as specified in the contract documents. Displacement during concrete placement operations is not allowed.
c. Use chairs to ensure proper placement of bar mats.

4. Tie Bars and Dowel Bars in Existing Pavement:

a. When anchoring in existing concrete, use a grout system according to the manufacturer's instructions. Obtain the Engineer's approval for the grout system.
b. For horizontal installations, use either a pressure injection system with mechanical proportioning and mixing, or use encapsulated chemical anchors. Install as follows:
   1) Ensure drilled holes to receive the grout match the dimensions and spacing specified in the contract documents. When not specified in the contract documents, the maximum nominal diameter of the hole must be 1/8 inch larger than the outside diameter of the dowel or bar, or as recommended by the manufacturer. Drill holes for tie bars and dowel bars into the face of the existing pavement at midpoint. To ensure proper horizontal alignment, do not allow any hole misalignments to exceed 1/4 inch in the vertical or horizontal plane. Clean the hole with compressed air immediately prior to placing the grout.
   2) Use a polymer grout to secure the dowels in the existing pavement. Inject the grout into the rear of the hole with pressure. Use sufficient grout so that when the bar to be grouted is placed in position, excess grout will be forced out the front of the hole. Rotate the bar during the insertion process to ensure complete coating with the grouting material. Hand proportioning and mixing is not allowed.
   3) If using grout with approved encapsulated anchors, install according to the manufacturer's recommendations.
   4) Use horizontal installation procedures for vertical or angled installations; however, pourable grouts may be used. Pourable grouts must be mechanically mixed.

F. Concrete Pavement Placement:

1. Use paving machine for all uniform width pavements 8 1/2 feet or more in width and 250 feet or more in length, unless alternate methods are approved by the Engineer. Screeds and laser guided screeds may be used on short pavement runs up to 250 feet.

2. Place, consolidate, and finish the concrete to the full depth and width conforming to the specified crown and cross-section in a single operation.

3. Keep a uniform pile of concrete in front of the paving machine, up to a maximum of 6 to 8 inches above the design surface elevation. Distribute and spread the concrete as soon as placed. A mechanical concrete spreader may be used.

4. Deposit the concrete upon the in-place bars keeping segregation to a minimum.
5. Use shovels, not rakes, to do necessary hand spreading and spading.

6. Do not allow the edges of pavement, including all longitudinal construction joints, to deviate from the line shown on the plans by more than 1/2 inch at any point.

7. If the paving machine operates on adjacent pavement, protect pavement from damage.

3.02 PAVEMENT CONSTRUCTION (Continued)

8. When placing by hand methods, consolidate the concrete by using vibrating units. Use a definite system or pattern in the operation of the vibrator so the full width of concrete in each linear foot of lane will receive adequate and uniform consolidation. The system and methods of vibrating is subject to approval of the Engineer. Do not use vibrating equipment as a tool for moving concrete laterally.

9. Stringless Paving:
   a. Provide an electronic file identifying x, y, and z coordinates for curbs and pavement edges, as well as pavement centerline based on project alignments and elevations.
   b. Location and elevation of the finished slab should be verified against grade check hubs at 25 foot intervals for the first 100 feet of each days run and at critical locations, such as intakes and through intersections where grades may be flat. The Engineer may waive these requirements if experience has shown compliance with the design elevations.
   c. Record each verification check and submit to the Engineer.
   d. At the beginning of paving operations on the project or after each modification to the paving machine, verify the paving equipment is calibrated per the manufacturer's recommendations.

G. Integral Curbs: Integral curbs are placed with the pavement in a single paving machine operation; however, hand methods may be allowed for radius, returns, and sections of curb and gutter 100 feet or less in length or in other special sections where mechanical equipment cannot be used.

1. Pave, edge, protect, saw, and cure curb in same manner as pavement.

2. Finish curb as rapidly as finishing operations on pavement permit. Maximum distance behind paving machine is 100 feet.

3. Complete final finish on curbs by hand methods, including the use of a 6 foot straightedge.

4. Check surfaces of curb and gutter with 10 foot straightedge; correct variations greater than 1/8 inch. Ensure top of curb slopes to street when Class A sidewalk will be constructed adjacent to the curb.

5. For drop curb at driveways and where sidewalks intersect streets, use forms to shape the backs of such curbs.

6. When using hand methods for building curb, the following additional requirements will apply:
   a. Remove free water, latency, dust, leaves, or other foreign matter from the slab prior to placing concrete for curb.
   b. Use freshly mixed concrete; do not store concrete in receptacles at side of pavement for use in curb at a later time; do not use concrete requiring retempering.
   c. Consolidate curb concrete to obtain adequate bond with the pavement slab and to eliminate honeycomb in the curb. Avoid disturbing the alignment of forms or the gutter flow line.

H. PCC Railroad Crossing Approach: Construct according to Section 7010 and Figure 7010.903. Construct asphalt section according to the full depth patch requirements of Section 7040.

I. Finishing:

1. Grade and Crown: Promptly after concrete has been placed and vibrated, strike off the surface to the true section by the screed. Finish the surface true to crown and grade.

3.02 PAVEMENT CONSTRUCTION (Continued)

2. Watering the Surface: The practice of lubricating the pavement surface by sprinkling water by spray, brush, or other methods to afford greater ease in finishing operation is not allowed.

3. Floats: Finish surface with wood or magnesium floats; finish from both sides simultaneously if pavement is placed to full width with one pass of paving machine.

4. Straightedging:

a. After the longitudinal floating has been completed and the excess water has been removed, and while the concrete is still plastic, test the pavement surface for trueness.
b. Immediately fill any depressions found with freshly mixed concrete, struck off, consolidated, and refinished.
c. Check surface longitudinally while concrete is still plastic; correct any surface deviations greater than 1/8 inch in 10 feet.

5. Surface Treatment:

a. Drag Surface Treatment: Unless otherwise specified, texture the finished surface with an artificial turf or burlap drag treatment.

1) Pull the artificial turf or burlap drag longitudinally over the finished surface to produce a tight, uniform, textured surface, and round the edges in a workmanlike manner.
2) Remove the artificial turf or burlap drag from the pavement surface at regular intervals and clean with water to remove accumulated concrete from the fabric in order to maintain a consistent finished texture.
3) When the desired texture is not attained, the Engineer may require the final finish be a broom finish.

b. Surface Tining: When surface tining is specified, use a longitudinal tining. Under special circumstances, when specified in the contract documents, transverse tining may be required.

1) Longitudinal:

a) Complete longitudinal surface tining using a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and uniformly spaced at 3/4 inch intervals. The depth of the grooves must be a minimum of 1/8 inch to a maximum of 3/16 inch in the plastic concrete.
b) Use equipment with horizontal and vertical string line controls to ensure straight grooves.
c) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.
d) At longitudinal joints, leave a 2 to 3 inch wide strip of pavement surface (centered along the joint) that is not grooved for the length of the joint.

2) Transverse:

a) If transverse surface tining is required or allowed, use a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and randomly spaced from 3/8 inch to 1 5/8 inch with no more than 50% of the spacing exceeding 1 inch. The depth of the grooves must be a minimum of 1/8 inch to a maximum of approximately 3/16 inch in the plastic concrete.
b) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.

3.02 PAVEMENT CONSTRUCTION (Continued)

c) Where abutting pavement is to be placed, the tining should extend as close to the edge as possible without damaging the edge.
d) If abutting pavement is not to be placed, do not tine the 6 inch area nearest the edge or 1 foot from the face of the curb.

6. Edge Finish: Before the concrete has taken its initial set, finish all edges of the pavement with an 1/8 inch radius edging tool.

7. Honeycomb Repair: When paving without forms, fill any honeycombed area immediately with freshly mixed concrete and work into the slab prior to initial set and the application of curing. Failure to do so may prompt the Engineer to declare the work defective and cause it to be removed and replaced at no additional cost to the Contracting Authority.

J. Surface Curing:

1. Apply liquid curing compound in a fine spray to form a continuous, uniform film on the horizontal surface and vertical edges of pavement, curbs, and back of curbs immediately after surface moisture has disappeared, but no later than 30 minutes after finishing. With approval of the Engineer, the timing of cure application may be adjusted due to varying weather conditions and concrete mix properties to ensure acceptable macrotexture is achieved.
   a. Use a white pigment liquid curing compound for concrete not receiving an asphalt overlay. When specified in the contract documents, use a linseed oil solution.
   b. Use a dark-colored curing compound for concrete receiving an asphalt overlay.

2. Apply compound with power sprayer; rate of application not less than 15 square yards per gallon (0.067 gallon per square yard); do not dilute compound. For concrete receiving an asphalt overlay, use a minimum rate for dark-colored cure of 12.5 square yards per gallon (0.08 gallon per square yards).

3. Ensure liquid curing materials are well agitated in the supply drum or tank immediately before transfer to the sprayer. Keep curing materials well agitated during application.

4. Hand operated sprayers may be used for small and irregular areas.

5. If forms are used, apply to pavement edges and back of curbs within 30 minutes after forms are removed.

6. If, due to other operations, the coating is damaged within 72 hours after being applied, immediately re-coat the affected areas. Coating of the sawed surface with curing compound will not be allowed on joints that are to be sealed. When pavement is opened to traffic prior to 72 hours after application of the curing coating, a re-coating will not be required.

K. Construction of Joints:

1. General:
   a. Construct joints of the type, dimensions, and at the locations specified in the contract documents. See the 7010 figures.
   b. Place longitudinal joints coincident with or parallel to the pavement centerline.
   c. Place all transverse joints at right angles to the centerline and extend the full width of the pavement.
   d. Place all joints perpendicular to the finished grade of the pavement and do not allow the alignment across the joint to vary from a straight line by more than 1 inch.
   e. Exercise care in placing, consolidating, and finishing the concrete at all joints.

2. Saw Joints:
   a. Mark joint locations with a string line before sawing.
   b. Begin transverse joint sawing as soon as the concrete has hardened sufficiently to allow sawing without raveling or moving of aggregate. Saw joints before uncontrolled cracking takes place.

3.02 PAVEMENT CONSTRUCTION (Continued)

c. Saw all joints in a single cutting operation for a specific joint. Make saw cuts true to line and to the dimensions specified in the contract documents.
d. Discontinue sawing a joint if a crack develops ahead of the saw.
e. Saw longitudinal joints within 24 hours of the concrete being placed.
f. If necessary, continue the sawing operations both day and night.
g. The concrete must be capable of supporting the sawing operations to allow the use of an early green concrete saw.
h. Repair or replace pavement with uncontrolled or random cracking at no additional cost to the Contracting Authority. Use repair methods approved by the Engineer. Repair or replace at the direction of the Engineer.
i. Use wet sawing for dust control when specified in the contract documents.
j. Where boxouts occur in pavement, construct joints as shown on Figures 7010.103 and 7010.904.

3. Construction Joints:

a. Place longitudinal and transverse construction joints where specified in the contract documents, at boxouts, and at headers.
b. Locate and place forms for boxouts on grade prior to paving as shown on Figures 7010.103 and 7010.904.
c. Construct a Days Work (DW) or a Rigid Tie (RT) transverse construction joint no closer than 5 feet of an existing or planned transverse contraction joint. Construct the DW or RT transverse construction joint if concrete placement is delayed for more than 30 minutes, at planned pavement gaps, or at the end of each day.
d. Finish the edges of the pavement at construction joints with a 1/8 inch radius edging tool.

4. Expansion Joints:

a. Install expansion joints as specified in the contract documents.
b. Prevent movement of or damage to joint assembly when placing concrete; set joint material low enough to clear the finish machine.
c. Construct double width expansion joint in curb over expansion joint in pavement. The backside of the joint must be clear of concrete.
d. Align the expansion joint straight and true. After the mechanical finishing equipment has passed over the joint, check the joint for movement. If movement in excess of 1/2 inch has occurred, immediately correct the installation to its intended position.
e. If joint fillers are assembled in sections, or if joints as a whole are constructed in sections, do not allow offsets between adjacent fillers.
f. Where more than one section is used in a joint, securely lace or clip the sections together.
g. Supplemental vibration equipment is required for proper consolidation of the concrete.
h. After the surface finishing has been completed, finish the edge of the joint with a 1/8 inch edging tool.

L. Joint Sealing:

1. Timing:

a. Unless otherwise allowed or approved by the Engineer, before any portion of the pavement is opened to the Contractor's equipment or to general traffic, clean and seal joints that require sealing.
b. The Engineer may limit the wheel loads and axle loads of equipment operating on the pavement during this operation, if prior to the age and strength specified in Section 7010, 3.05. Additional tests to determine the pavement strength may be required.

3.02 PAVEMENT CONSTRUCTION (Continued)

2. Cleaning:
a. For those joints that are not to be sealed, cleaning is not required.
b. Within 3 hours after a joint has been wet sawed to the finished dimension, flush the wet sawing residue away from the sawed faces using a high pressure water blast operating with a minimum pressure of 1,000 pounds per square inch. Within 3 hours after a joint has been dry sawed to the finished dimension, blow the dry sawing residue from the joint using air compressors that provide moisture and oil free compressed air.
c. Immediately prior to installation of sealant, clean joints with an air blast. Do not perform sealing until visual examination verifies the joint surfaces appear dry, in addition to being clear of dust and contamination.

3. Sealing:
a. Prepare and install joint sealer in the joint and to the proper level specified in the contract documents and as recommended by the manufacturer.
b. Heat hot-poured sealers in a thermostatically controlled heating kettle; heat the material to the temperature required for use, but not above that recommended by the manufacturer. After sealing, remove excess sealer from the pavement surface.
c. Seal joints the same day they are cleaned. Apply sealant only when the joint surfaces appear dry by visual examination.
d. Place joint sealer only when the pavement and ambient air temperatures are 40°F or above. When near this minimum, additional air blasting or drying time, or both, may be necessary to ensure a satisfactory bond to the joint faces. When this sealer cannot be properly placed due to late fall work, submit a joint construction plan and sealing details to the Engineer for approval before commencing paving. Delay the cleaning, sealing, and, if required, resawing of joints until the following spring. This delay requires the Engineer's approval.
e. When surface correction is required, repair seals damaged from the corrective work. Joint preparation, cleaning, and sealing may be delayed until after corrective work, provided the pavement is not opened to traffic before corrective work is performed.

M. Pavement Backfill: Following slipform paving operations, place backfill material along the pavement within 48 hours of pavement attaining opening strength or as directed by the Engineer to prevent flow of water and any subsequent damage caused by undermining of the pavement. Prior to placement of full backfill material, construct check dams or other protection as appropriate to ensure no damage to the subgrade and/or subbase occurs.

N. Form Removal:

1. Timing:
a. Remove forms after the initial set of the concrete has taken place.
b. Remove stakes and forms with care to prevent cracking, spalling, or over stressing concrete. If damage does occur, repairs will be made as required by the Engineer.

2. Honeycomb Repair:
a. When the forms are removed, fill honeycombs with mortar composed of 1 part cement and 2 parts fine aggregate by weight.
b. If the honeycombing is to the degree and nature that it is considered by the Engineer as defective work, remove and replace at no additional cost to the Contracting Authority.

3. Paving Protection: In the area adjacent to the curbs and pavement edge, immediately place backfill after the forms are removed. Construct dams or other protection to ensure that no saturation or erosion of the subgrade under or near the pavement occurs. This may include check dams, pumping, etc.

3.03 CURB AND GUTTER CONSTRUCTION (See Figure 7010.102)

A. Complete the construction of curb and gutter separate from pavement in the same manner as for pavement in Section 7010, 3.02.

B. Use a paving machine for curb and gutter. For curb and gutter sections less than 250 feet, hand finish methods may be used.

3.04 PAVEMENT PROTECTION

A. Weather Conditions: Do not place concrete when stormy or inclement weather or temperature prevents good workmanship. Temperature restrictions and protection requirements may be modified by the Engineer under unusual conditions.

1. Cold Weather:

a. Paving: Do not place aggregates containing frozen lumps, and do not place concrete on a frozen subgrade or subbase. Take all necessary actions to prevent the pavement from freezing.

1) Concrete mixing and placement may be started, if weather conditions are favorable, when the air temperature is at least 34ºF and rising. At the time of placement, concrete must have a temperature of at least 40ºF.
2) Stop mixing and placing when the air temperature is 38ºF or less and falling or if the temperature stops rising and does not reach 38ºF.

b. Protection: Prior to applying protection, cure all concrete pavement and curb/gutters, including exposed edges of the pavement and curb. In addition, protect concrete less than 36 hours old as follows:

Night Temperature Forecast	Type of Protection[1]
35°F to 32°F	One layer of burlap for concrete.
31°F to 25°F	Two layers of burlap or one layer of plastic on one layer of burlap.
Below 25°F	Four layers of burlap between layers of 4 mil plastic or equivalent commercial insulating material approved by the Engineer.

[1] Keep protection in place until one of the following conditions is met:
a. The pavement is 5 calendar days old.
b. Opening strength is attained.
c. Forecasted low temperatures exceed 35°F for the next 48 hours.
d. Forecasted high temperatures exceed 55°F for the next 24 hours and subgrade temperatures are above 40°F.

1) Shut down paving operations in time to comply with protection requirements outlined above. During cold weather, allow more time for finishing and protection. Perform all finishing and covering operations prior to darkness. Temperature restrictions and protection requirements may be modified by the Engineer.
2) Equivalent commercial insulating material approved by the Engineer may be used. This material must be waterproof and have a minimum R value of 1.0. If initial set has not yet occurred, place a layer of burlap on top of concrete prior to placing insulating blankets.
3) Use a method of protection and materials that will maintain the concrete temperature above 40°F.

3.04 PAVEMENT PROTECTION (Continued)

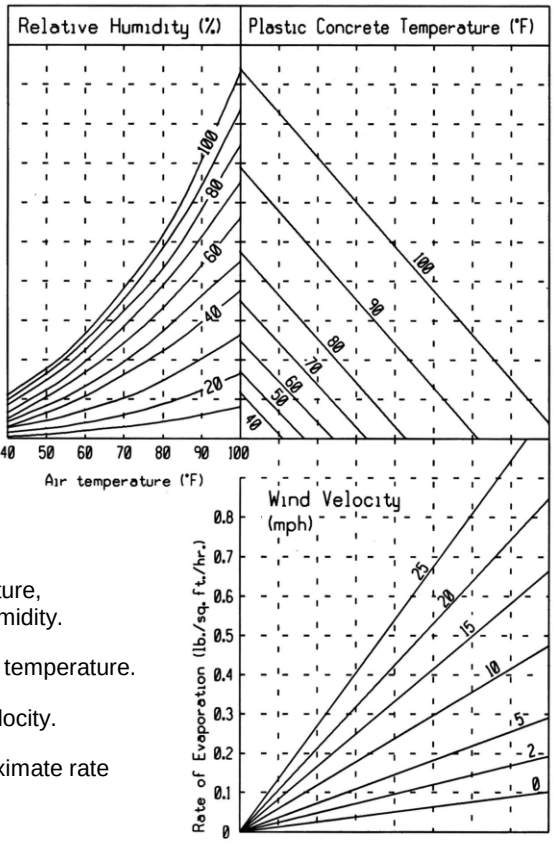
2. Hot Weather: Hot weather condition is defined as any combination of the following conditions that tend to impair the quality of plastic concrete by accelerating the rate of moisture loss and rate of cement hydration causing thermal shrinkage and resulting in plastic shrinkage cracking:

- High Ambient Temperature
- High Concrete Temperature
- Low Relative Humidity
- High Wind Velocity
- Solar Radiation

a. General:
   1) During hot weather conditions, the Engineer may restrict concrete placement to early morning or evening hours.
   2) During hot weather conditions, advise the Engineer of the results of the theoretical evaporation rate throughout paving operations.

b. Determine the Theoretical Rate of Evaporation: Use the following chart and the National Weather Service's predicted maximum air temperature, relative humidity, and maximum steady wind velocity without gusts, for the date and the location of the paving pour.

Theoretical Rate of Evaporation Chart



To Use this Chart:

1. Enter with air temperature, move up to relative humidity.
2. Move right to concrete temperature.
3. Move down to wind velocity.
4. Move left , read approximate rate of evaporation

c. If the evaporation rate exceeds 0.1 pounds per square foot per hour but is less than 0.3 pounds per square foot per hour, provide the following concrete evaporation protection.
   1) Immediately apply an approved evaporation retarder to the concrete pavement and curbs or increase the surface cure application to 1.5 times the standard specified rate.

3.04 PAVEMENT PROTECTION (Continued)

2) Take special precautions to ensure that the forms and subgrade are sufficiently moist or protected to avoid lowering the water content at the pavement/subgrade interface. In hot weather conditions, moisten the subgrade the evening before operations.
3) Ensure that the time between placing and curing is minimized and eliminate delays.
4) Moisten concrete aggregates that are dry and absorptive.
5) Use a fog spray to raise the relative humidity of the ambient air if there is a delay in immediately applying the curing compound.
6) Minimize solar heat by shading, wetting, or covering concrete chutes or other equipment that comes in contact with plastic concrete.

d. If the evaporation rate is 0.3 pounds per square foot per hour or greater, discontinue placement of concrete.

3. Rain Protection:

a. Have materials available, near the work site, for proper protection of the edges and surface of concrete. Protective material may consist of sheets of burlap or plastic film. Also have planks or other material with suitable stakes that can be used as temporary forms available.
b. If initial set has not occurred, take every precaution necessary to protect the surface texture of the concrete.
c. If so determined by the Engineer, failure to properly protect concrete will constitute cause for removal and replacement of defective pavement.

B. Night Conditions: Perform all finishing and covering operations prior to darkness (half an hour after sunset). Do not commence construction until half an hour before sunrise. Do not place or finish concrete under artificial light, unless approved by the Engineer.

C. Protection from Traffic:

1. General:

a. Protect the new pavement and its appurtenances from traffic, both public and that caused by the Contractor's own employees and agents, at no additional cost to the Contracting Authority. This includes the erection and maintenance of warning signs, lights, barricades, watchmen to direct traffic, and pavement bridges or crossovers.
b. Do not operate equipment with metal tracks, metal bucket blades, or metal motor patrol blades directly on new paving. Do not unload soil or granular materials, including base rock for storage and future reloading directly onto new paving.

2. End of Day's Run:

a. At the end of each day's run and at all side streets, erect and maintain safety barriers and fencing as necessary to protect the pavement from damage.
b. Install safety fences within 1 hour of the completion of finishing and curing operations. Leave fences in place and maintained until the concrete has attained the minimum strength or age.
c. Intermediate safety fences may be required for the purpose of opening the pavement for access to a side road, side street, or entrance.

3. Repair of Damages: At the discretion of the Engineer, and at no additional cost to the Contracting Authority, repair or replace any part of the pavement damaged by traffic or other causes occurring prior to final acceptance of the pavement.

3.05 USE OF PAVEMENT

Time for opening pavement for use is determined by maturity method complying with Iowa DOT Materials I.M. 383 or age and test results. The minimum age and test results needed for opening are shown in Table 7010.01.

Table 7010.01: Minimum Age and Tested Strength of Pavement Before Opening

Class of Mix	Type of Cement	Minimum Age For Opening[1]	Minimum Compressive Strength (psi)	Minimum Flexural Strength Center Point (psi)
C	Type I	7 Days[2]	3,000	500
M	Type I	48 Hours	3,000	500

[1] Opening without testing only allowed upon approval of Engineer
[2] Five calendar days for concrete 9 inches thick or more. If maturity testing is used to determine opening, minimum flexural strength may be lowered to 350 psi if approved by the Engineer.

3.06 TRANSPORTATION RESTRICTIONS

A. Do not use concrete transported with continuous agitation when the cement has been in contact with the aggregate more than 90 minutes before it is placed. With the approval of the Engineer, an approved retarding admixture may be used at the rates required in Iowa DOT Materials I.M. 403.

B. Do not use concrete transported without continuous agitation if the period elapsed between the time the concrete is mixed and the time it is placed is greater than 30 minutes. With the approval of the Engineer, an approved retarding admixture may be used at the rates required in Iowa DOT Materials I.M. 403 and the mixed-to-placed time may be extended.

C. Ensure the methods of delivering and handling the concrete are such that objectionable segregation or damage to the concrete will not occur, and concrete placing will occur with a minimum of rehandling.

D. Thoroughly clean the truck compartment in which concrete is transported and flush with water to ensure that hardened concrete will not accumulate. Discharge the flushing water from the truck compartment to the designated discharge point before it is charged with the next batch.

3.07 QUALITY CONTROL

A. Testing: Provide the following material certifications and testing required to be performed by Supplier or Contractor.

Table 7010.02: Material Certifications and Testing

Material or Construction Item	Tests	Applicable Standard[1]	Methods of Acceptance of Sampling and Testing	Field Sampling and Testing	
				Frequency (minimum)	Responsible Party
Fine Aggregates	Gradation	I.M. 302, 306, 336	Cert. Plant Insp.[2]	1/250 CY or min 1/day	Supplier/ Contractor
	Moisture	I.M. 308, 527	Cert. Plant Insp.[2]	1 per 1/2 day	
	Specific Gravity	I.M. 307	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Quality	I.M. 209	Approved Source	Prior to use	
Coarse Aggregates	Gradation	I.M. 302, 306, 336	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Moisture	I.M. 308, 527	Cert. Plant Insp.[2]	1 per 1/2 day	
	Specific Gravity	I.M. 307	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Quality	I.M. 209	Approved Source	Prior to use	
Portland Cement	Quality	I.M. 401	Approved Source	Prior to use	
Fly Ash	Quality	I.M. 491.17	Approved Source	Prior to use	
GGBFS	Quality	I.M. 491.14	Approved Source	Prior to use	
Curing Compound	Quality	Iowa DOT Section 4105	Approved Source	Prior to use	
Joint Sealer	Quality	I.M. 436.01	Approved Source	Prior to use	
Epoxy Dowel Bars and Assemblies	Quality	I.M. 451.03B	Approved Source	Prior to use	
Tie Bars	Quality	I.M. 451	Approved Source	Prior to use	
Plastic Concrete	Air Content	I.M 318, 327	Field Test	1/200 CY or min. 1/day	Engineer
	Slump	I.M. 317	Field Test	1/200 CY or min. 1/day	
	Cylinders	I.M. 315	Field Test	Set of 3/500 CY or two sets/day	
	Beams	I.M. 316, 327, 328	Field Test	Set of 3/500 CY or two sets/day	
	Thickness	----------	Field Test	1/200 CY	
Hardened Concrete	Smoothness	SUDAS 7010, 3.07	Field Test - Straightedge	Project length	
	Smoothness	SUDAS 7010, 3.07	Field Test - Inertial Profiler	Project length	Contractor
	Thickness	SUDAS 7010, 3.07	Field Test	1 core/1000 SY or 3 cores/project	
	Strength	I.M. 383	Maturity Tests[3]	Prior to placement	

[1] Refers to the Iowa DOT Materials I.M.s, Iowa DOT Standard Specifications, or SUDAS Standard Specifications.
[2] Certified plant inspection per Iowa DOT Materials I.M. 527.
[3] The Contractor is responsible for developing the maturity curve for the specified mix, taking maturity readings, and delivering a copy of the results to the Engineer.

B. Air Content:

1. Air content of the concrete will be evaluated according to Iowa DOT Materials I.M. 318 and 327.

3.07 QUALITY CONTROL (Continued)

2. When a test result is outside the tolerance for the target air content, the contractor will be notified immediately. An air test will then be immediately run behind the paver to aid in identifying the limits of the non-complying air. A test result between 5% and 8% behind the paver will be considered complying. This test will represent all concrete from the back of the paver back to the last documented complying test. Make immediate adjustments to the mix production and placement process to bring the air content back within tolerance. Do not use succeeding loads below the lower target air content tolerance by more than 0.5%. Each subsequent load will be tested until air content is within tolerance for two consecutive loads. For all incorporated, non-complying concrete that is out of tolerance, the Engineer will determine if removal and replacement is required or if a price adjustment, according to Table 7010.03, will be applied.

Table 7010.03: Concrete Air Content Price Adjustments

Air Content Range			% Payment of Unit Price
Minimum		**Maximum**	
1.1*	and	below	0%
0.6	to	1.0*	50%
0.1	to	0.5*	75%
Low air tolerance limit			100%
Target			100%
High air tolerance limit			100%
0.1	to	0.5**	95%
0.6	to	1.0**	85%
1.1	to	1.5**	75%
1.6	to	2.0**	60%
2.1**	and	above	0%

*Air content deviation below the acceptable limits
** Air content deviation above the acceptable limits

C. Pavement Smoothness: Evaluate pavement smoothness for all PCC pavement and overlay surfaces.

1. Straightedge: The Engineer will check PCC pavement surfaces with a 10 foot straightedge placed parallel to the centerline. Areas showing high spots of more than 1/4 of an inch in 10 feet will be marked. Complete surface corrections according to the following procedures to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straightedge.

a. Complete surface corrections by diamond grinding, placing a PCC overlay, or replacement.
b. Use grinding and texturing equipment complying with Iowa DOT Section 2532. Use a minimum 36 inch wide cutting head, unless a 24 inch cutting head is necessary due space limitations.
c. Perform surface correction parallel to lane lines or edge lines as directed by the Engineer. Make each pass parallel to the previous pass. Ensure the ground surface is of a uniform texture.
d. Do not allow adjacent passes to overlap more than 1 inch or have a vertical difference of 1/8 inch as measured from bottom of groove to bottom of groove.
e. Begin and end smoothness corrections at lines normal to the pavement lanes lines or edge lines within any one corrected area. Proceed from the centerline or lane line toward the pavement edge to maintain pavement cross slope.

Surface corrections will be completed at the direction of the Engineer with no additional cost to the Contracting Authority.

3.07 QUALITY CONTROL (Continued)

2. Inertial Profilers:

a. If specified in the contract documents, comply with Iowa DOT Section 2317 and Materials I.M. 341, Appendix A to measure pavement smoothness with an inertial profiler and start appropriate corrective measures, if necessary; the engineer will determine the corrective measures to be taken. No incentive for pavement smoothness will be made.

b. Evaluate according to the smoothness requirements of Table 7010.04 and make surface corrections and/or price reductions. Surface corrections will be completed with no additional cost to the Contracting Authority. No incentive for pavement smoothness will be made.

c. Smoothness measurements will be suspended for structures and through intersections.

Table 7010.04: Smoothness Adjustment/Correction

Segment Speed	Mean Roughness Index (inches per mile)	Pay Factor
Greater than 45 mph	< 200	100%
	200 to 250	-$15.00/foot/lane or grind[1]
	≥ 250	Grind[1]
Less than or equal to 45 mph	< 250	100%
	250 to 300	-$15.00/foot/lane or grind[2]
	≥ 300	Grind[2]

[1] Correct to below 200 inches per mile
[2] Correct to below 250 inches per mile

D. Pavement Thickness:

1. At locations determined by the Engineer, cut samples from the pavement by drilling with a core bit that will provide samples with a 4 inch outside diameter. Restore the surface by tamping low slump concrete into the hole, finishing, and texturing. The Engineer will witness the core drilling, identify, and take possession of the cores. The Engineer will determine the core locations, measure the cores, and determine the thickness index according to Iowa DOT Materials I.M. 346 and 347, except as modified as follows:
   a. For regular or irregular shaped areas, use a lot size of 1,000 square yards. Include remnants less than 500 square yards in the last lot and remnants greater than 500 square yards in a separate lot. Take a minimum of three cores per project.
   b. For any core with a deficiency greater than 0.15 inch, take two additional cores in that pavement lot and use the average of the three cores.

2. If approved by the Engineer, take non-destructive measurements to determine the pavement thickness and the thickness index for each section.
   a. Use Magnetic Imaging Tomography (MIT) Scan T2 or T3 gauge to perform thickness measurements.
   b. Use 24 gauge commercial steel as targets that are 11.81 inches in diameter with G90 coating meeting ASTM A 653.
   c. The Engineer will determine the location of each lot, the random location of each metal target, and the random thickness measuring scheme for each section using an Iowa DOT developed spreadsheet. Immediately prior to paving, the Engineer will place the target or observe the contractor place the target. The program will randomly determine which targets to measure.

3.07 QUALITY CONTROL (Continued)

1) For regular or irregular areas, the section will be divided longitudinally into 1,000 square yard lots. One target will be located in each lot based on the spreadsheet selection. Beginning with the first station at +00, place a target from the edge of the pavement halfway between dowel baskets, if applicable. If the +00 station falls on a basket, move the target location ahead halfway between the dowel baskets. A minimum of 10 targets will be tested. If a target location falls on a bridge or in an approach section, it will be eliminated.
2) The transverse location of the targets will be randomly determined by the spreadsheet. The random locations will be 4 feet from edge of pavement, left or right. Place targets in the center of the pavement panel to prevent interference by the steel in the joints. For ease of measuring, plates may be placed 18 inches from the edge if there is no tie steel or a work bridge is not available.

d. Follow the manufacturer's instructions for operating the thickness gauge. It is important to avoid testing close to any steel including vehicles, equipment, steel toed shoes as well as tie bars, dowel bars and baskets, and manhole covers. When wearing steel toed shoes, always keep both toes at least 2 feet from the gauge during the test. Three repeat readings will be taken. The readings should all be within 0.15 inch of each other.
e. Evaluate each section according to Iowa DOT Materials I.M. 346.
f. The Engineer will perform quality assurance testing at a minimum of one random test per seven plate locations, using one of the following methods.
   1) Probe during paving operations according to Iowa DOT Materials I.M. 396. Plates may be moved to 18 inches from the edge of the pavement to allow easier testing.
   2) Survey, to a minimum of 0.005 foot, on the plate prior to paving and on top of the pavement directly over the plate after placement to determine an accurate thickness verification.
   3) MIT gauge according to Iowa DOT Materials I.M. 346. Use a different gauge than the one used by the contractor on the project.
g. Include all MIT Scan measurements and quality assurance measurements for calculation of pavement thickness. The final pavement thickness will be determined by one of the following:
   1) If all the quality assurance measurements are within ±0.25 inch of the MIT Scan measurements, the MIT Scan measurements will be considered validated. The Engineer will determine final thickness based on the average MIT Scan measurements.
   2) If at any one location, the quality assurance measurements are greater than ±0.25 inch difference from the MIT Scan measurements, core at the plate location and 2 feet away from the plate location. If the core at the plate location indicates that it has moved during placement, use the core thickness from the core taken 2 feet away as the pavement thickness. The Engineer will replace the MIT Scan thickness at the location with the core thickness taken 2 feet away along with the average MIT Scan measurements as final pavement thickness.
   3) If all of the quality assurance measurements are greater than ±0.25 inch difference from the MIT Scan measurements, the Engineer will randomly select a minimum of 10 random locations, at 2 feet from the plate location, for coring by the Contractor. The Engineer will use the average core thickness, tested according to Iowa DOT Materials I.M. 346, to determine final pavement thickness.

3.07 QUALITY CONTROL (Continued)

h. If any measurement is deficient from T by 0.5 inch or more, the measurement should be rechecked to confirm the reading and the equipment. If the repeat measurement is also 0.5 inch or more below T, mark the location directly over the target. Drill a 4.0 inch diameter core at that location. If the core length confirms the pavement is deficient by 0.5 inch or more, drill a core 60 feet in each direction longitudinally at the same transverse location from the deficient core. Drilling will be continued at 60 feet intervals until a core is obtained that is not deficient. Interpolate between this core and the adjacent core to determine the limits of the deficient area. These additional cores are to be used to define the deficient area and will not be used in the thickness index calculation. When an obstruction, such as a bridge, intersection, previous work, etc., prevents drilling a core at the required 60 feet interval in either direction longitudinally, continue the balance of the distance on the other side of the obstruction.

3. Coring of pavement or other work for thickness determination may be waived by mutual agreement for sections of the same design thickness less than 2,500 square yards.

4. Based on the thickness index determined by the Engineer, the pavement payment will be as shown in Tables 7010.05 and 7010.06.

5. If the thickness index deficiency is greater than 0.51 for pavements thinner than 9 inches or 0.91 for pavements 9 inches or thicker, the Engineer will study the extent and severity of the deficiency of the pavement areas. The Engineer will require one of the following based on a review on the level of deficiency, the amount of the payment penalty, and the estimated reduction in the design life of the deficient pavement:
   a. Removal and replacement of the deficient areas with pavement complying with the contract documents at no additional cost to the Contracting Authority.
   b. Completion of an agreement that provides a combination of an extended guarantee period and payment penalty and allows the deficient pavement to be left in place.

Table 7010.05: Pay Factor for PCC Pavement for Design Thickness less than 9"

Thickness Index Range	Percent Payment
More than 0 to -0.15	100
-0.16 to -0.25	95
-0.26 to -0.50	85
-0.51 or less	As determined by the Engineer

3.07 QUALITY CONTROL (Continued)

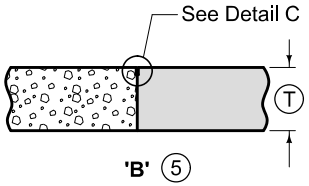
Table 7010.06: Pay Factor for PCC Pavement for Design Thickness 9" or Greater

Thickness Index Range	Percent Payment
More than 0.00 to -0.15	100
-0.16 to -0.20	99
-0.21 to -0.25	98
-0.26 to -0.30	97
-0.31 to -0.35	96
-0.36 to -0.40	95
-0.41 to -0.45	94
-0.46 to -0.50	93
-0.51 to -0.55	92
-0.56 to -0.60	91
-0.61 to -0.65	90
-0.66 to -0.70	89
-0.71 to -0.75	88
-0.76 to -0.80	87
-0.81 to -0.85	86
-0.86 to -0.90	85
-0.91 or less	As determined by the Engineer

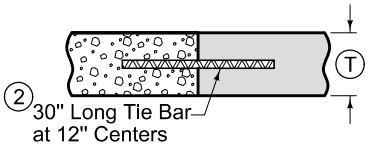
E. Defects or Deficiencies: Remove and replace or repair pavement containing excessive cracks, fractures, spalls, or other defects at no additional cost to the Contracting Authority. The method of replacement or repair will be determined by the Engineer.

END OF SECTION

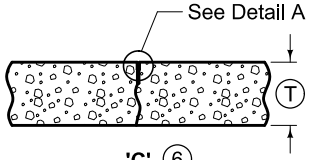
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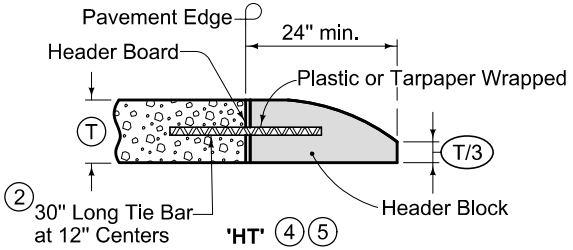
'B' (5)
PLAIN JOINT
(Abutting Pavement Slabs)



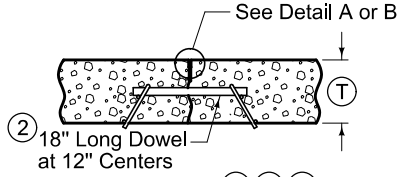
'DW' (3)(4)(7)
DAY'S WORK JOINT(Non-working)



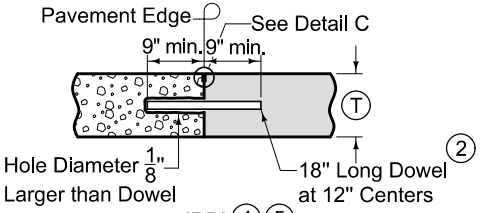
'C' (6)
CONTRACTION JOINT



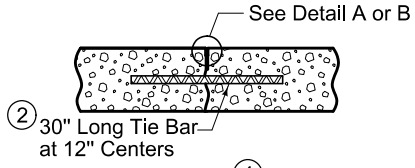
'HT' (4)(5)
HEADER JOINT
(End Rigid Pavement)



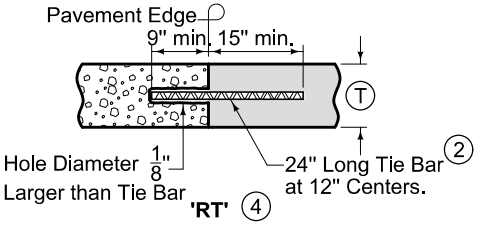
'CD' (1)(4)(6)
DOWELED CONTRACTION JOINT



'RD' (4)(5)
ABUTTING PAVEMENT JOINT

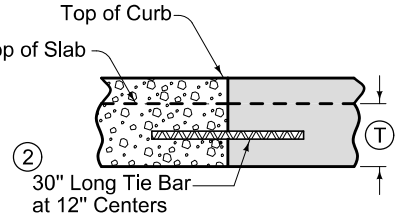


'CT' (4)
TIED CONTRACTION JOINT

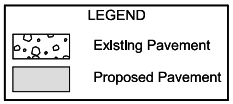


'RT' (4)
ABUTTING PAVEMENT JOINT
RIGID TIE

1. See dowel assemblies for fabrication details.
2. See Bar Size Table for Contraction Joints on Sheet 2.
3. Locate 'DW' joint at a mid-panel location between future 'C' or 'CD' joints. Place no closer than 5 feet to a 'C' or 'CD' joint.
4. Place bars within the limits shown under dowel assemblies.
5. Edge with 1/8 inch tool for length of joint. For HT joint, remove header block and board when second slab is placed.
6. Unless specified otherwise, use 'CD' transverse contraction joints in mainline pavement when (T) is greater or equal to 8 inches. Use 'C' joints when (T) is less than 8 inches.
7. 'RT' joint may be used in lieu of 'DW' joint at the end of the days work. Remove any pavement damaged due to the drilling at no additional cost to the Contracting Authority.



'DW - CG' (3)(4)
DAY'S WORK JOINT
CURB AND GUTTER UNIT



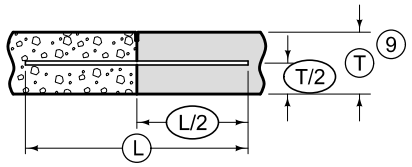
TRANSVERSE CONTRACTION JOINTS

FIGURE 7010.101 SHEET 1 OF 8

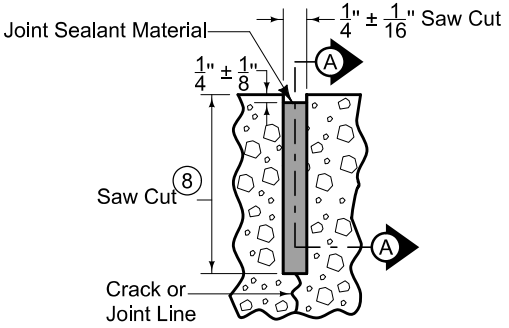
SUDAS | INTERIM | REVISION 13 01-01-26
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 1 of 8

REVISIONS: Updated SUDAS and IDOT Logo.

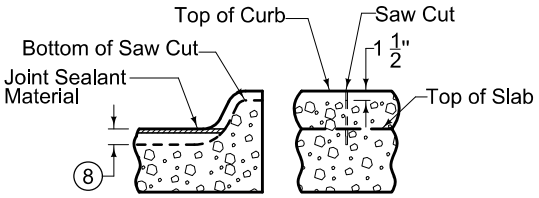
SUDAS DIRECTOR | DESIGN METHODS ENGINEER



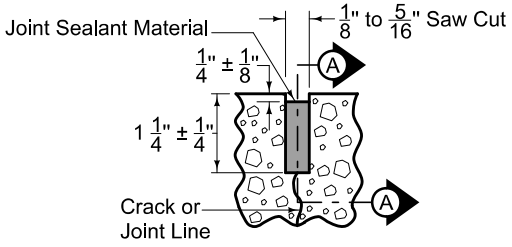
BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



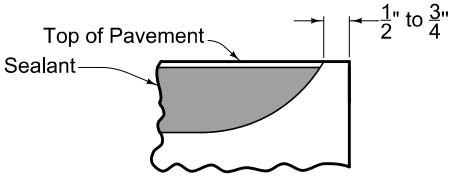
DETAIL A
(Saw cut formed by conventional concrete sawing equipment.)



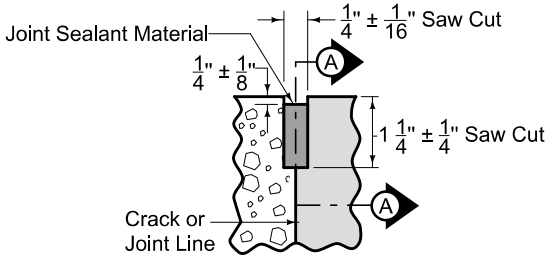
'C' JOINT IN CURB
(Match 'CT', 'CD', or 'C' joint in pavement.)



DETAIL B
(Saw cut formed by approved early concrete sawing equipment.)



SECTION A-A
(Detail at Edge of Pavement)

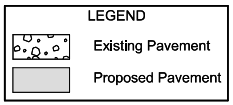


DETAIL C

(8) Saw 'CD' joint to a depth of T/3 ± 1/4"; saw 'C' joint to a depth of T/4 ± 1/4".

(9) When tying into old pavement, (T) represents the depth of sound PCC.

BAR SIZE TABLE FOR CONTRACTION JOINTS				
(T)	Solid Dowel Diameter	Tubular Dowel Diameter	Elliptical	Tie Bar Size
< 8"	3/4"	7/8"	N/A	#6
≥ 8" but < 10"	1 1/4"	1 3/8"	Small	#10
≥ 10"	1 1/2"	1 5/8"	Medium	#11
Tubular and Elliptical Dowel Bars will not be allowed for RD joints.				



SUDAS | INTERIM | REVISION 13 01-01-26
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 2 of 8

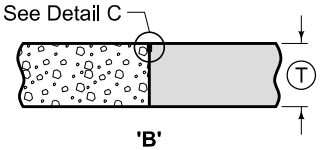
REVISIONS: Updated SUDAS and IDOT Logo.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

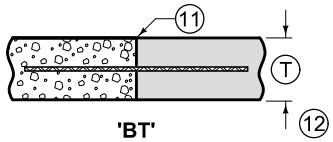
JOINTS

TRANSVERSE CONTRACTION

FIGURE 7010.101 | SHEET 2 OF 8

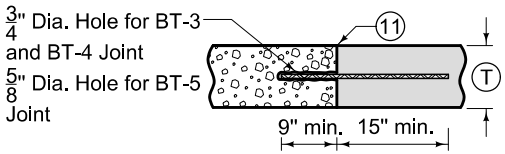


'B'
PLAIN JOINT
(Abutting Pavement Slabs)



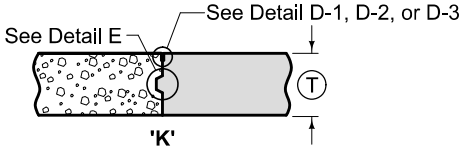
'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE

(T)	Joint	Bars	Bar Length and Spacing
< 8"	'BT-1'	#4	36" Long at 30" Centers
		#5	30" Long at 30" Centers
≥ 8"	'BT-2'	#5	36" Long at 30" Centers
	'BT-6'	#5	36" Long at 15" Centers

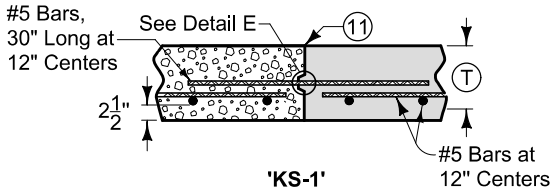


'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE (Drilled)

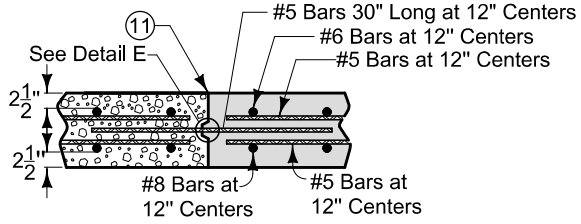
(T)	Joint	Bars	Bar Length and Spacing
< 8"	'BT-5'	#4	24" Long at 30" Centers
≥ 8"	'BT-3'	#5	24" Long at 30" Centers
	'BT-4'		24" Long at 15" Centers



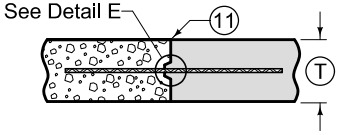
'K'
KEYED JOINT FOR ADJACENT SLABS
(Where T is 8" or more)



'KS-1'
[Single Reinforced Pavement (Bridge Approach)]



'KS-2'
[Double Reinforced Pavement (Bridge Approach)]



'KT' (10)(12)
ABUTTING PAVEMENT JOINT - KEYWAY TIE

(T)	Joint	Bars	Bar Length and Spacing
< 8"	'KT-1'	#4	30" Long at 30" Centers
≥ 8"	'KT-2'	#5	30" Long at 30" Centers
	'KT-3'		30" Long at 15" Centers

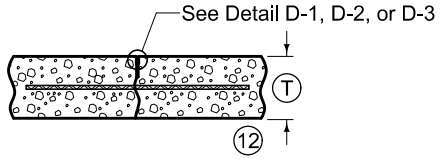
LONGITUDINAL CONTRACTION

(10) Bar supports may be necessary for fixed form paving to ensure the bar remains in a horizontal position in the plastic concrete.

(11) Sawing or sealing of joint not required.

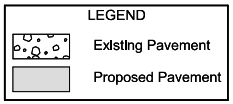
(12) The following joints are interchangeable, subject to the pouring sequence:
'L-1', 'BT-1', and 'KT-1'
'L-2', 'BT-2', and 'KT-2'
'L-3', 'BT-6', and 'KT-3'

KT joints should not be used when DOT is contracting authority.



'L'
CONTRACTION JOINT

(T)	Joint	Bars	Bar Length and Spacing
< 8"	'L-1'	#4	36" Long at 30" Centers
≥ 8"	'L-2'	#5	36" Long at 30" Centers
	'L-3'		36" Long at 15" Centers



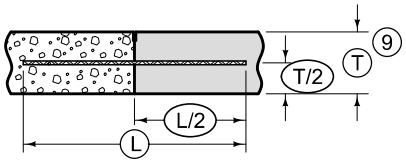
SUDAS | INTERIM | REVISION 13 01-01-26
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 3 of 8

REVISIONS: Updated SUDAS and IDOT Logo.

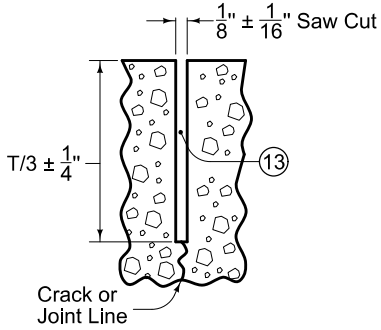
SUDAS DIRECTOR | DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 SHEET 3 OF 8



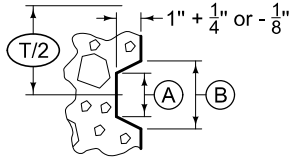
TIE BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



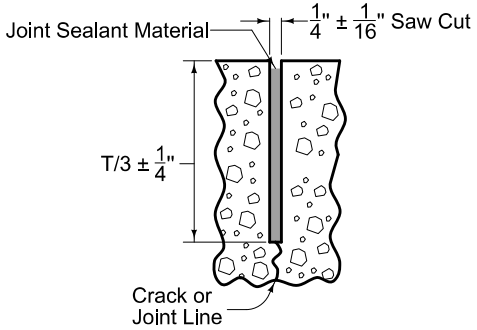
DETAIL D-1
(Required when specified in the contract documents.)

⑨ When tying into old pavement, Ⓣ represents the depth of sound PCC.

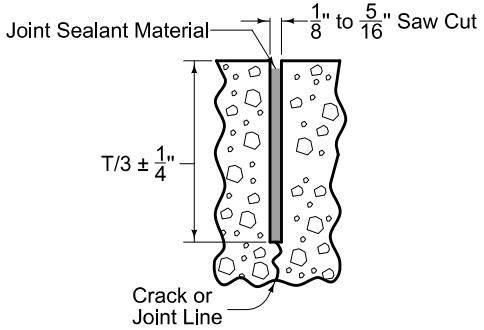
⑬ Sealant or cleaning not required.



DETAIL E



DETAIL D-2
(Required when the Department of Transportation is not the Contracting Authority, or when specified in the contract documents)



DETAIL D-3
(Required when the Department of Transportation is the Contracting Authority, or when specified in the contract documents)

KEYWAY DIMENSIONS			
Keyway Type	Pavement Thickness Ⓣ	Ⓐ	Ⓑ
Standard	8" or greater	1 3/4"	2 3/4"
Narrow	Less than 8"	1"	2"

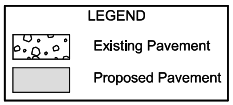


FIGURE 7010.101 | SHEET 4 OF 8

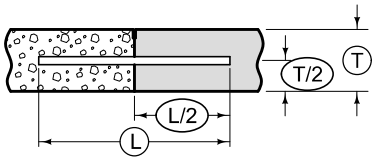
LONGITUDINAL CONTRACTION

SUDAS | FIGURE 7010.101 | INTERIM | STANDARD ROAD PLAN | REVISION 13 01-01-26 | PV-101 | SHEET 4 of 8

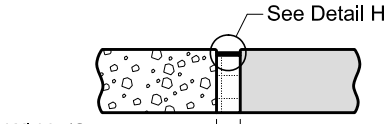
REVISIONS: Updated SUDAS and IDOT Logo.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

JOINTS

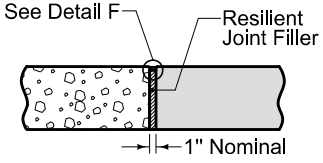


DOWEL PLACEMENT
(Applies to all joints unless otherwise detailed.)

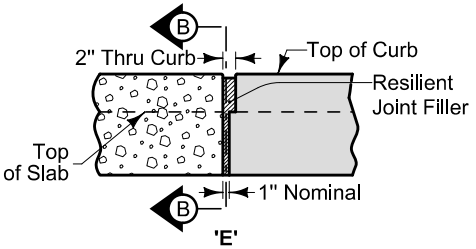


'CF' JOINT

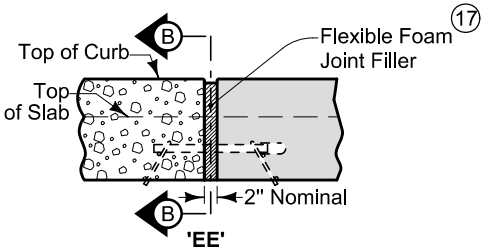
TYPE	WIDTH
CF-1	2"
CF-2	$2\frac{1}{2}$"
CF-3	3"
CF-4	$3\frac{1}{2}$"



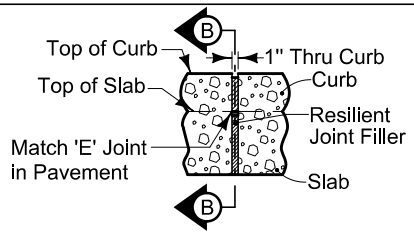
'E'
1" EXPANSION JOINT



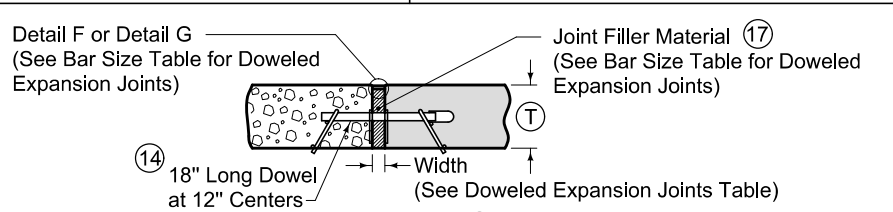
'E'
JOINT IN CURB
(View at Back of Curb)



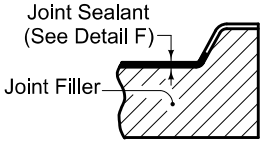
'EE'
JOINT IN CURB
(View at Back of Curb)



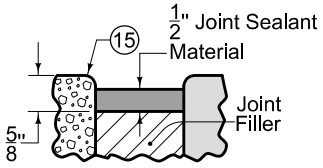
'ES'
JOINT IN CURB
(View at Back of Curb)



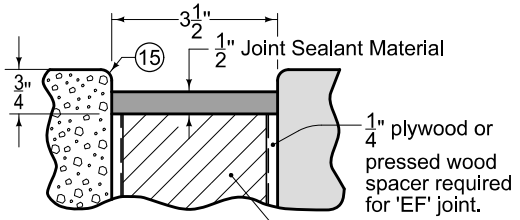
'ED', 'EE', 'EF' 16
DOWELED EXPANSION JOINT



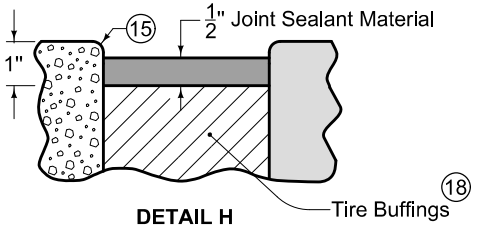
SECTION B-B



DETAIL F



DETAIL G



DETAIL H

EXPANSION

14 See Bar Size Table for Doweled Expansion Joints.

15 Edge with 1/4 inch tool for length of joint indicated if formed; edging not required when cut with diamond blade saw.

16 See Dowel Assemblies for fabrication details and placement limits. Coat the free end of dowel bar to prevent bond with pavement. At intake locations, dowel bars may be cast-in-place.

17 Predrill or preform holes in joint material for appropriate dowel size.

18 Compact tire buffings by spading with a square-nose shovel.

DOWELED EXPANSION JOINTS		
TYPE	WIDTH	FILLER MATERIAL 17
ED	1"	Resilient (Detail F)
EE	2"	Flexible Foam (Detail F)
EF	$3\frac{1}{2}$"	Flexible Foam (Detail G)

BAR SIZE TABLE FOR DOWELED EXPANSION JOINTS			
T	< 8"	≥ 8" but < 10"	≥ 10"
Dowel Diameter	$\frac{3}{4}$"	$1\frac{1}{4}$"	$1\frac{1}{2}$"
Tubular, GFRP, and Elliptical Dowel Bars will not be allowed for expansion joints.			

LEGEND
Existing Pavement
Proposed Pavement

SUDAS
INTERIM
REVISION 13 01-01-26
FIGURE 7010.101
STANDARD ROAD PLAN
PV-101
SHEET 5 of 8

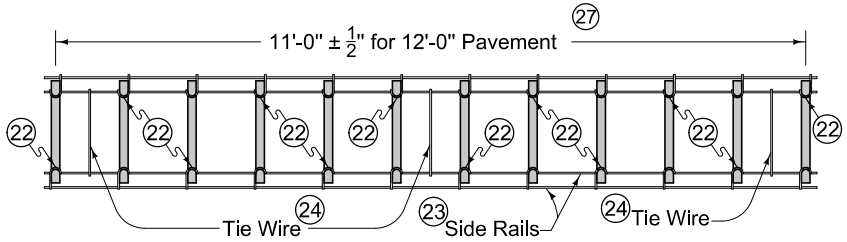
REVISIONS: Updated SUDAS and IDOT Logo.

SUDAS DIRECTOR
DESIGN METHODS ENGINEER

JOINTS

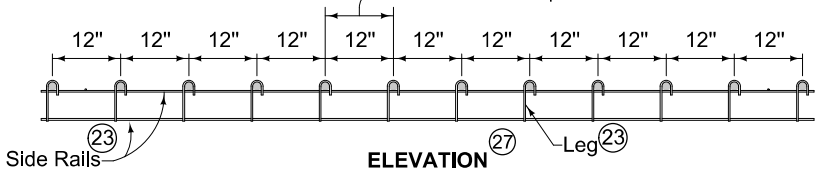
FIGURE 7010.101
SHEET 5 OF 8

CONTRACTION JOINTS

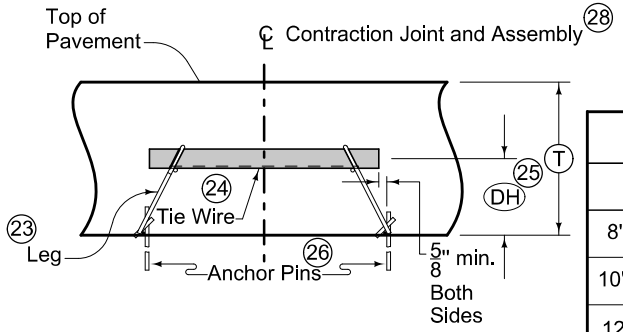


PLAN

Spaces between dowel bars are nominal dimensions with a $\frac{1}{4}$" allowable tolerance.



ELEVATION



LONGITUDINAL SECTION

DOWEL ASSEMBLIES (19) (20) (21)

DOWEL HEIGHT AND DIAMETER FOR DOWELED CONTRACTION JOINTS				
(T)	(DH) (25)	Diameter (Solid)	Diameter (Tubular)	Elliptical
8" to 9 1/2"	4 1/4"	1 1/4"	1 3/8"	Small
10" to 11 1/2"	5 1/4"	1 1/2"	1 5/8"	Medium
12" to 13"	6 1/4"	1 1/2"	1 5/8"	Medium
Tubular, Elliptical Dowel Bars will not be allowed for RD joints.				

(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

(21) Details apply to both transverse contraction and expansion joints.

(22) Weld alternately throughout.

(23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.

(24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.

(25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

(26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

(27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

(28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

FIGURE 7010.101 | SHEET 6 OF 8

SUDAS | INTERIM | REVISION 13 01-01-26

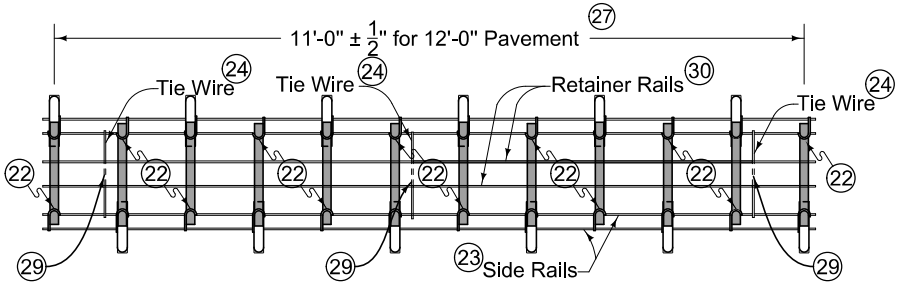
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 6 of 8

REVISIONS: Updated SUDAS and IDOT Logo.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

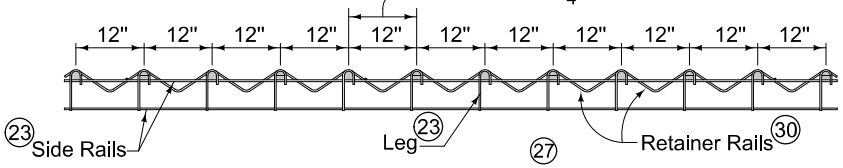
JOINTS

EXPANSION JOINTS

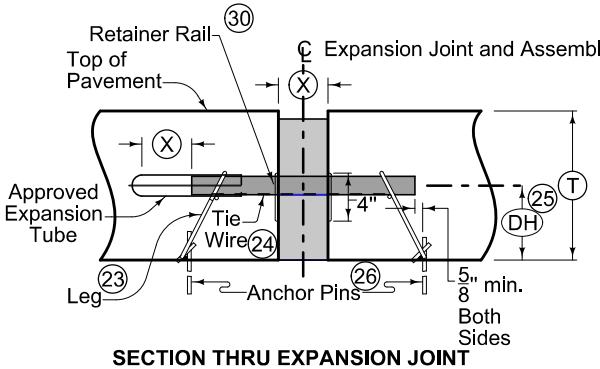


PLAN

Spaces between dowel bars are nominal dimensions with a $\frac{1}{4}$" allowable tolerance.



ELEVATION



SECTION THRU EXPANSION JOINT

JOINT OPENING AND EXPANSION TUBE EXTENSION		
Joint Type	(X)	Minimum Tube Length
"ED"	1"	6"
"EE"	2"	7"
"EF"	$3\frac{1}{2}$"	9"

DOWEL HEIGHT AND DIAMETER FOR DOWELED EXPANSION JOINTS		
(T)	(DH) (25)	Diameter
8" to $9\frac{1}{2}$"	$4\frac{1}{4}$"	$1\frac{1}{4}$"
10" to $11\frac{1}{2}$"	$5\frac{1}{4}$"	$1\frac{1}{2}$"
12" to 13"	$6\frac{1}{4}$"	$1\frac{1}{2}$"
Tubular, GFRP, and Elliptical Dowel Bars will not be allowed for expansion joints.		

DOWEL ASSEMBLIES (19) (20) (21)

(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

(21) Details apply to both transverse contraction and expansion joints.

(22) Weld alternately throughout.

(23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.

(24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.

(25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

(26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

(27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

(28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

(29) Clip and remove center portion of tie during field assembly.

(30) 1/4 inch diameter wire.

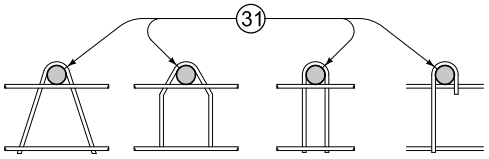
SUDAS	INTERIM	REVISION 13 01-01-26
FIGURE 7010.101	STANDARD ROAD PLAN	PV-101
		SHEET 7 of 8

REVISIONS: Updated SUDAS and IDOT Logo.

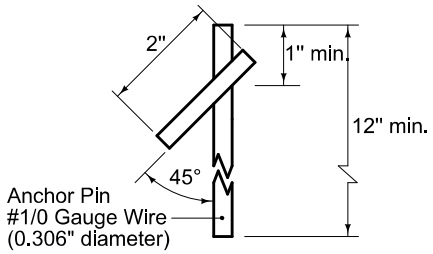
SUDAS DIRECTOR | DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 SHEET 7 OF 8



OPTIONAL LEG SHAPES



ANCHOR PIN

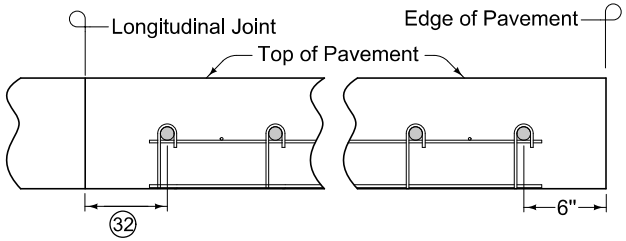
19 Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

20 Use wires with a minimum tensile strength of 50 ksi.

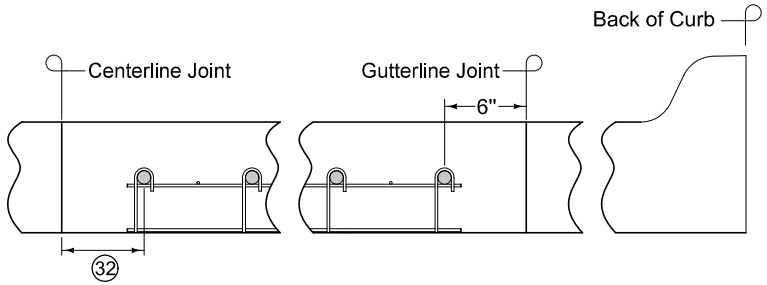
21 Details apply to both transverse contraction and expansion joints.

31 Diameter of bend around dowel is dowel diameter + 1/8 to 3/16 inches.

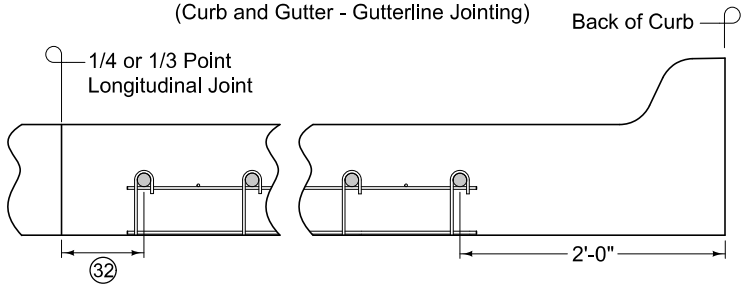
32 For uniform lane widths: 3 to 6 inches. For taper and variable width pavements: 3 to 12 inches.



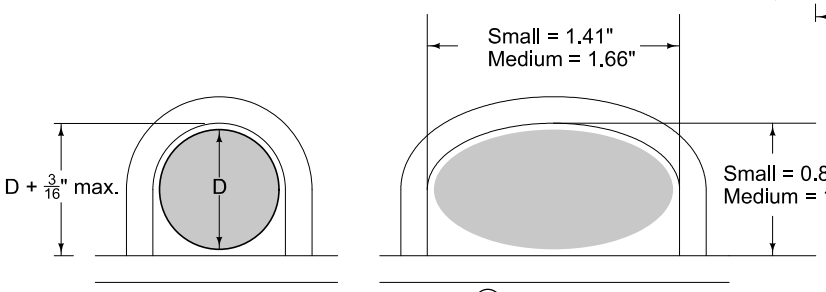
PLACEMENT LIMITS
(Rural Section)



PLACEMENT LIMITS
(Curb and Gutter - Gutterline Jointing)



PLACEMENT LIMITS
(Curb and Gutter - 1/4 or 1/3 Point Jointing)



BEND AROUND DOWEL 31

DOWEL ASSEMBLIES 19 20 21

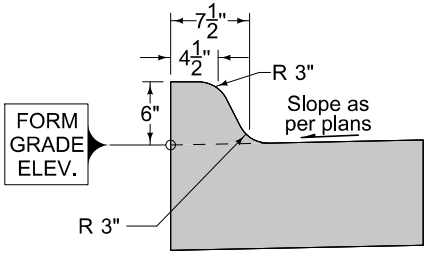
FIGURE 7010.101 SHEET 8 OF 8

SUDAS	INTERIM	REVISION 13 01-01-26
FIGURE 7010.101	STANDARD ROAD PLAN	PV-101 SHEET 8 of 8

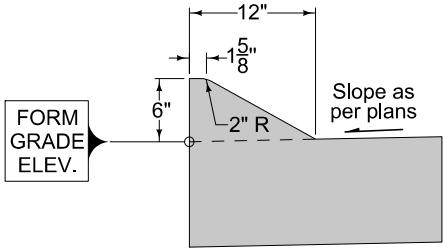
REVISIONS: Updated SUDAS and IDOT Logo.

SUDAS DIRECTOR — DESIGN METHODS ENGINEER

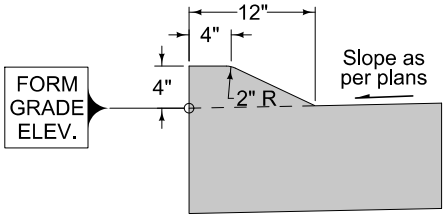
JOINTS



6" STANDARD CURB



6" SLOPED CURB



4" SLOPED CURB

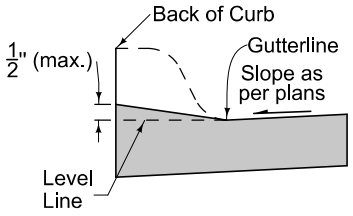
For joint details, see PV-101.

① 6 inch Standard Curb, 6 inch Sloped Curb, or 4 inch Sloped Curb as specified.

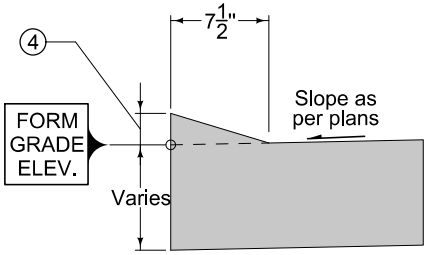
② ⅛ inch if Proposed Pavement is HMA. No elevation difference if Proposed Pavement is PCC.

③ 'BT' , 'KT', or 'L' joint if Proposed Pavement is PCC. 'B' joint if Proposed Pavement is HMA.

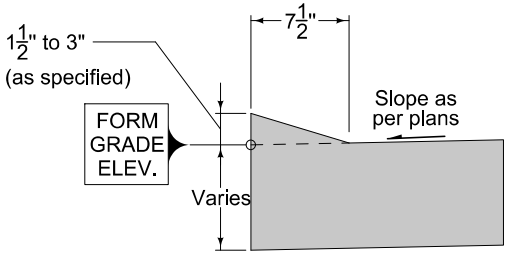
④ 0 to 2 inches for residential entrances. 1½ to 3 inches for industrial or commercial entrances.



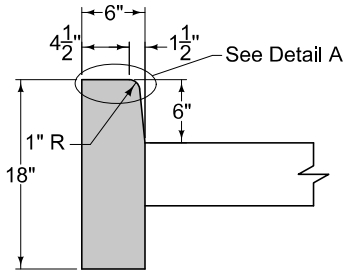
DROP CURB AT SIDEWALK



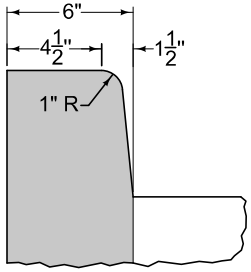
DRIVEWAY DROP CURB (IowaDepartment of Transportation is not the Contracting Authority)



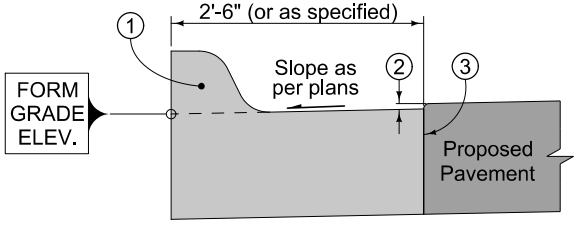
DRIVEWAY DROP CURB (Iowa Department of Transportation is the Contracting Authority)



BEAM CURB*
*For short replacement sections, match existing curb profile



DETAIL A



CURB AND GUTTER UNIT

FIGURE 7010.102

SHEET 1 OF 2

SUDAS | IOWA DOT

REVISION 5 04-21-20

PV-102

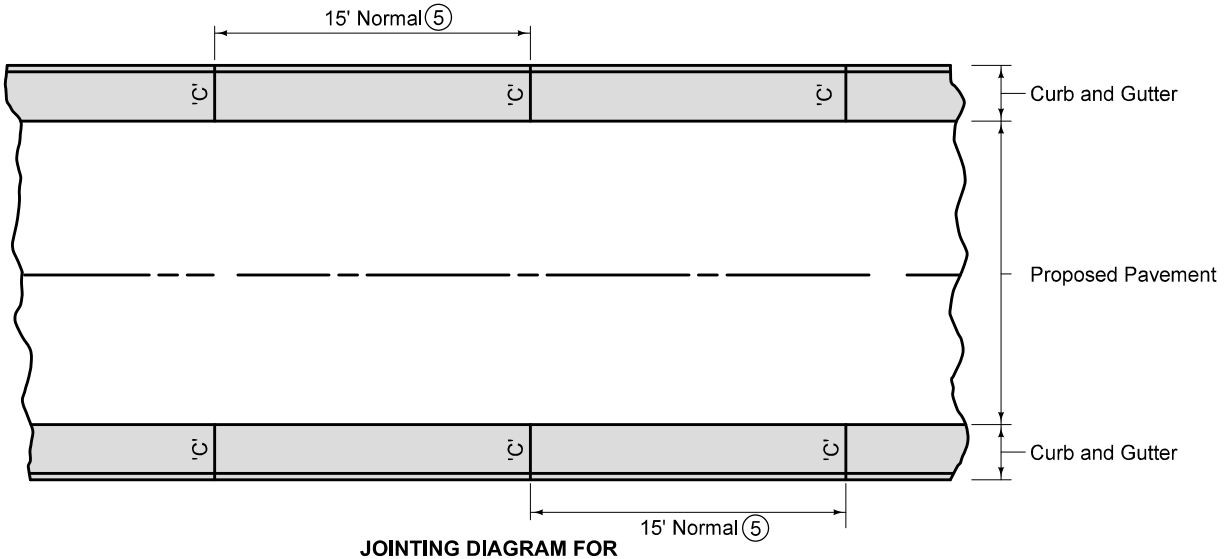
FIGURE 7010.102 | STANDARD ROAD PLAN | SHEET 1 of 2

REVISIONS: Split DRIVEWAY DROP CURB detail into two details. Added new circle note 4 on Sheet 1. Renumbered circle note on Sheet 5.

Paul D. Wigant
SUDAS DIRECTOR

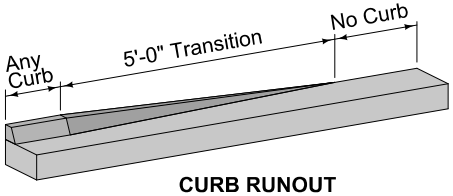
Stuart Nicholson
DESIGN METHODS ENGINEER

PCC CURB DETAILS

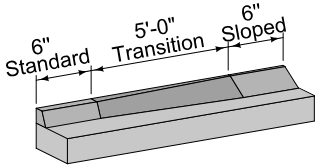


JOINTING DIAGRAM FOR CURB AND GUTTER UNIT

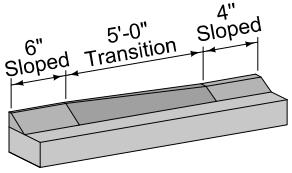
(5) If proposed pavement is PCC, match joint spacing for proposed pavement. Place 'E' joints in curb and gutter section where expansion joints are to be placed in proposed pavement.



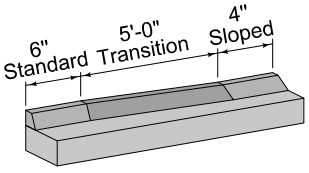
CURB RUNOUT FOR ALL CURBS



CURB TRANSITION FROM 6" STANDARD TO 6" SLOPED



CURB TRANSITION FROM 6" SLOPED TO 4" SLOPED



CURB TRANSITION FROM 6" STANDARD TO 4" SLOPED

FIGURE 7010.102 | SHEET 2 OF 2

SUDAS | IOWA DOT

REVISION	
5	04-21-20

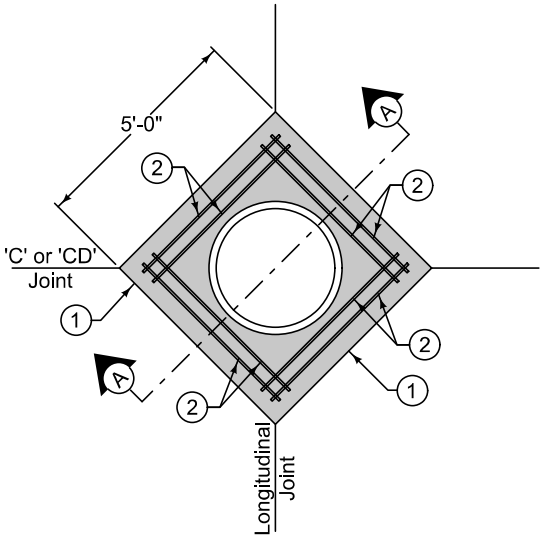
FIGURE 7010.102 | STANDARD ROAD PLAN | PV-102 | SHEET 2 of 2

REVISIONS: Split DRIVEWAY DROP CURB detail into two details. Added new circle note 4 on Sheet 1. Renumbered circle note on Sheet 5.

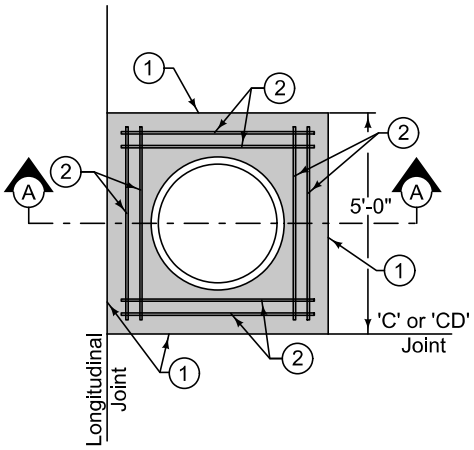
Paul D. Wigand — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

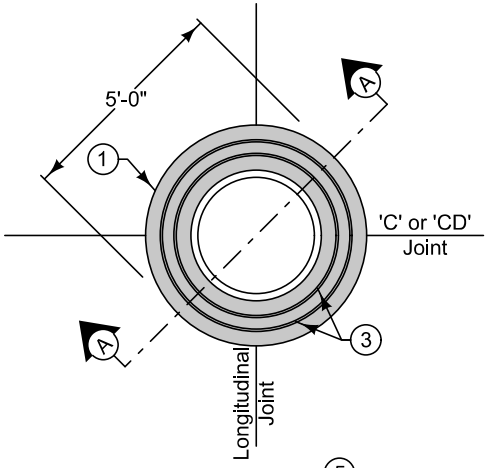
PCC CURB DETAILS



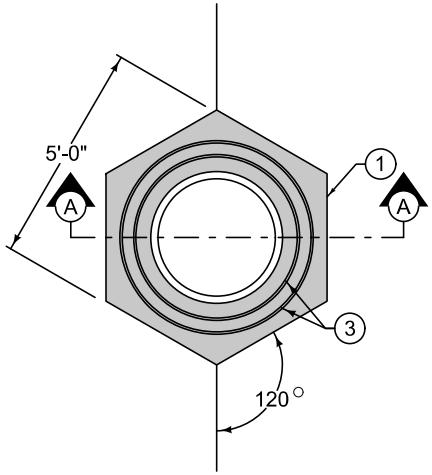
AT JOINT INTERSECTION



OFFSET AT JOINT INTERSECTION



CIRCULAR (5)



AT A SINGLE JOINT

Construct boxout with Class C concrete or match pavement class. Minimum 2 inches clear on reinforcement. Minimum 12 inches of concrete between outside of casting and nearest joint. Center casting within boxout area if possible.

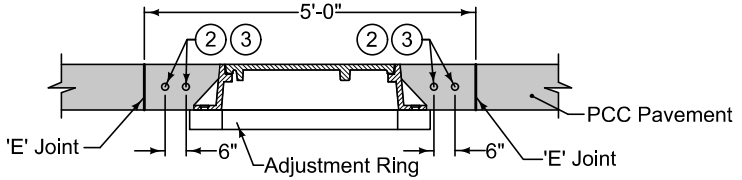
(1) 'KT-1', 'KT-2', 'BT-1', or 'BT-2' joint if three-piece floating casting (SW 601 Type B and D or SW-602 Type F) is used. 'E' joint if two-piece fixed casting (SW 601 Type A and C or SW-602 Type E) is used.

(2) 4 foot 8 inch (typ.) #4 bar. Place at mid-slab.

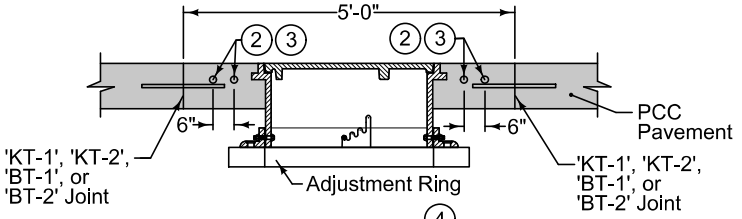
(3) #4 hoops (variable length). Place at mid-slab.

(4) No boxout is required for three-piece floating castings (SW 601 Type B and D or SW-602 Type F). If a boxout is used with a three-piece casting, construct as detailed in Section A-A for three-piece floating casting.

(5) If a circular boxout is cut and extracted after PCC construction, a 'B' joint may be substituted for the 'E' joint if approved by the Engineer.



SECTION A-A
(For two-piece fixed casting)



SECTION A-A (4)
(For three-piece floating casting)

FIGURE 7010.103 | SHEET 1 OF 1

SUDAS | IOWADOT

REVISION	
2	04-19-22

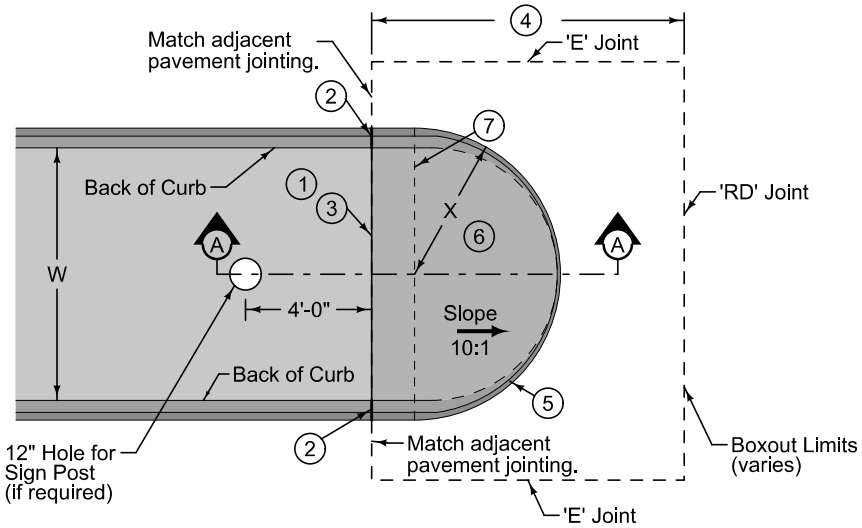
FIGURE 7010.103 | STANDARD ROAD PLAN | PV-103 | SHEET 1 of 1

REVISIONS: Added note 5.

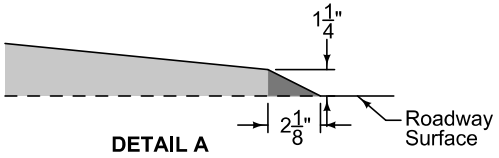
Paul D. Wigand
SUDAS DIRECTOR

Steven Nichols
DESIGN METHODS ENGINEER

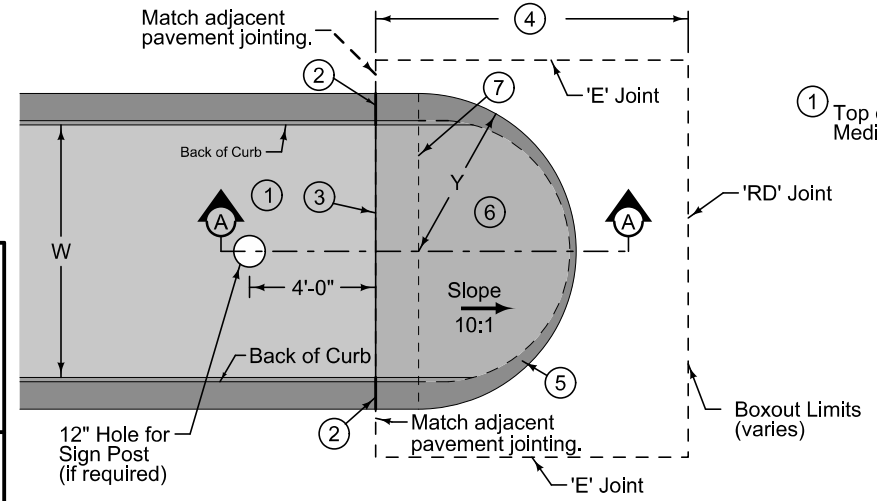
MANHOLE BOXOUTS IN PCC PAVEMENT



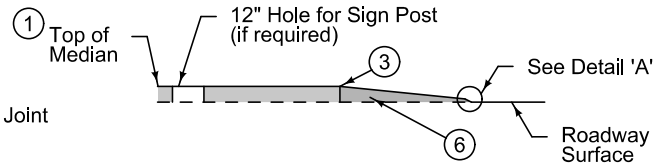
6" STANDARD
PLAN



DETAIL A



6" SLOPED
PLAN



SECTION A-A

1. For details of paved median, see contract documents.
2. 'EE' Joint. Expansion joints located at the end of normal curb.
3. 'E'Joint. If median is paved, place expansion joints at the end of normal curb.
4. If boxout length is less than or equal to 12 feet, provide 'C' Joint. If boxout length is greater than 12 feet, provide 'RD' joint.
5. Special shaping of curb.
6. Quantities for ramped median nose area is included in roadway pavement quantities.
7. When X or Y is 4 feet or greater the expansion joints will be at the begining of the rounded median.

W = Width from back of curb to back of curb

X = W/2 + 7.5"

Y = W/2 + 12"

RAMPED MEDIAN NOSE
(Median Width 8'-0" or Less)

FIGURE 7010.104 | SHEET 1 OF 1

SUDAS | IOWADOT | REVISION 1 04-21-20

FIGURE 7010.104 | STANDARD ROAD PLAN | PV-104 | SHEET 1 of 1

REVISIONS: New logo.

Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

RAMPED MEDIAN NOSE

For joint details, see PV-101.
For curb details, see PV-102.

(1) If more than 20 feet, add extra joint at midpoint.

(2) 'BT' Joint.

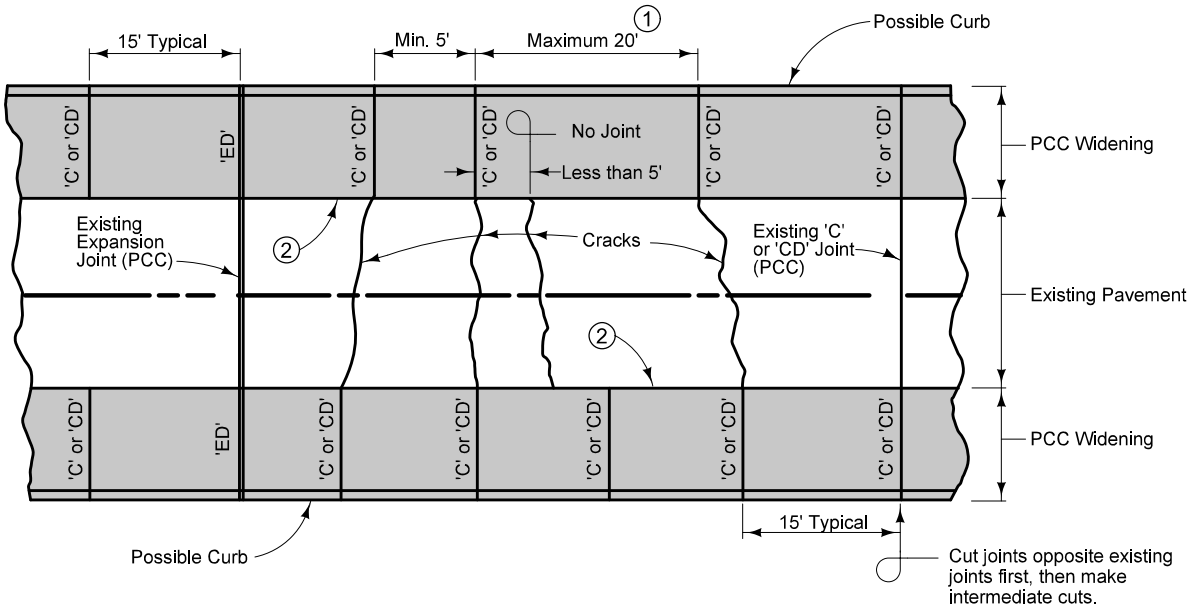


FIGURE 7010.121 | SHEET 1 OF 1

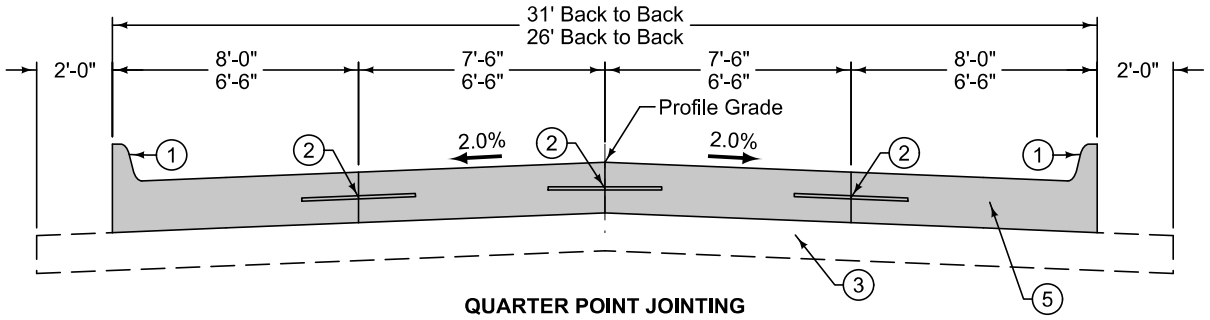
SUDAS | IOWA DOT | REVISION 1 04-21-15

FIGURE 7010.121 | STANDARD ROAD PLAN | PV-121 | SHEET 1 of 1

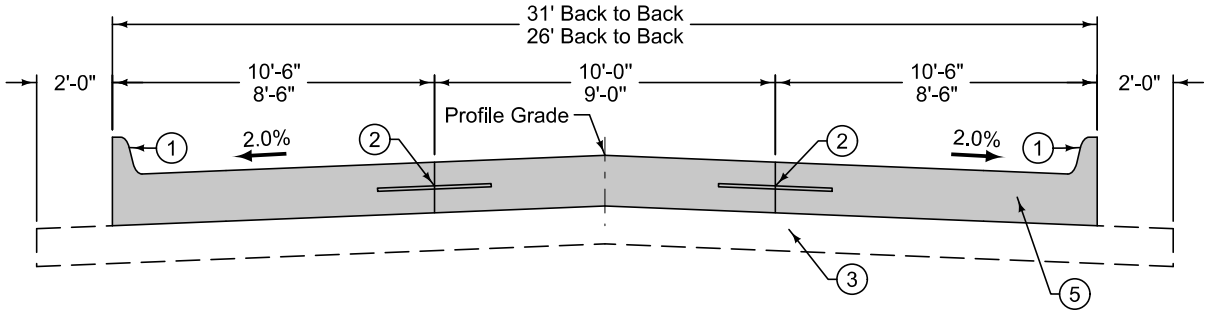
REVISIONS: Added circle note 2 and replaced the DOT logo in the title block with the new version.

Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

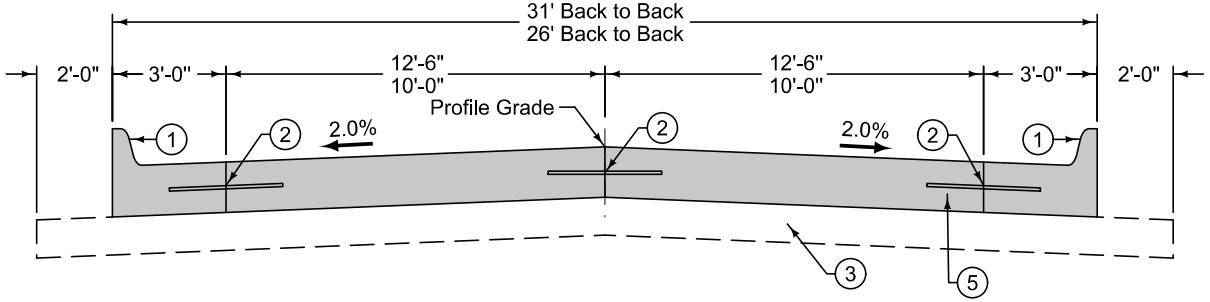
JOINTING PCC PAVEMENT WIDENING



QUARTER POINT JOINTING



THIRD POINT JOINTING



GUTTERLINE JOINTING

(1) 6 inch standard curb.

(2) BT, KT, or L joint depending on pavement thickness and construction staging.

(3) Subbase or subgrade as specified.

(4) Unless otherwise specified in the contract documents.

(5) No dowels within 24" of the back of curb. With gutterline joint, place first dowel 6 inches from the joint. See Figure 7010.101, Sheet 8.

TRANSVERSE JOINT REQUIREMENTS (4)		
Pavement Thickness	Transverse Joint Type	Transverse Joint Spacing
6"	C	12'
7"	C	15'
8"	CD (5)	15'
9"	CD (5)	15'
≥10"	CD (5)	17'

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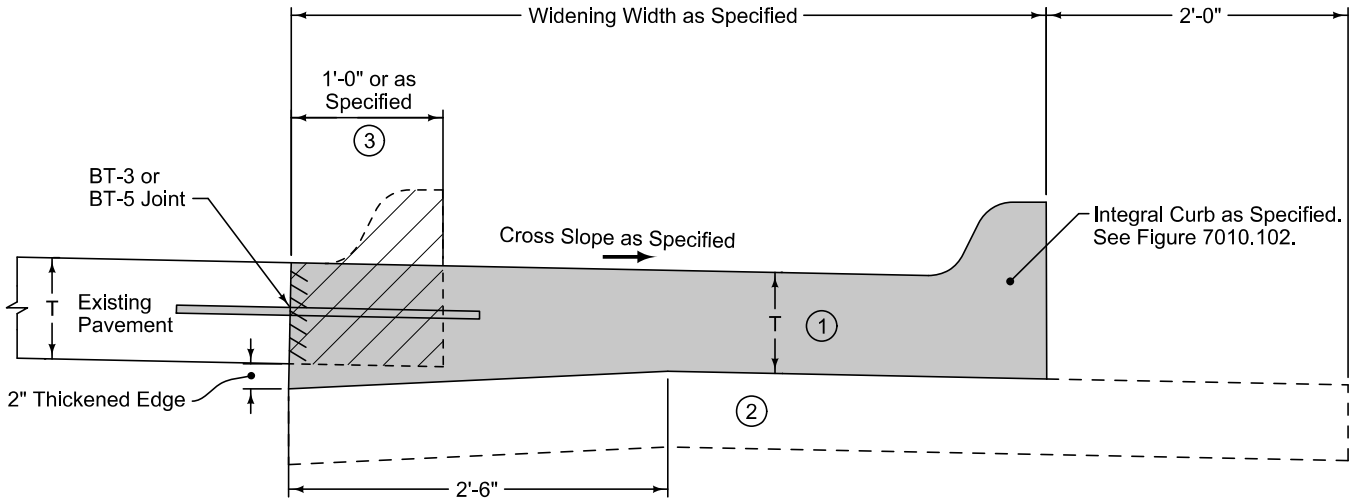
7010.901

SHEET 1 of 1

SUDAS Standard Specifications

PCC PAVEMENT JOINTING

FIGURE 7010.901 | SHEET 1 OF 1



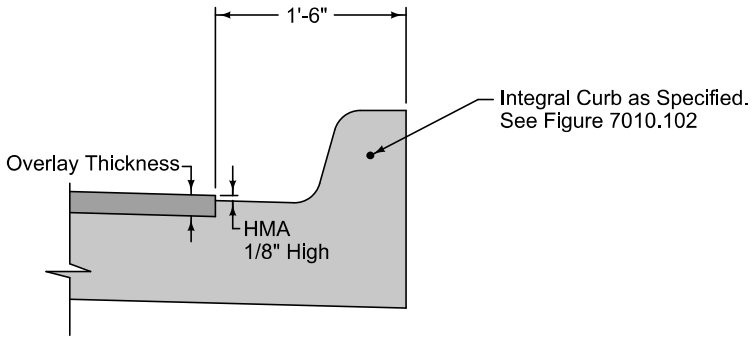
TYPICAL SECTION

See Figure 7010.121 for typical joint layout.

(1) Match existing pavement thickness or as specified in the contract documents.

(2) Subgrade or subbase material as specified.

(3) Remove existing curb using full depth saw cut.



CURB FOR WIDENING WITH HMA OVERLAY

FIGURE 7010.902 | SHEET 1 OF 1

SUDAS

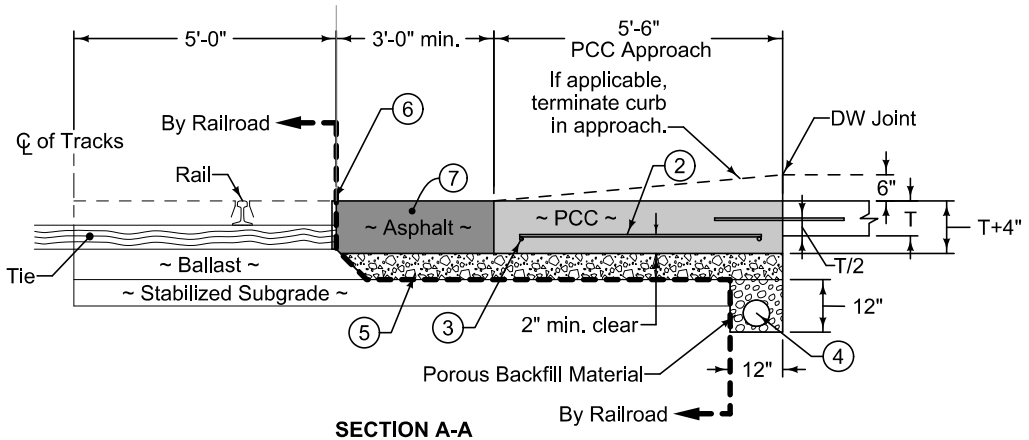
REVISION 1 10-15-13

7010.902

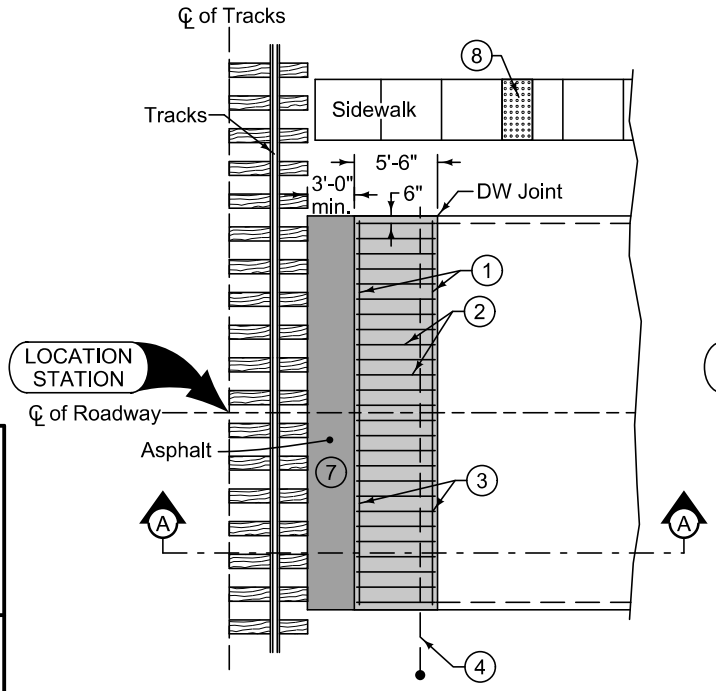
SHEET 1 of 1

SUDAS Standard Specifications

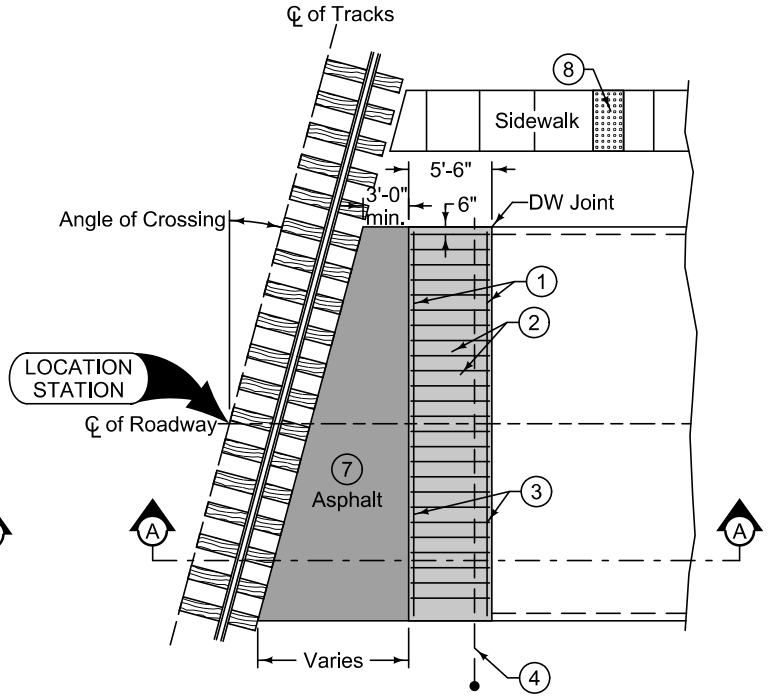
PCC PAVEMENT WIDENING



SECTION A-A



PLAN VIEW - STRAIGHT CROSSING



PLAN VIEW - SKEWED CROSSING

1. Tie reinforcing bars with wire at all intersections with other bars. Lap reinforcing bars a minimum of 12 inches when necessary and tie securely.
2. 5 foot 2 inch (typ.) #5 bar or pavement length minus 4 inches, at 12 inches on center.
3. #5 bars X (approach width minus 4 inches).
4. Install 6 inch perforated CMP subdrain, if specified. Include rodent guard per Iowa DOT Materials I.M. 443.01.
5. Granular subbase, modified subbase, or ballast meeting railroad specifications.
6. For new crossings, construct pavement 1/2 inch to 1 inch below top of rail. For existing crossings, construct pavement level to 1/2 inch below top of rail.
7. Full depth asphalt patch per Section 7040.
8. Refer to Figure 7030.205 for detectable warning location.

FIGURE 7010.903

SHEET 1 OF 1

SUDAS

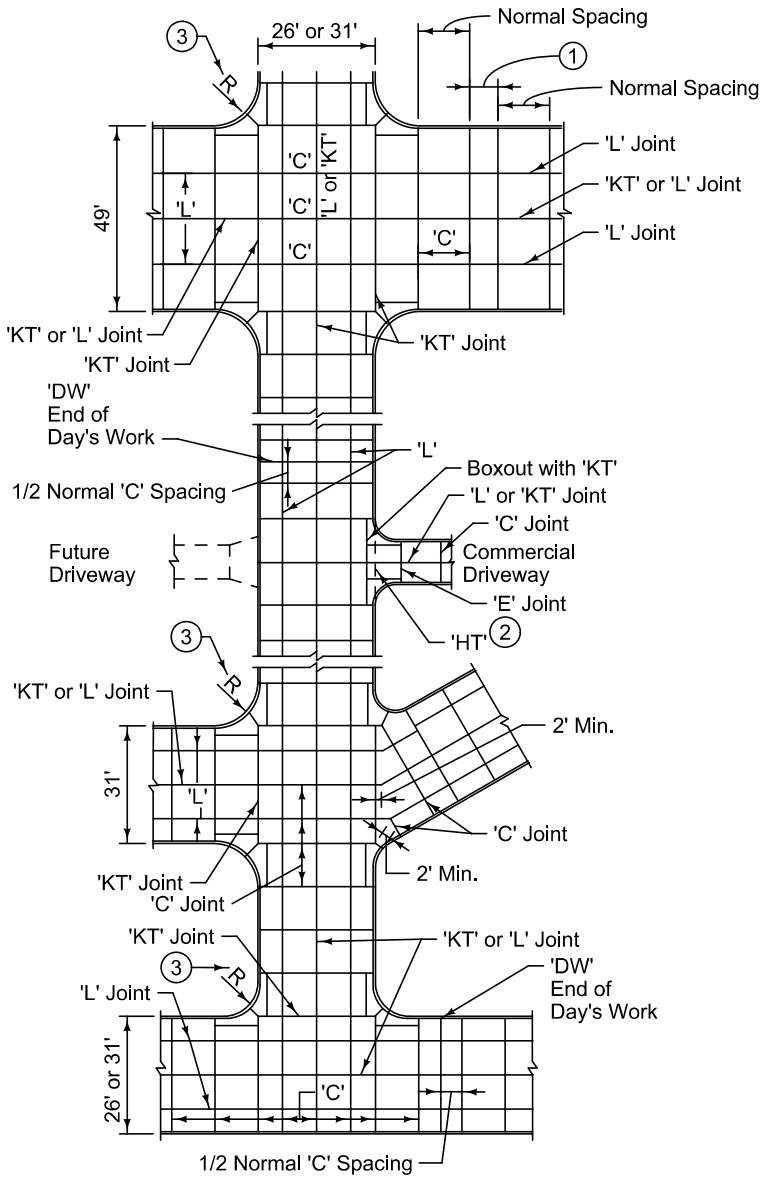
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7010.903

SHEET 1 of 1

SUDAS Standard Specifications

PCC RAILROAD CROSSING APPROACH



PLAN VIEW

Refer to Figure 7010.901 for maximum transverse joint spacing.

Where new and existing pavements meet, and no existing dowels, tie bars, or keyed joints are present, provide a 'BT', 'RT', or 'RD' joint.

(1) Shorten jointing pattern on either side of openings to allow joints to intersect round castings and fall at the edges of intake boxouts.

(2) Where pavement abuts an unimproved street, terminate with a type 'HT' joint.

(3) When radius exceed 20 feet, add one additional 'C' joint at radius intersections.

FIGURE 7010.904 | SHEET 1 OF 1

SUDAS

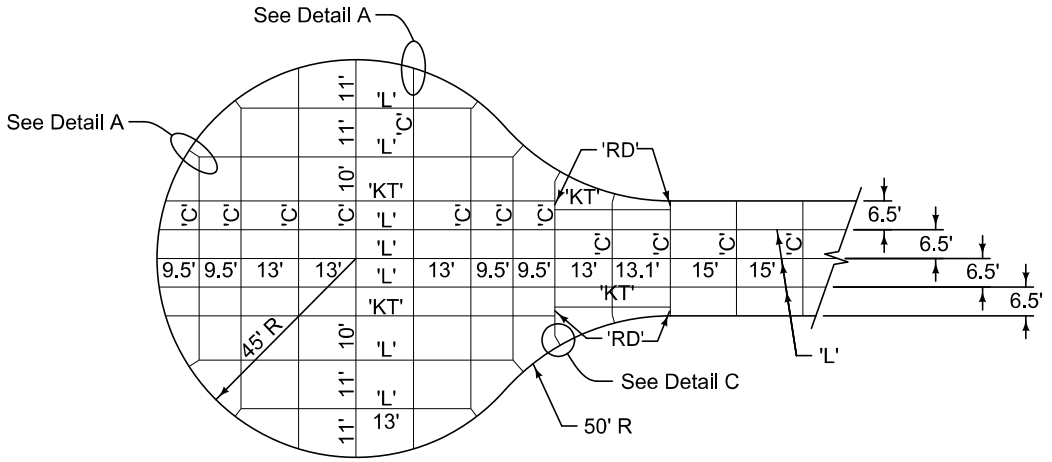
REVISION
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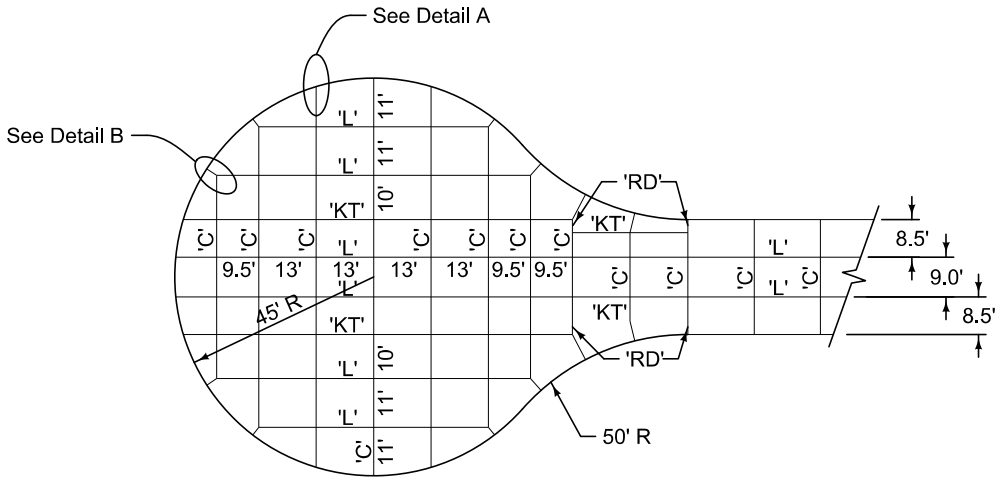
7010.904

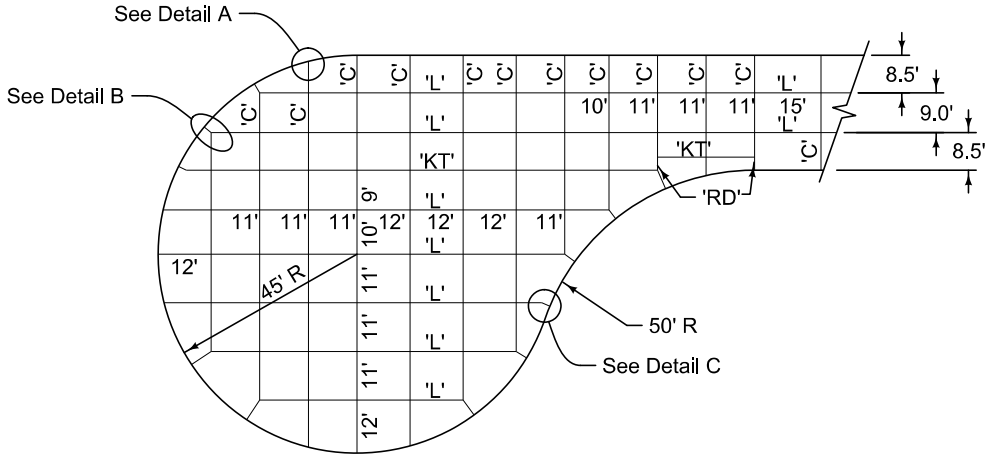
SHEET 1 of 1

SUDAS Standard Specifications

TYPICAL JOINTING LAYOUT


See Detail A
See Detail A
'RD'
'KT'
'KT'
'KT'
'KT'
'L'
'C'
'L'
'KT'
'L'
'L'
'L





THIRD POINT JOINTING

FIGURE 7010.905 | SHEET 2 OF 3

SUDAS

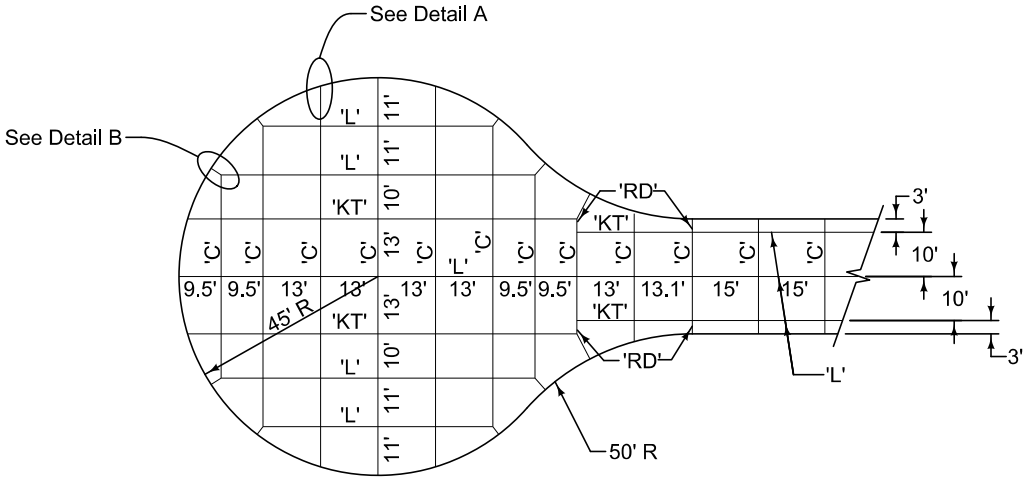
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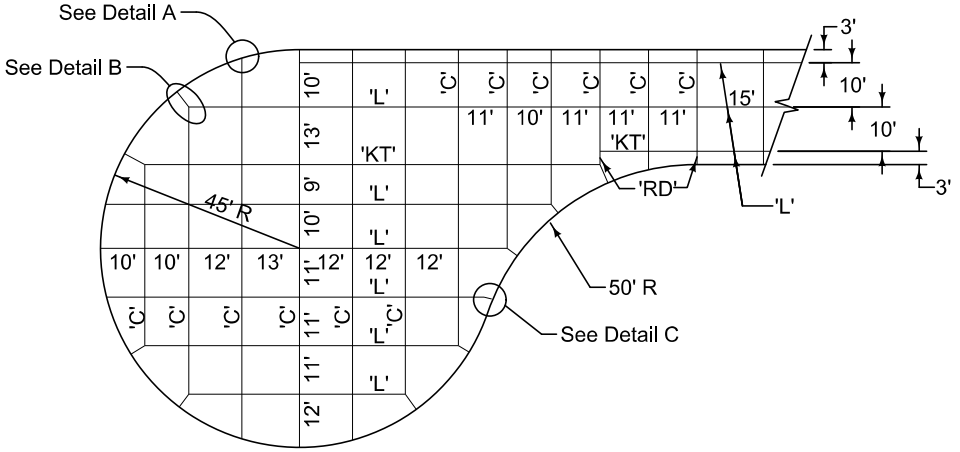
7010.905

SHEET 2 of 3

SUDAS Standard Specifications

PCC CUL-DE-SAC JOINT LOCATIONS





GUTTERLINE JOINTING

FIGURE 7010.905 SHEET 3 OF 3

SUDAS

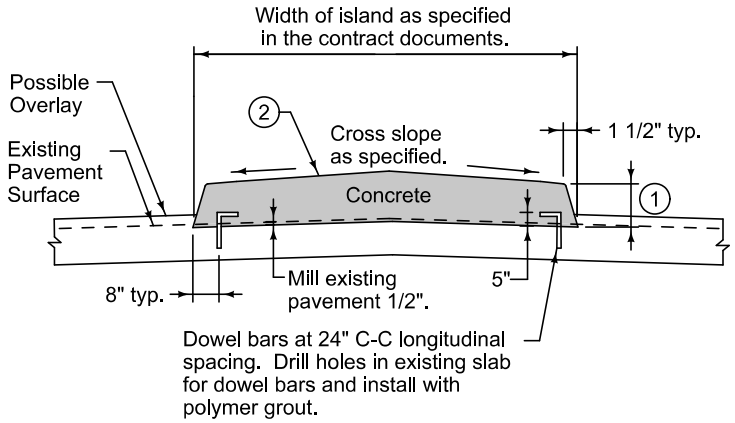
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7010.905

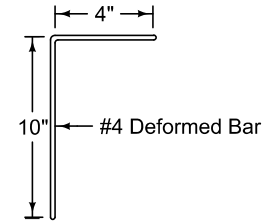
SHEET 3 of 3

SUDAS Standard Specifications

PCC CUL-DE-SAC JOINT LOCATIONS



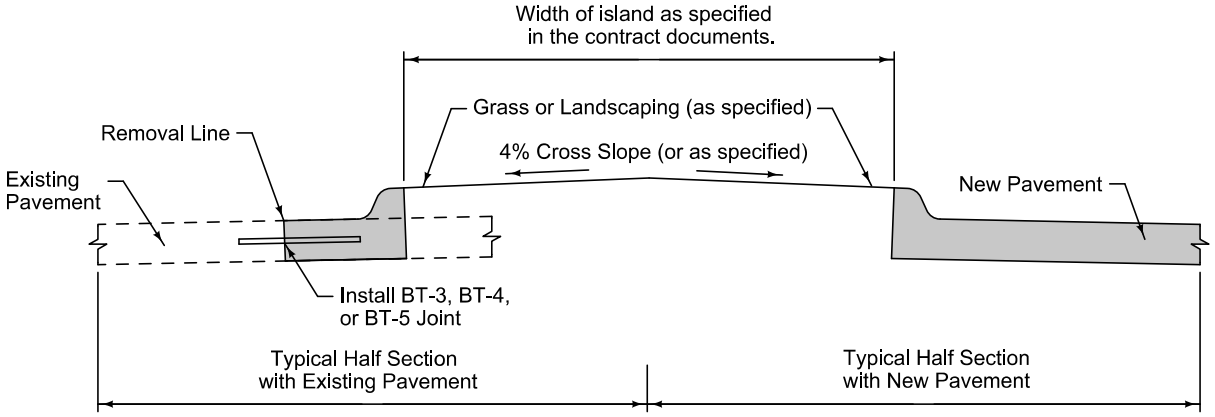
DOWELED MEDIAN



DOWEL BAR DETAIL

(1) Median height as specified in the contract documents.

(2) Construct 'C' joints at a maximum spacing of 15'. Match the joint pattern of the existing pavement. Install expansion joints as directed by the Engineer. Construct expansion joints with 1 inch expansion material. Seal all joints.



LANDSCAPE MEDIAN

FIGURE 7010.906

SHEET 1 OF 1

SUDAS

REVISION
New 10-19-10

7010.906

SHEET 1 of 1

SUDAS Standard Specifications

MEDIANS

PORTLAND CEMENT CONCRETE OVERLAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Bonded Concrete Overlays Over Concrete

B. Bonded Concrete Overlays Over Asphalt

C. Unbonded Concrete Overlays Over Concrete (with separation layer)

D. Unbonded Concrete Overlays Over Asphalt

1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of PCC overlays.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants and Section 7010, 1.03.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants and Section 7010, 1.05.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants and Section 7010, 1.06.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. PCC Overlays:

1. **PCC Overlay, Furnish Only:**
   - **a. Measurement:** Measurement will be in cubic yards of PCC furnished and incorporated into the PCC overlay, including widening sections, partial depth patches (as part of pre-overlay repairs), and irregular sections.
   - **b. Payment:** Payment will be at the unit price per cubic yard of PCC furnished and incorporated into the PCC overlay.
   - **c. Includes:** Unit price includes, but is not limited to, furnishing the concrete mixture and delivery to the project site.

2. **PCC Overlay, Place Only:**
   - **a. Measurement:** Measurement will be in square yards of PCC overlay placed, including widening sections, partial depth patches, and irregular sections. The area of manholes, intakes, or other fixtures in the overlay will not be deducted from the measured overlay area. Area is based on the longitudinal surface and nominal width of existing pavement.
   - **b. Payment:** Payment will be at the unit price per square yard of PCC overlay placed.
   - **c. Includes:** Unit price includes, but is not limited to, integral curb, bars and reinforcement, joints and sealing, finishing and texturing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness testing.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. **Surface Preparation for Bonded PCC Overlay:**
   a. **Measurement:** Measurement will be in square yards of pavement surface prepared for bonded PCC overlay based on the area shown in the contract documents. Area is based on the longitudinal surface and nominal width of existing pavement.
   b. **Payment:** Payment will be at the unit price per square yard of pavement surface prepared for bonded PCC overlay.
   c. **Includes:** Unit price includes, but is not limited to, sandblasting, shot blasting, scarification, and surface cleaning.

4. **Surface Preparation for Unbonded PCC Overlay:**
   a. **Measurement:** Measurement will be in square yards of pavement scarified for unbonded PCC overlay based on the area shown in the contract documents. Area is based on the longitudinal surface and nominal width of existing pavement.
   b. **Payment:** Payment will be at the unit price per square yard of pavement scarified for unbonded PCC overlay.
   c. **Includes:** Unit price includes, but is not limited to, surface preparation required by the contract documents, including scarification and surface cleaning.

5. **Asphalt Separation Layer for Unbonded PCC Overlay:**
   a. **Measurement:** Measurement will be in square yards of asphalt separation layer for unbonded PCC overlay. Area is based on the longitudinal surface and nominal width of existing pavement.
   b. **Payment:** Payment will be at the unit price per square yard of asphalt separation layer for unbonded PCC overlay.
   c. **Includes:** Unit price includes, but is not limited to, cleaning surface and furnishing and placing asphalt mix, including asphalt binder.

6. **Geotextile Fabric Separation Layer for Unbonded PCC Overlay:**
   a. **Measurement:** Measurement will be in square yards of geotextile fabric separation layer for unbonded PCC overlay. Area is based on the longitudinal surface and nominal width of existing pavement.
   b. **Payment:** Payment will be at the unit price per square yard of geotextile fabric separation layer for unbonded PCC overlay.
   c. **Includes:** Unit price includes, but is not limited to, cleaning surface and furnishing, placing, and securing the geotextile fabric separation layer.

7. **Liquid Curing Compound Separation Layer on PCC Surface Patches for Unbonded PCC Overlay:**
   a. **Measurement:** Measurement will be in square yards of liquid curing compound for a separation layer.
   b. **Payment:** Payment will be the unit price per square yard of liquid curing compound separation layer.
   c. **Includes:** Unit price includes but is not limited to, cleaning PCC surface patches and furnishing and placing the liquid curing compound.

B. Pavement Removal: Comply with Section 7040, 1.08, H.

C. Air Content Deficiency: Comply with Section 7010, 1.08, B.

D. Pavement Smoothness Deficiency: Comply with Section 7010, 1.08, C.

E. PCC Pavement Thickness Deficiency: Comply with Section 7010, 1.08, D.

F. Curb and Gutter: Comply with Section 7010, 1.08, E.

G. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

H. PCC Pavement Samples and Testing: Comply with Section 7010.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: Comply with Section 7010, 2.01, A.

B. Supplementary Cementitious Materials (SCM): Comply with Section 7010, 2.01, B.

C. Fine Aggregate for Concrete: Comply with Section 7010, 2.01, C.

D. Coarse Aggregate for Concrete:

1. Crushed stone particles with Class 2 durability complying with Iowa DOT Section 4115 and Materials I.M. 409.

2. Comply with Iowa DOT Section 4115 and Article 4109.02, Gradation No. 3 and 5 in the Aggregate Gradation Table.

3. Bonded PCC Overlays:
   a. Use the maximum nominal coarse aggregate size that is no greater than one-third of the overlay thickness.
   b. Provide aggregates that will produce a concrete mixture having a coefficient of thermal expansion (CTE) equal to or less than the CTE of the existing concrete pavement.

4. The Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

E. Fiber Reinforcement:

1. Provide macro-synthetic fibers complying with ASTM C 1116, Type III Section 4.1.3

2. Incorporate at a dosage rate according to the manufacturer's recommendations (typically 3 pounds per cubic yard to 7.5 pounds per cubic yard).

F. Water Requirements: Comply with Section 7010, 2.01, E.

G. Admixtures: Comply with Section 7010, 2.01, F.

H. Tie Bars, Dowel Bars, and Expansion Tubes: Comply with Section 7010, 2.01, G and H.

I. Joint Fillers and Sealers: Comply with Section 7010, 2.01, L.

J. Liquid Curing Compound:

1. White Pigmented Compounds. Comply with Iowa DOT Section 4105.

2. Poly Alpha-methylstyrene: Comply with ASTM C 309, Type 2, Class B with 100% of the resin consisting of poly alpha-methylstyrene (PAMS) meeting the requirements of Table 7011.01.

Table 7011.01: PAMS Curing Compound

Properties	Range
Total solids, % by weight of compound	$\geq$ 42
% reflectance in 72 hr (ASTM E 1347)	$\geq$ 65
Loss of water, kg/m^2 in 24 hr (ASTM C 156)	$\leq$ 0.15
Loss of water, kg/m^2 in 72 hr (ASTM C 156)	$\leq$ 0.40
V.O.C. Content, g/L	$\leq$ 350

2.01 MATERIALS (Continued)

K. Asphalt Separation Layer for Unbonded Overlay over Concrete:

1. Asphalt Binder: PG 58-28S.

2. Mixture: Standard Traffic (ST) 3/8 inch asphalt mix.
a. Target air voids is 3%.
b. No maximum film thickness restriction.
c. No minimum filler/bitumen ratio restriction.

3. Aggregate:
a. Type B.
b. No percent crushed particle requirement.
c. Gradation cannot fall below the restricted zone.

L. Geotextile Fabric Separation Layer for Unbonded Overlay over Concrete:

1. Material Properties: Based on the contract document's specified mass per unit area, provide a geotextile fabric meeting the requirements of Table 7011.02.

2. Fabric Weight and Thickness:
a. For unbonded overlays less than or equal to 4 inches thick, provide a geotextile separation layer with a weight of 13.3 oz/yd^2 and a thickness of 130 mils.
b. For unbonded overlays greater than or equal to 4.5 inches thick, provide a geotextile separation layer with a weight of 14.7 oz/yd^2 and a thickness of 170 mils.

Table 7011.02: Geotextile Separation Layer

Property	Requirements	Test Procedures
Geotextile Type	Nonwoven, needle-punched, no thermal treatment to include calendaring*	EN 13249, Annex F (Certification)
Color	Uniform/nominally same color fibers	(Visual Inspection)
Weight (mass per unit area)[13]	≥ 13.3 oz/yd^2 ≥ 14.7 oz/yd^2 ≤ 16.2 oz/yd^2	ISO 9864 (ASTM D 5261)
Thickness under load (pressure)	[a] 0.29 psi: ≥ 0.12 in. [b] 2.9 psi: ≥ 0.10 in. [c] 29 psi: ≥ 0.04 in.	ISO 9863-1 (ASTM D 5199)
Wide-width tensile strength	≥ 685 lb/ft.	ISO 10319 (ASTM D 4595)
Wide-width maximum elongation	≤ 130 percent	ISO 10319 (ASTM D 4595)
Water permeability in normal direction under load (pressure)	≥ 3.3 x 10^{-4} ft/s at 2.9 psi	DIN 60500-4 (modified ASTM D5493)
In-lane water permeability (transmissivity) under load (pressure)	[a] ≥ 1.6 x 10^{-3} ft/s at 2.9 psi [b] ≥ 6.6 x 10^{-3} ft/s at 2.9 psi	ISO 12958 (ASTM D 6574) or ISO 12958 (modified ASTM D 4716)
Weather resistance	Retained strength ≥ 60 percent (70% average)	EN 12224 (ASTM D 4355 @ 500 hr exposure for grey, white, or black material only)
Alkali resistance	≥ 96 percent polypropylene/polyethylene	EN 13249, Annex B (Certification)

* Calendering is a process that passes the geotextile through one or more heated rollers during the manufacturing process. The surface of the geotextile is modified during this process. Calendering may reduce the absorption properties of the geotextile on the calendered side.

2.01 MATERIALS (Continued)

M. Liquid Curing Compound Separation Layer on PCC Surface Patches for Unbonded Overlay over Concrete: Comply with Iowa DOT Section 4105.

N. Covering:

1. Burlap: Comply with Iowa DOT Section 4104.

2. Plastic Film: Comply with Iowa DOT Section 4106.

3. Insulating Cover: Comply with Iowa DOT Section 4106.

2.02 CONCRETE MIXES

A. Mix Design: Comply with Section 7010, 2.01 and 2.02, except as modified below:

1. Provide C-3WR or C-4WR for bonded overlays.

2. Comply with Iowa DOT Class C mix meeting the requirements of Iowa DOT Materials I.M. 529.

2. Ensure compatibility of all material combinations. If the concrete materials are not producing a workable concrete mixture, a change in the material may be required. Changes will be at no additional cost to the Contracting Authority.

B. Consistency and Workability: Comply with Section 7010, 2.02, B.

C. Fly Ash and Ground Granulated Blast Furnace Slag (GGBFS) as Supplementary Cementitious Materials: Comply with Section 7010, 2.02, C.

PART 3 - EXECUTION

3.01 EQUIPMENT

Comply with Section 7010, 3.01.

3.02 CONSTRUCTION

Construct overlays in the same manner as PCC pavement (Section 7010, 3.02), except as modified herein.

A. Pre and Post Construction: Comply with the contract documents.

B. Overlay Transition Areas: Refer to the contract documents for details of overlay transitions at project limits, bridges, intersections, and other locations.

C. Temperature Limitations:

1. **Air Temperature:** Do not place overlay concrete when air or existing pavement surface is below 40°F.

2. **Surface Temperature:** Do not place overlay on pavement when the surface temperature exceeds 120°F. If the surface is above 110°F:
   a. Apply water to the pavement surface ahead of the paving operation. Ensure no standing water remains on the pavement at the time the overlay is placed.
   b. If a fabric separation layer is used, wet the fabric but do not saturate.
   c. Do not apply water to the surface if the temperature is below 100°F.

D. Bonded Overlay Surface Preparation:

1. **Over PCC:**
   a. Remove all dirt, oil, and other foreign materials, as well as any laitance or loose material from the surface against which new concrete is to be placed, including all pavement markings and raised pavement markings.
   b. If the existing pavement is milled, shotblast or waterblast the milled surface.
   c. Complete patching with concrete patches after milling, as shown in the contract documents.
   d. Sweep the prepared surface and blow clean with dry, oil free compressed air directly ahead of the paving operation to remove loose dirt or debris. Keep air blasting operations as close to overlay operations as possible to prevent any resettlement of debris onto the previously cleaned area. If material is subsequently tracked onto the surface, the surface must be re-cleaned.

2. **Over Asphalt:**
   a. If required, mill the existing surface to the depth and cross-slope shown in the contract documents. If stripped or loose asphalt is encountered, remove to provide sound structural layer for bonding. Minimum thickness of sound asphalt required for bonding is 3 inches.
   b. Complete patching with concrete patching after milling, as shown in the contract documents. Adjust panel location as necessary so no single overlay panel is located over both asphalt pavement and a concrete patch.
   c. Sweep the prepared surface and blow clean with dry, oil free compressed air directly ahead of the paving operation to remove loose dirt or debris. Keep air blasting operations as close to overlay operations as possible to prevent any resettlement of debris onto the previously cleaned area. If material is subsequently tracked onto the surface, the surface must be re-cleaned.

3.02 CONSTRUCTION (Continued)

E. Unbonded Overlay Surface Preparation: Clean the existing pavement surface immediately prior to paving to remove dirt or debris.

1. Over PCC with Asphalt Separation Layer:

a. Do not scarify the existing PCC surface if an asphalt separation layer will be constructed.
b. Use Class II compaction except use only static steel wheeled rollers complying with Iowa DOT Articles 2303.03 and 2303.04.

2. Over PCC with Geotextile Fabric Separation Layer:

a. Limit ridges on milled surfaces to 1/4 inch maximum height.
b. Roll fabric onto pavement and pull fabric tight without wrinkles.
c. Do not place more fabric than can be paved over within one day.
d. Overlap adjacent rolls by 8 inches ± 2 inches. No more than three layers should overlap.
e. Fasten fabric to existing pavement with pneumatic driven nails every 6 feet or less or secure the geotextile with 3M HoldFast 70 Cylinder Spray Adhesive or approved equal. Apply adhesive to all edges of the fabric and as needed to prevent shifting or folding of the fabric during concrete placement.

3. Over PCC with Liquid Curing Compound

a. Place liquid curing compound meeting Iowa DOT Section 4105 on all PCC patched surfaces prior to placement of the PCC overlay.
b. Apply a minimum of two coats evenly on the full patch area with each coat at a rate of 1 gallon per 200 square feet.
c. If dry to the touch within 10 minutes or rapid absorption is noted, apply a third coat at a rate of 1 gallon per 200 square feet.
d. Prohibit traffic on patches with curing compound applied, and ensure the curing compound is surface dry prior to placement of the overlay.

4. Over Asphalt:

a. Mill high spots in the existing asphalt surface as specified in the contract documents.
b. Remove all loose asphalt material after milling.

F. Existing Pavement Loading:

1. Do not allow concrete delivery trucks to travel over existing pavement unless approved by the Engineer. If approved, limit cleaning and water misting of the existing pavement to just ahead of the paving machine.

2. Do not allow loads in excess of the legal axle load on the existing pavement.

3. Partially loaded trucks may be required to prevent damage to the existing pavement. If asphalt thickness after milling is 3 inches or less, reduce loaded truck hauling over the existing pavement.

G. Paving Suspended:

1. Suspend the paving operation where stability of the underlying pavement section has been lost.

2. Do not place concrete on an underlying pavement that has become unstable.

3.02 CONSTRUCTION (Continued)

H. Bar and Reinforcement Placement:

1. Tie Bars: When the contract documents require tie bars for widening units greater in thickness than the overlay:
   a. Provide No. 4 tie bars.
   b. For overlay thickness 4.5 inches or less, secure tie bars to surface of existing pavement.
   c. For overlay thickness 5 inches or greater, place tie bars at mid-point of overlay thickness.

2. Dowel Bars:
   a. At least 7 days prior to the beginning of concrete paving, submit a written Quality Control Plan that provides a method for keeping the dowel basket assemblies anchored to the subgrade, the existing pavement, or bond breaker layer and into the underlying pavement. Ensure the Quality Control Plan includes the following:
      1) Proposed type and number of fasteners
      2) Proposed installation equipment
      3) Dowel basket assembly anchoring plan (i.e. anchor all basket assemblies prior to concrete placement, one lane at a time, anchor all basket assemblies during the concrete placement operation, etc.)
      4) Action plan if misaligned baskets are identified during concrete pavement placement
   b. Paving operations may be suspended by the Engineer if basket anchoring fails to comply with the Quality Control Plan.

I. Surface Curing:

1. For bonded concrete overlays, apply curing compound at twice the standard rate recommended by the manufacturer.

2. For unbonded concrete overlays 6 inches or thinner, apply curing compound at twice the standard rate recommended by the manufacturer.

3. If PAMS curing compound is specified per Section 7011, 2.01, J, apply at the rate recommended by the manufacturer.

J. Saw Joints:

1. General: Submit a plan for the Engineer's approval, which includes the following items.
   a. Method(s) for assuring adequate sawcut depth in areas of variable concrete overlay thickness.
   b. Anticipated production rate of concrete overlay placement.
   c. Estimated number of saws necessary to prevent random cracking.
   d. Appropriate corrective actions should random cracking occur.
   e. Seal all joints unless directed otherwise.

2. Bonded Overlay Over Existing Concrete Pavement: Submit a plan for the Engineer's approval, which includes the following items.
   a. Marking of all existing joint locations to ensure that joints in the overlay will be placed directly over all existing joints in the underlying concrete pavement.
   b. Transverse Joints:
      1) Saw transverse contraction joints directly over the existing concrete joint the full depth of the overlay plus 1/2 inch (including accommodating variable thickness of the bonded concrete overlay).
      2) Ensure that the width of the sawed transverse joints in the bonded concrete overlay exceeds the width of the crack opening in the underlying joints.

3.02 CONSTRUCTION (Continued)

c. Longitudinal Joints: Saw directly over existing joints full depth.

3. Bonded Overlay Over Existing Asphalt or Composite Pavement:

a. Transverse Joint: Saw to a depth of 1/3 of the overlay thickness or no less than 1.25 inches with an early entry saw.
b. Longitudinal Joints: Saw to a depth of 1/3 of the overlay thickness.
c. Expansion Joints: Match expansion joints in the bonded overlay to those in the existing concrete pavement.

4. Unbonded Overlays Over Concrete, Composite, or Asphalt Pavement:

a. Transverse Joints: Saw to a depth of 1/3 of the overlay thickness or no less than 1.25 inches with an early entry saw.
b. Longitudinal Joints: Saw to a depth of 1/3 of the overlay thickness.
c. Expansion Joints: Match expansion joints in the bonded overlay to those in the existing concrete pavement.

3.03 CURB AND GUTTER CONSTRUCTION

Comply with Section 7010, 3.03.

3.04 PAVEMENT PROTECTION

Comply with Section 7010, 3.04.

3.05 USE OF PAVEMENT

Comply with Section 7010, 3.05.

3.06 TRANSPORTATION RESTRICTIONS

Comply with Section 7010, 3.06.

3.07 QUALITY CONTROL

Comply with Section 7010, 3.07.

END OF SECTION

ASPHALT PAVEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Asphalt Pavement

B. Base Widening

1.02 DESCRIPTION OF WORK

A. Includes the requirements for the construction of asphalt surface, intermediate, and base courses placed upon a prepared subgrade, subbase, base, or pavement and asphalt base widening.

B. Comply with Iowa DOT Section 2303 for construction of asphalt pavement and base widening, except as modified herein.

1. Provide Quality Management - Asphalt (QM-A) for bid items with asphalt quantities exceeding 1,000 tons. Provide quality control for bid items with asphalt quantities of 1,000 tons or less according to Section 7020, 3.06.

2. Refer to Table 7020.01 for gyratory mixture design criteria.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Prepare and submit the job mix formula to the Engineer for approval prior to asphalt production.

B. Provide quality control test results.

C. Submit all pavement smoothness testing and certifications according to Section 7020, 3.05.

D. Upon request, provide material certifications to the Engineer.

E. Submit asphalt certifications for all bid items with asphalt quantities of 1,000 tons or less, according to Section 7020, 3.06.

F. Weight receipts should include mix size and type and/or correlate to the bid item.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Table 7020.01: Mixture Design Criteria
(derived from Iowa DOT Materials I.M. 510)

Mix	Layer Designation	Gyratory Density		Film Thickness	Aggregate[2]			
		N_{des}	Design % G_{mm} (target)		Quality Type	Crush (min)	FAA (min)	Sand Equivalent (min)
LT	0.3 M S	50	96.0	8.0 - 15.0	A[1]	60[1]	---	40
	0.3 M I							
	0.3 M B		97.0		A[1]	45		
ST	1M S	50	96.0	8.0 - 15.0	A	75[1]	40	40
	1M I				A[1]	60[1]		
	1M B		97.0				---	
HT	10M S	75	96.0	8.0 - 15.0	A	75	43	45
	10M I							
	10M B		96.5		A[1]	60		
For mix design levels exceeding 10M ESALs, see Iowa DOT Materials I.M. 510.								

[1] Requirements differing from Iowa DOT Materials I.M. 510; for base mixes, aggregate quality improved from B to A and percent crushed aggregate increased by 15%.

[2] Flat & Elongated 10% maximum at a 5:1 ratio

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Aggregate Storage: Prevent contamination and intermingling per Iowa DOT Section 2303.

B. Salvaged or Reclaimed Materials: Classification of RAP will be as determined by the Iowa DOT. If RAP stockpile classification has not been determined by the Iowa DOT, the Contractor is responsible for obtaining the classification from an outside testing firm using the same tests as the Iowa DOT.

C. Disposal: Dispose of excess asphalt according to applicable local, state, and federal regulations in a manner that does not cause damage or harm to adjacent properties or public facilities.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Complete elements of the work that can affect line and grade in advance of other open cut construction unless noted on plans.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Asphalt Pavement by Ton:

1. **Measurement:** Measurement will be in tons for each different layer (surface, intermediate, base), aggregate size, and binder grade of asphalt pavement.

2. **Payment:** Payment will be at the unit price per ton for each different layer (surface, intermediate, base), aggregate size, and binder grade of asphalt pavement.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

B. Asphalt Pavement by Square Yards:

1. **Measurement:** Measurement will be in square yards for each different thickness and binder grade of asphalt pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each different thickness and binder grade of asphalt pavement.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

C. Asphalt Base Widening by Ton:

1. **Measurement:** Measurement will be in tons for each different layer (surface, intermediate, base), aggregate size, and binder grade of asphalt base widening.

2. **Payment:** Payment will be at the unit price per ton for each different layer (surface, intermediate, base), aggregate size, and binder grade of asphalt base widening.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat between layers, construction zone protection, and quality control.

D. Asphalt Base Widening by Square Yard:

1. **Measurement:** Measurement will be in square yards for each different thickness and binder grade of asphalt base widening. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured base widening area.

2. **Payment:** Payment will be at the unit price per square yard for each different thickness and binder grade of asphalt base widening.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat between layers, construction zone protection, and quality control.

1.08 MEASUREMENT AND PAYMENT (Continued)

E. Asphalt Railroad Crossing Approach:

1. **Measurement:** Measurement will be in square yards of railroad crossing approach.

2. **Payment:** Payment will be at the unit price per square yard of railroad crossing approach.

3. **Includes:** Unit price includes but is not limited to excavation for modified subbase and subdrain, furnishing and installing subdrain, furnishing and installing subdrain outlet, furnishing and installing porous backfill material, furnishing and placing modified subbase material, furnishing and applying tack coat, furnishing, placing, and compacting asphalt.

F. Density Deficiency:

1. **Measurement:** Measurement will be in square yards for each different density of asphalt pavement subject to a unit price reduction for density deficiency according to Section 7020, 3.04.

2. **Payment:** Payment will be at the reduced unit price according to Table 7020.02 for each density of asphalt pavement. If there is a density deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

G. Asphalt Pavement Thickness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of asphalt pavement that has deficient pavement thickness as determined in Section 7020, 3.04.

2. **Payment:** Payment will be at the percentage of the unit price indicated in Table 7020.03 for each different thickness of asphalt pavement. If there is a pavement thickness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

H. Asphalt Pavement Smoothness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different segment of asphalt pavement subject to a unit price reduction for pavement smoothness according to Section 7020, 3.05.

2. **Payment:** Payment will be at the reduced unit price according to Table 7020.04 for each segment of asphalt pavement. If there is a pavement smoothness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

I. Asphalt Pavement Samples and Testing:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for asphalt pavement samples and testing.

3. **Includes:** Lump sum price includes, but is not limited to, certified plant inspection, pavement thickness cores, density analysis, pavement smoothness measurement (when required by the contract documents), and air void testing.

1.08 MEASUREMENT AND PAYMENT (Continued)

J. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

K. Pavement Removal: Comply with Section 7040.

L. Subgrade and Subbase: For excavation and construction of subgrade and subbase, comply with Section 2010.

M. Asphalt Cold Weather Paving:

1. Measurement: When cold weather paving is required and authorized by the Engineer, measurement will be in tons of flexible paving mixture in which the warm mix additive is incorporated, regardless of the method of measurement for asphalt pavement.

2. Payment: Payment will be at the unit price of $3.00 per ton. Payment will be limited to the use of the warm mix additive incorporated only within the contract period and with prior authorization of the work by the Engineer. No price modifications will be made for quantity underruns or overruns for this item. Warm mix additive necessary after the completion date, after all calendar days have passed, or after all working days have been used is incidental to the work regardless if a quantity was included in the contract.

3. Includes: Unit price includes, but is not limited to, all additional labor, materials, and equipment to supply and place the flexible pavement under the approved cold weather paving plan.

PART 2 - PRODUCTS

2.01 ASPHALT MATERIALS

Comply with Iowa DOT Section 2303, with the following exception:

Follow the procedure outlined in Iowa DOT Materials I.M. 510 for asphalt mixture designs, except replace Table 1 in Appendix A, Asphalt Mixture Design Criteria with the SUDAS Asphalt Mixture Design Criteria (Table 7020.01) (Tables 2 through 4 in Appendix A still apply).

2.02 WARM MIX ASPHALT MATERIALS

If use of warm mix asphalt (WMA) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

2.03 RECYCLED ASPHALT MATERIALS

A. Recycled Asphalt Pavement: If use of recycled asphalt pavement (RAP) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

B. Recycled Asphalt Shingles: If use of recycled asphalt shingles (RAS) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

2.04 SUBGRADE AND SUBBASE

Comply with Section 2010.

PART 3 - EXECUTION

3.01 ASPHALT PAVEMENT

Construct according to Iowa DOT Section 2303 and the following:

A. Preparation of Pavement Foundation: Construct subgrade and subbase according to Section 2010.

B. Compaction: Compact to a minimum of 94% of laboratory density. Do not exceed 8% average air void level for roadway density specimens.

C. Tack Coats: Apply tack coats according to Iowa DOT Section 2303. In addition, if the emulsion is diluted, the dilution must be done by the manufacturer and certified. Provide the Engineer with the new application rate required to achieve the specified undiluted application rate.

D. Fillets and Runouts: Rake out coarse aggregate prior to shaping and compaction of fillets and runouts.

E. Asphalt Railroad Crossing Approach: Construct according to Section 7020 and Figure 7020.902.

F. Fixtures in the Pavement Surface:

1. Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with Section 6010, 3.04 for manhole adjustments and Section 5020, 3.04 for water fixture adjustments.

2. Clean outside of fixture to depth of pavement before asphalt placement.

3. Construct boxouts where allowed for later adjustment of fixtures. See Figure 7020.201 for the size and shape of the boxout.

G. Samples and Testing: Take samples from the compacted material and test according to Section 7020, 3.04. Randomly locate samples in the pavement area Notify the Jurisdiction the day prior to coring and testing to give the Jurisdiction the opportunity to witness coring and testing.

H. Cold Weather Paving: When authorized by the Engineer, comply with the following.

1. Street Surface Temperatures: When street surface temperature is below requirements shown in Tables 7020.02 and 7020.03, or when air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40°F, cold weather paving may be considered by the Engineer.

Table 7020.02: Street Surface Temperatures for Base and Intermediate Course Lifts of Asphalt Mixtures

Nominal Thickness (inches)	Street Surface Temperature (°F)
Less than 2	40
2 to 3	35
Over 3	35

3.01 ASPHALT PAVEMENT (Continued)

Table 7020.03: Street Surface Temperatures for Surface Course Lift of Asphalt Mixtures

Nominal Thickness (inches)	Street Surface Temperature (°F)
1	HMA: 50/WMA: 40
1 1/2	HMA: 45/WMA: 40
2 and Greater	40

2. Cold Weather Paving Plan:

a. Submit a written cold weather paving plan to the Engineer for approval. Document material, operational, and equipment changes for paving when air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40°F.

b. Include the following:
   1) Use an approved mix design that incorporates a warm mix additive. Do not use water injection.
   2) Identify warm mix additive and dosage rate.
   3) Identify modifications to compaction process and when modifications apply.

c. If the National Weather Service forecast for the construction area predicts ambient air temperature less than 40°F at the projected time of paving within the next 24 hours, confirm or submit revisions to the cold weather paving plan for Engineer validation. Update plan as required to accommodate conditions anticipated for the next day's operations. Upon validation of the plan, the Engineer will allow paving for the next day. Once in effect, pave conforming to the Engineer-accepted cold weather paving plan for balance of that workday or shift regardless of the temperature at time of paving.

d. Engineer's written acceptance will be required for the cold weather paving plan. Engineer's acceptance of the plan does not relieve Contractor of responsibility for the quality of pavement placed in cold weather.

3. Restrictions and Limitations:

a. Do not place flexible paving mixtures over frozen subgrade or base, or where roadbed is unstable.

b. Engineer may further limit placement if, in the Engineer's judgment, other conditions are detrimental to quality work.

3.02 BASE WIDENING

A. Equipment: Use equipment complying with Iowa DOT Section 2213.

B. Conditions:

1. Resurfacing over Concrete Base Widening: When the existing pavement is asphalt material over concrete pavement, saw or mill the old asphalt to the full depth of the proposed resurfacing or to depth of sound material producing a reasonable vertical line at the edge of the underlying concrete.

2. Asphalt Base Widening: Apply a tack coat to the vertical edge of the old pavement at a rate of 0.10 to 0.15 gallon per square yard according to Section 7020, 3.01. No waiting period will be required before placing the widening.

3.02 BASE WIDENING (Continued)

C. Preparation of Subgrade:

1. Cut the width of the trench for the widening at least 6 inches greater than the base width of the widening according to the contract documents. If widening roadways with open ditches, provide ditches or drains from the widening trench at frequent intervals to allow subgrade drainage to side ditches.

2. Construct subgrade and subbase according to Section 2010.

3. Bring the subgrade to an elevation and cross-section such that, after being compacted to a minimum of 95% of maximum Standard Proctor Density, the surface will be at the required elevation.

4. Remove material, other than sand, that will not readily compact. Replace with material that will readily compact and roll that portion of the subgrade again. Use an appropriate roller complying with Iowa DOT Article 2001.05.

5. While constructing the subgrade, maintain the soil in a condition sufficiently moist to facilitate compaction.

6. Check the finished subgrade with a template supported on the surface of the adjacent pavement. Clean the edge of the old pavement.

D. Construction:

1. Place the asphalt mixture in the number of lifts required to produce the required thickness. Do not allow the compacted thickness of the top lift to exceed 2 1/2 inches.

2. The maximum compacted thickness of lower lifts may exceed 3 inches if the thicker lifts demonstrate satisfactory compaction. Maximum lift thickness shall be 4 1/2 inches.

3. Do not place asphalt on the surface of the existing pavement, and immediately remove any spilled base material.

4. Ensure that, after compaction, the constructed width conforms to the required width.

5. Promptly and thoroughly compact each lift. Comply with Section 7020, 3.01.

6. Place succeeding lifts of asphalt material as soon as the previous lift has been compacted.

7. Obtain the lab density for that day's asphalt paving from an Iowa DOT-approved testing lab and based on the job mix formula design criteria.

8. Take density samples from the compacted material and test according to Section 7020, 3.04. Randomly locate samples in the area 6 inches from the base being widened to 6 inches from the outside edge of a given pass of the placing equipment. Notify the Jurisdiction the day prior to coring and testing to give the Jurisdiction the opportunity to witness coring and testing.

9. When the contract for base widening does not include resurfacing, construct the final surface of widening flush with, or no more than 1/8 inch below, the surface of the old pavement.

10. Do not open the widening to traffic until it has cooled sufficiently to support the traffic without displacement or movement.

3.03 PROTECTION FROM TRAFFIC

A. General:

1. Protect the new pavement and its appurtenances damages caused by traffic, both public and that of the Contractor's own employees and agents, at no additional cost to the Contracting Authority. This includes the erection and maintenance of warning signs, lights, fence, and barricades; flaggers to direct traffic; and pavement bridges or crossovers as appropriate.

2. Do not operate equipment with metal tracks, metal bucket blades, or metal motor patrol blades directly on new paving. Do not unload soil or granular materials, including base rock for storage and future reloading directly onto new paving.

B. End of Day's Run:

1. At the end of each day's run and at all side streets, erect and maintain safety barriers and fencing as necessary to protect the pavement from damage.

2. Install construction zone protection upon completion of paving operations. Leave protection in place and maintained until the pavement has cooled sufficiently to withstand traffic without damage.

3. Intermediate construction zone protection may be required for the purpose of opening the pavement for access to a side road, side street, or entrances.

C. Repair of Damages: At the discretion of the Engineer, and at no additional cost to the Contracting Authority, repair or replace any part of the pavement damaged by traffic or other causes occurring prior to final acceptance of the pavement.

3.04 DEFECTS OR DEFICIENCIES

A. Repairs Required:

1. Remove and replace or repair pavement containing excessive cracks, deformities, deficiencies, or other defects at no additional cost to the Contracting Authority. The method of replacement or repair will be determined by the Engineer. Extended warranty may be approved by the Engineer.

2. Areas to be replaced will be determined by the Engineer. Complete all repairs according to Section 7040.

B. Density Deficiencies:

1. The Engineer will obtain and test 7 samples for each lot according to Iowa DOT Materials I.M. 204 Appendix F. The quality index for density of each lot will be determined by the following formula:

$$\text{Density (Q.I.)} = \frac{(\text{Average } G_{mb})_{\text{Field Lot}} - ((\%\ \text{Density})_{\text{Specified}} \times (\text{Average } G_{mb})_{\text{Lab Lot}})}{(\text{Standard Deviation } G_{mb})_{\text{Field Lot}}}$$

where G_{mb} = bulk Specific Gravity of the mixture

3.04 DEFECTS OR DEFICIENCIES (Continued)

2. Payment will be adjusted according to the density requirements of Table 7020.02 for the quality index for density determined for the lot:

Table 7020.02: Pay Factor for Asphalt Pavement Density

Density Index 7 Samples[1]	Percent Payment
greater than 0.72	100
0.40 to 0.72	95
0.00 to 0.39	85
less than 0.00	75 Maximum

[1]Or 6 samples and 1 outlier. Only one outlier will be allowed.

No incentive payment for pavement density will be made.

C. Thickness Deficiencies:

1. The Engineer will measure the cores according to Iowa DOT Materials I.M. 337. All areas of uniform and similar thickness and width for the project will be divided into lots.
2. The thickness of the completed course will be measured to the nearest 1/8 inch, exclusive of seal coat. All areas of uniform and similar thickness and width for the project will be divided into lots. The frequency specified for taking density samples from the surface lift will be used when measuring for completed thickness. However, samples that may not be tested for density because they are less than 70% of the intended thickness will be used for thickness, and in these particular instances, the additional samples of sufficient thickness that are used for density tests will not be measured for thickness. Thickness samples will be taken full depth of the completed course and after measurement; remove the density samples for the top layer from the core. If any of the measurements for a lot is less than the designated thickness, the quality index for thickness of that lot will be determined by the following formula:

$$\text{Thickness (Q.I.)} = \frac{\text{Avg. Thickness - (Design Thickness - 0.50)}}{\text{Max Thickness - Minimum Thickness}}$$

3. Payment will be further adjusted by the appropriate percentage according to the quality index for thickness determined for that lot and the following table:

Table 7020.03: Pay Factor for Asphalt Pavement Thickness

Thickness Index 7 Samples	Percent Payment (Previously Adjusted for Density)
greater than 0.34	100
0.14 to 0.34	95
0.00 to 0.13	85
less than 0.00	75 Maximum

No incentive payment for pavement thickness will be made.

4. Do not apply the thickness quality index adjustment to a layer with a designated thickness of “variable” or “nominal”, or to a layer designated as a scratch course or leveling course. Do not apply the quality index adjustment to pavement layers designated in the contract documents as grade correction or cross slope correction.

3.05 PAVEMENT SMOOTHNESS

A. Straightedge: The Engineer will check asphalt pavement surfaces with a 10 foot straightedge placed parallel to the centerline. Areas showing high spots of more than 1/4 of an inch in 10 feet will be marked. Complete surface corrections according to the following procedures to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straightedge.

1. Complete surface corrections by diamond grinding, placing an asphalt overlay per Section 7021, replacing the area per Section 7040, or inlaying the area.

2. For diamond grinding, perform the same work and use the same equipment as specified in Section 7010, 3.07, C. After diamond grinding, cover the surface with a slurry seal complying with Section 7070.

3. If the surface is corrected by overlay, replacement, or inlay, begin and end the surface correction with a transverse saw cut normal to the pavement lane lines or edge lines within any one area. Ensure the profile of the surface is smooth with no bumps or dips at the beginning or end of the correction. Correction must be a minimum of the entire lane width.

Surface corrections will be completed at the direction of the Engineer with no additional cost to the Contracting Authority.

B. Inertial Profilers:

1. If specified in the contract documents, comply with Iowa DOT Section 2317 and Materials I.M. 341, Appendix A to measure pavement smoothness with an inertial profiler and start appropriate corrective measures, if necessary; the engineer will determine the corrective measures to be taken. No incentive for pavement smoothness will be made.

2. Evaluate according to the smoothness requirements of Table 7020.04 and make surface corrections and/or price reductions. Surface corrections will be completed with no additional cost to the Contracting Authority. No incentive for pavement smoothness will be made.

3. Smoothness measurements will be suspended for structures and through intersections.

Table 7020.04: Smoothness Adjustment/Correction

Segment Speed	Mean Roughness Index (inches per mile)	Pay Factor
Greater than 45 mph	< 200	100%
	200 to 250	-$15.00/foot/lane or correct[1]
	≥ 250	Correct[1]
Less than or equal to 45 mph	< 250	100%
	250 to 300	-$15.00/foot/lane or correct[2]
	≥ 300	Correct[2]

[1] Correct to below 200 inches per mile
[2] Correct to below 250 inches per mile

3.06 QUALITY CONTROL

A. Provide Quality Management - Asphalt (QM-A) for bid items with asphalt quantities exceeding 1,000 tons. On locally let projects, all testing normally conducted by the Iowa DOT may be performed by the Jurisdiction or an independent testing laboratory hired by the Jurisdiction.

1. General: Follow the procedures and meet the criteria established in Iowa DOT Article 2303.03, B; Section 2521; and Materials I.M. 510 and 511. Percent within Limits (PWL) stipulations in these documents is not required.

2. Mix Design - Job Mix Formula (JMF):
   a. The Contractor is responsible for the JMF for each mixture.
   b. Submit a completed JMF for approval to the materials lab designated by the Contracting Authority. Submit supporting documentation demonstrating the design process was followed and how the recommended JMF was determined. Include an economic evaluation when required according to Iowa DOT Section 2303. Include trial and final proposed aggregate proportions and corresponding gyratory data. In addition, submit sufficient loose mixture and individual material samples for approval of the design if requested by the Engineer.
   c. The person preparing the JMF must be Iowa DOT certified in bituminous mix design.
   d. If the JMF is not satisfactory, submit another JMF for review. An approved JMF will be required prior to beginning plant production.

3. Plant Production:
   a. General:
      1) Perform sampling and testing to provide the quality control of the mixture during plant production. Certified Plant Inspection according to Iowa DOT Section 2521 is required.
      2) Ensure personnel performing production quality control testing is Iowa DOT certified for the duties performed.
      3) Provide easy and safe access to the location in the plant where samples are taken.
      4) A "significant mix change" is defined as a single occurrence of an aggregate interchange of greater than 5%, a single occurrence of an asphalt content change greater than 0.2%, or any deletion or introduction of a new material into the mix.
   b. Sampling and Testing:
      1) Sample and test asphalt binder to verify the quality of the binder grade. Take asphalt binder samples at random times as directed and witnessed by the Engineer according to Iowa DOT Materials I.M. 204.
      2) Use cold feed or ignition oven gradation for aggregate gradation control to assure materials are being proportioned according to the specifications. Take aggregate samples at random times as directed and witnessed by the Engineer according to Iowa DOT Materials I.M. 204. The Engineer will secure the samples according to Iowa DOT Materials I.M. 205, Appendix A.
      3) Sample the hot asphalt mixture at random locations as directed and witnessed by the Engineer according to Iowa DOT Materials I.M. 322. Secure the samples according to Iowa DOT Materials I.M. 205, Appendix A.
      4) Assist the Engineer with material sampling for verification testing. When the Engineer provides notification that a sample is to be taken, obtain sample within 15 minutes.
      5) Each day's production of a mix design will be considered a lot.
         a) When the anticipated quantity for the day is 2,000 tons or more, divide that day's production into four sublots, with the first sublot being the first 500 tons produced. The Engineer will divide the remaining anticipated quantity for the day into three equally sized sublots.

3.06 QUALITY CONTROL (Continued)

b) When the anticipated quantity for the day is less than 2,000 tons, use the first 500 tons produced for the first daily sublot. The Engineer will establish 750 ton daily sublots for mix production exceeding the first 500 tons.

6) No more than four paired hot asphalt mixture samples will be required for acceptance of a lot.

7) Do not take paired samples from the first 100 tons of mix produced each day or the first 100 tons of mix following a significant mix change. When paving operations are staged so each day of placement is less than 100 tons for the entire production of a bid item, establish a sampling plan with the Engineer that includes a minimum of one sample per 2,500 tons.

8) Test the quality control sample of each production paired sample as follows:
   a) Prepare and compact two gyratory specimens according to Iowa DOT Materials I.M. 325G.
   b) Determine the density for each specimen according to Iowa DOT Materials I.M. 321. Average the results to determine sample density.
   c) Use the field quality control laboratory compaction for field density control. The laboratory density for field control will be the bulk specific gravity of compacted mixture (Gmb) at Ndesign. Bulk specific gravity at Ndesign will be determined by compacting specimens to Nmax and back calculating the bulk specific gravity at Ndesign.
   d) Determine the Theoretical Maximum Specific Gravity of the uncompacted mixture according to Iowa DOT Materials I.M. 350 or other test methods recognized by AASHTO or ASTM.
   e) Determine laboratory air voids for each sample according to Iowa DOT Materials I.M. 501.

9) When liquid anti-strip additives are used, satisfy one of the following methods to regulate the quantity of additive:
   a) Present certification that the equipment used to measure and blend the liquid anti-strip additive:
      - Meets the anti-strip supplier's recommended practice,
      - Is directly tied to the asphalt binder supply system, and
      - Has been calibrated to the equipment manufacturer's guidelines.
   b) Test the binder to measure the quantity of liquid anti-strip additive in the binder for every 5,000 tons of asphalt production. Obtain the Engineer's approval for the supplier's test method prior to use of the test.
   c) Run the test method in Iowa DOT Materials I.M. 319 during production. If unable to certify or test for the presence and quality, run the test method in Iowa DOT Materials I.M. 319 each 10,000 tons of production to measure the effectiveness of the additive. Ensure test results satisfy the minimum requirements of Iowa DOT Article 2303.02, E.

c. Production Control:

1) After the JMF is established, the combined aggregate furnished for the project, the quantity of asphalt binder, and the laboratory air voids should consistently comply with the JMF, as target values. Control them within the production tolerance given in Table 7020.05.

3.06 QUALITY CONTROL (Continued)

Table 7020.05 Production Tolerances

Measured Characteristic	Target Value (%)	Specifications Tolerance (%)[1]
Cold feed gradation No. 4 (4.75 mm) and larger sieves	by JMF	± 7.0
Cold feed gradation No. 8 (2.36 mm)	by JMF	± 5.0
Cold feed gradation No. 30 (600 µm)	by JMF	± 4.0
Cold feed gradation No. 200 (75 µm)	by JMF	± 2.0[2]
Daily asphalt binder content	by JMF	± 0.3
Field laboratory air voids - absolute deviation from target	0.0[3]	<1.0[4]

[1] Based on single test unless otherwise specified.
[2] Maintain the filler/bitumen ratio of the plant produced mixture between 0.6 and 1.4.
[3] Unless otherwise specified.
[4] Based on the moving average of four test values.

2) Control plant production so that the plant produced asphalt mixture will meet mixture design criteria (within the test tolerances given in Table 7020.05) for Air Voids at Ndesign gyrations of the gyratory compactor. Monitor the slope of the gyratory compaction curve of plant produced material. Slope variations in excess of ±0.40 of the mixture design gyratory compaction curve slope may indicate potential problems with uniformity of the mixture.
3) The gyratory mix design gradation control points for the size mixture designated in the project plans will not apply to plant production control.
4) Strive for the target value of the percent air void and asphalt binder by adjusting gradation and asphalt binder content.
5) Produce a uniform composition mixture complying with the JMF.
6) Adjustments to the JMF target gradation and asphalt binder content values may be made.
   a) Determine from quality control testing that adjustments are necessary to achieve the specified properties.
   b) Consult with the Engineer regarding adjustments to the JMF.
   c) The Contractor's adjustment recommendations prevail, provided all specifications and established mix criteria are being met for plant production.
7) Measure estimated film thickness and voids in the mineral aggregate (VMA) for specifications compliance every day of asphalt production.
8) Prepare quality control charts according to Iowa DOT Materials I.M. 511. Keep the charts current and available showing both individual sample results and moving average values. Base moving average values on four consecutive sample results. Moving averages may restart only in the event of a mandatory plant shutdown for failure to maintain the average within the production tolerance. Include the target value and specifications tolerances on control charts.
9) Calculate laboratory voids for individual samples according to Iowa DOT Materials I.M. 501. Use the individual density and individual maximum specific gravity determined for each sample. To determine the moving average of laboratory voids, use the average of the last four individual sample laboratory voids.
10) Monitor the test results and make mix adjustments, when appropriate, to keep the mixture near the target values. Notify the Engineer whenever the process approaches a specification tolerance limit. Cease operations when the moving average point for laboratory air voids is outside the specification tolerance limit. Assume responsibility to cease operations, including not incorporating material which has not been placed. Do not start the process again until notifying the Engineer of the corrective action proposed.

3.06 QUALITY CONTROL (Continued)

B. Provide quality control for bid items with asphalt quantities of 1,000 tons or less as follows:

1. Mix Design: Prepare the job mix formula. Prior to asphalt production, obtain the Engineer's approval for the job mix formula. Comply with Iowa DOT Article 2303.02 and Iowa DOT Materials I.M. 510. Submit for approval.

2. Plant Production: Use a current calibration of the asphalt production plant for the job mix formula no more than 12 months old. Maintain an asphalt binder log to track when the binder was delivered. Identify the job mix formula on the asphalt delivery ticket. Use certified asphalt binder and approved aggregate sources meeting the job mix formula. Monitor the quality control test results and make adjustments to keep the mixture near the target job mix formula values.

3. Construction: Take density measurements of the compacted mixture. Use the field quality control laboratory compaction for field density control as specified in Section 7020, 3.04. The Engineer may accept the density of the compacted layer based on cores or density gauge. The Engineer may waive density measurement provided the compaction has been thorough and effective. Take density measurements of the compacted mixture no later than the next working day following placement and compaction. For small quantities, a lot is the entire quantity of each asphalt mixture bid item. The quality index for density will not apply to small quantities.

4. Sampling and Testing: Material sampling and testing is for production quality control only. Acceptance of mixture is based on Contractor certification. Perform a minimum of one aggregate cold-feed and one loose asphalt test per lot. Sampling and testing of loose asphalt is only required for mechanically placed mixture. All sampling and testing procedures will follow the Iowa DOT Specifications and Materials I.M.s using certified technicians and qualified testing equipment. The Engineer may approve alternative sampling procedures, or may approve sampling of uncompacted mix and gradation if Contractor can provide plant reports for other recent projects(s) demonstrating the job mix formula has been produced according to the specifications. Take the sample between the first 100 to 200 tons of production. No split samples for agency correlation testing are required. Asphalt binder will be accepted based on the asphalt supplier's shipment certification. No binder sampling or testing is required. No material sampling or testing is required for daily asphalt production of less than 100 tons on any project.

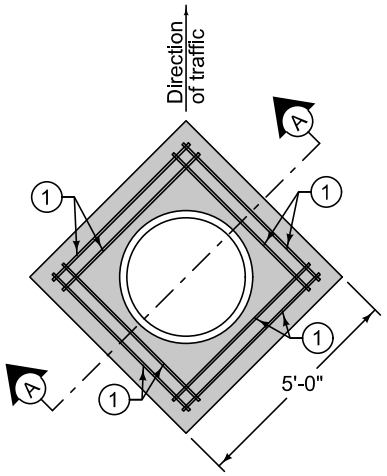
5. Certification: Provide a certification for the production of any mixture in which the requirements in this section for small quantities are applied. Place the test results and certification statement on the Iowa DOT Daily Plant Report. The Daily Plant Report for certified asphalt may be submitted at the end of the project for all certified asphalt quantities, or submitted at intervals for portions of the certified quantity. Use the following certification statement:

> "The certified asphalt was produced in compliance with the provisions of Section 7020, of the SUDAS Standard Specifications. The certified asphalt was produced with certified asphalt binder and approved aggregates as specified in the approved mix design."

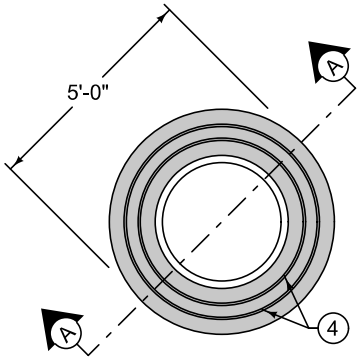
3.07 REMOVAL OF PAVEMENT

Comply with Section 7040.

END OF SECTION



RECTANGULAR



CIRCULAR

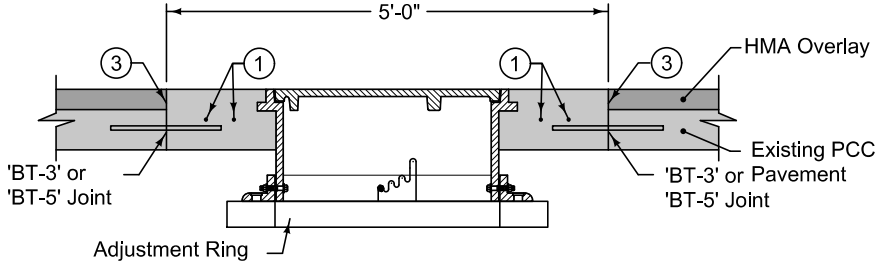
Construct boxout with Class C concrete or match pavement class. Minimum 2 inches clear on reinforcement. Minimum 12 inches of concrete between outside of casting and nearest joint. Center casting within boxout area if possible.

(1) 4 foot 8 inch (typ.) #4 bar. Place at mid-slab.

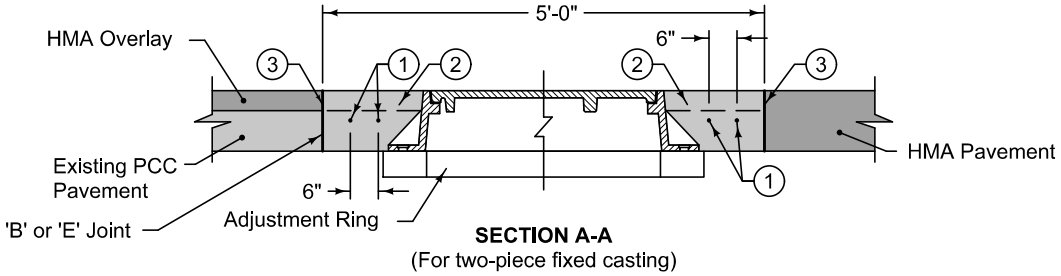
(2) If boxout is constructed prior to placement of HMA overlay or final lift of HMA pavement, boxout may be constructed low, with a 'B' joint in place of the 'E' joint, and then final lift or overlay placed.

(3) Apply tack coat.

(4) #4 hoops (variable length). Place at mid-slab.



SECTION A-A
(For three-piece floating casting)



SECTION A-A
(For two-piece fixed casting)

FIGURE 7020.201

SHEET 1 OF 1

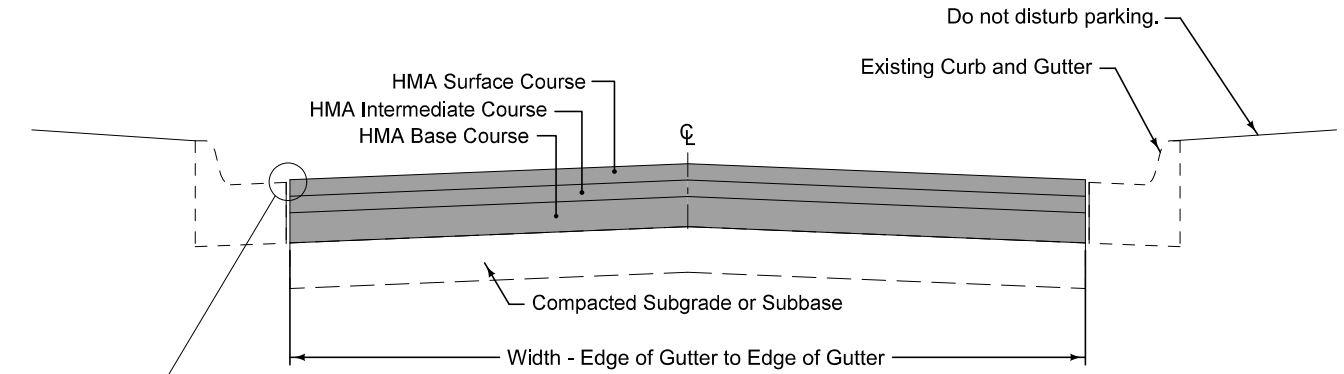
SUDAS | IOWADOT | REVISION 2 04-19-22

FIGURE 7020.201 | STANDARD ROAD PLAN | PV-201 | SHEET 1 of 1

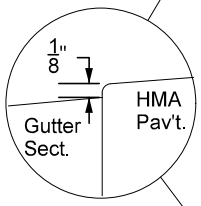
REVISIONS: Added note 12 inch minimum around casting.

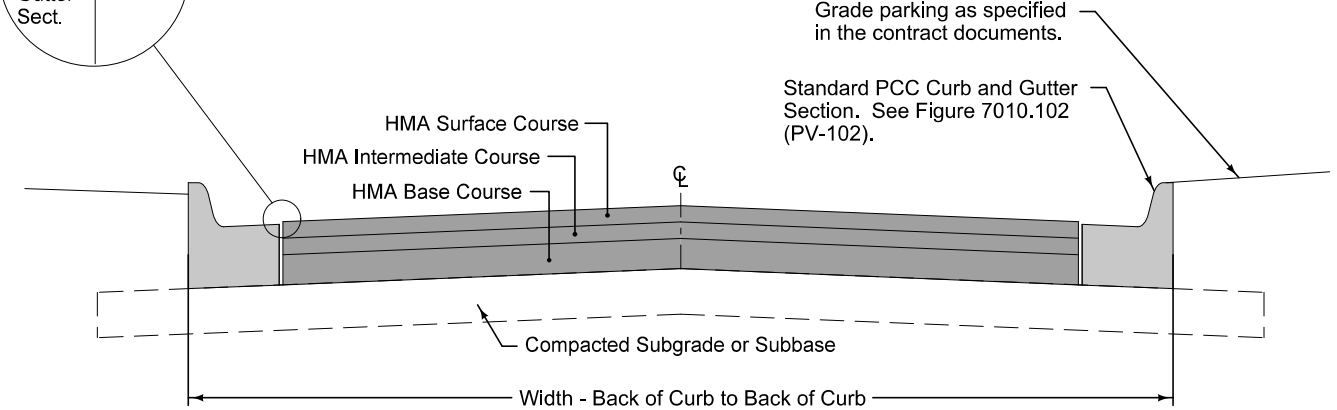
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

MANHOLE BOXOUTS IN HMA PAVEMENT AND HMA OVERLAYS



HMA PAVEMENT SECTION
(With Existing Curb and Gutter)





HMA PAVEMENT SECTION
(With New Curb and Gutter)

FIGURE 7020.901

SHEET 1 OF 2

SUDAS

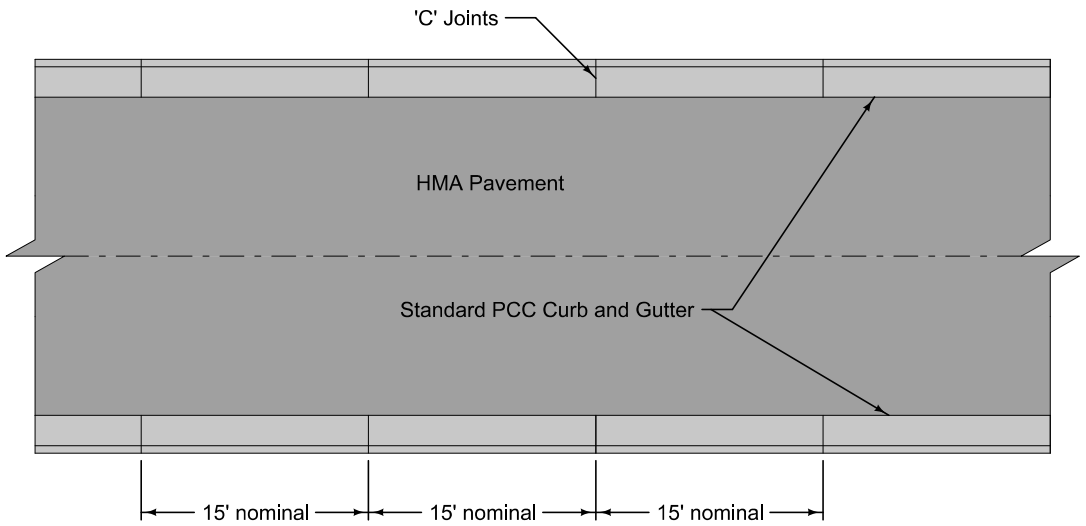
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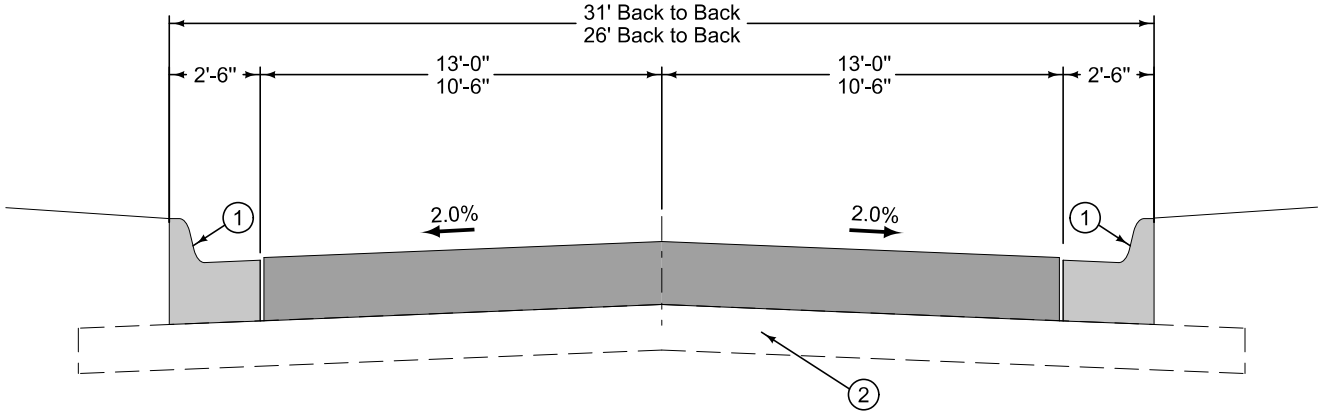
SHEET 1 of 2

SUDAS Standard Specifications

HMA PAVEMENT



1. 6 inch standard curb and gutter.
2. Subbase or subgrade as specified.



TYPICAL CROSS-SECTION

FIGURE 7020.901 | SHEET 2 OF 2

SUDAS

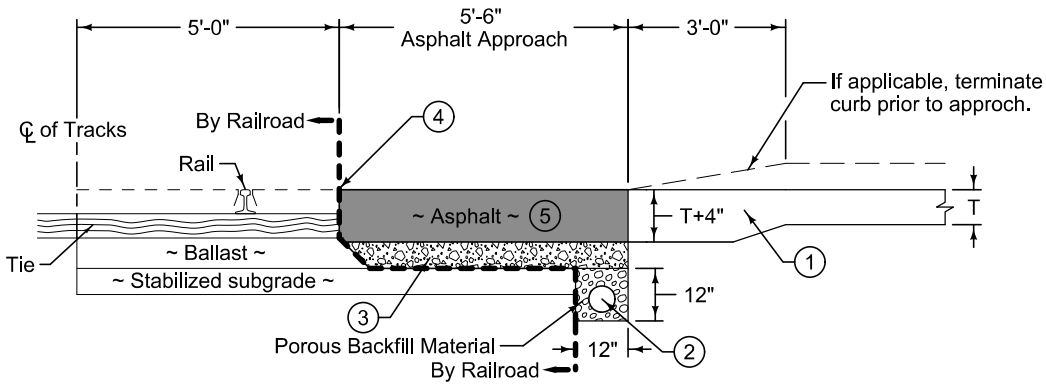
REVISION
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7020.901

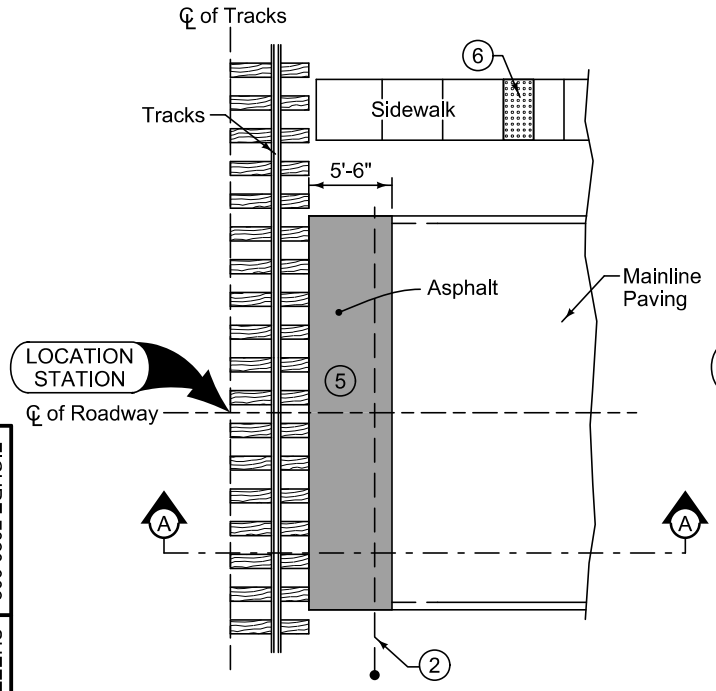
SHEET 2 of 2

SUDAS Standard Specifications

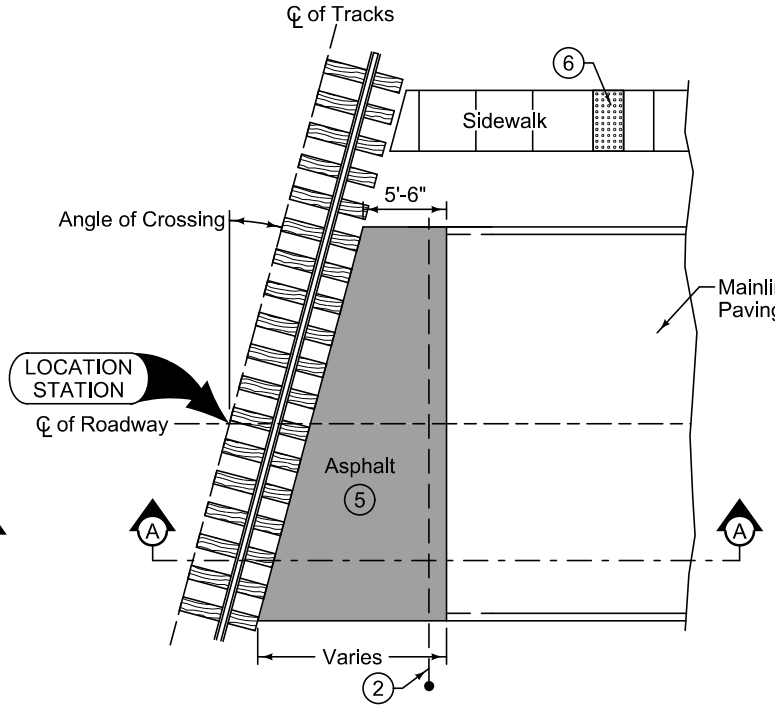
HMA PAVEMENT



SECTION A-A



PLAN VIEW - STRAIGHT CROSSING



PLAN VIEW - SKEWED CROSSING

1. Asphalt mainline paving.
2. Install 6 inch perforated CMP subdrain, if specified. Include rodent guard per Iowa DOT Materials I.M. 443.01.
3. Granular subbase, modified subbase, or ballast meeting railroad specifications.
4. For new crossings, construct pavement 1/2 inch to 1 inch below top of rail. For existing crossings, construct pavement level to 1/2 inch below top of rail.
5. Construct asphalt approach according to the requirements for full depth asphalt patching or the requirements for asphalt paving if constructed in conjunction with mainline asphalt.
6. Refer to Figure 7030.205 for detectable warning location.

FIGURE 7020.902

SHEET 1 OF 1

SUDAS

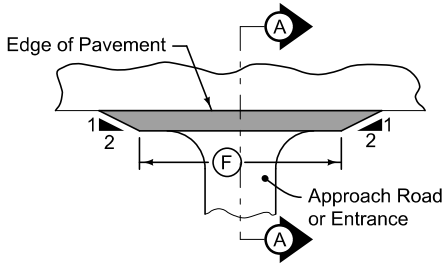
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7020.902

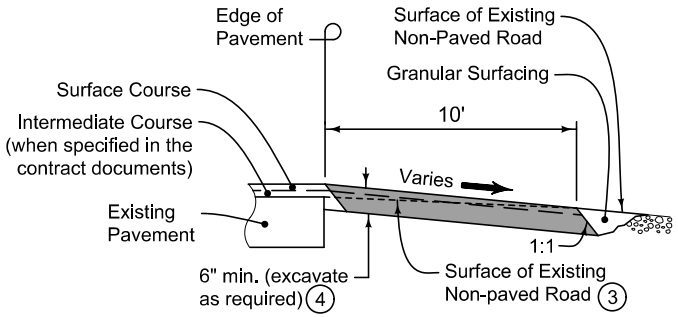
SHEET 1 of 1

SUDAS Standard Specifications

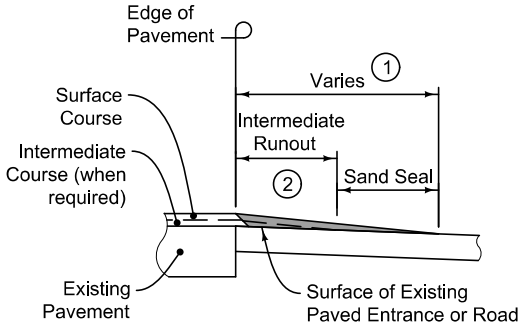
ASPHALT RAILROAD CROSSING APPROACH



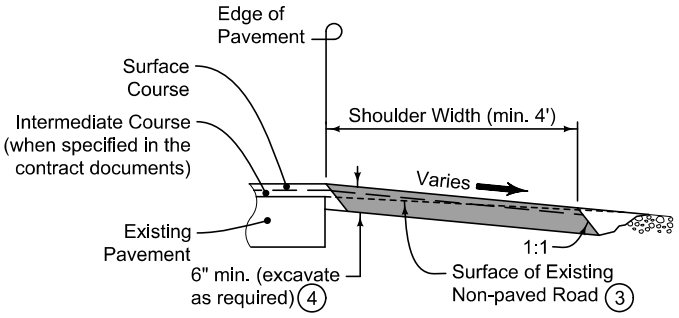
TYPICAL PLAN FOR FILLET AT ENTRANCE OR INTERSECTING ROAD



SECTION A-A
(Full Thickness Fillet - Non-paved Road)



SECTION A-A
(Wedge Shaped Fillet - Paved Entrance or Road)



SECTION A-A
(Full Thickness Fillet - Non-paved Entrance)

MINIMUM FILLET WIDTH		
TYPE OF ACCESS	PRIMARY ROADS (F) ft.	SECONDARY AND LOCAL ROADS (F) ft.
Residential Entrance	40	12
Farm Entrance	60	18
Commercial Entrance	80	24
Non-paved Road	100	30
Paved Road	Variable (5)	Variable (5)

For temporary runouts and wedges, place subgrade paper, burlap, or similar material over adjacent surfaces to facilitate removal. Construct temporary runout at a length of 10 feet for each 1 inch of resurfacing thickness.

Construct wedge shaped asphalt fillets at all paved entrances and paved roads. Construct full thickness fillets at all non-paved entrances and non-paved roads.

1. Width of fillet is 4 feet for each inch of overlay thickness.
2. The runout length of the intermediate course is equal to the total runout length, multiplied by the intermediate course thickness, divided by the total resurfacing thickness.
3. Excavate and shape road or entrance as required to accommodate proposed fillet.
4. For existing fillets at non-paved roads and entrances, construct a wedge shaped fillet matching the thickness of the resurfacing.
5. Match width and shape of existing pavement.

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7020.903

SHEET 1 of 1

SUDAS Standard Specifications

DETAILS FOR ASPHALT PAVING

FIGURE 7020.903

SHEET 1 OF 1

ASPHALT OVERLAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES

Asphalt Overlays

1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of asphalt overlay surface course placed upon an existing pavement.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants and Section 7020, 1.03.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants and Section 7020, 1.05.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as Section 7020, 1.06.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

Comply with Section 7020, 1.08, except as modified herein:

A. Asphalt Overlay by Ton:

1. **Measurement:** Measurement will be in tons of asphalt overlay.
2. **Payment:** Payment will be at the unit price per ton of asphalt overlay.
3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

B. Asphalt Overlay by Square Yards:

1. **Measurement:** Measurement will be in square yards for each different thickness of asphalt overlay. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. **Payment:** Payment will be at the unit price per square yard for each thickness of asphalt overlay.
3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat, construction zone protection, and quality control.

PART 2 - PRODUCTS

2.01 ASPHALT OVERLAY MATERIALS

Comply with Iowa DOT Section 2303, with the following exception:

Follow the procedure outlined in Iowa DOT Materials I.M. 510 for asphalt mixture designs, except replace Table 1 in Appendix A, Asphalt Mixture Design Criteria with the SUDAS Asphalt Mixture Design Criteria (Table 7020.01) (Tables 2 through 4 in Appendix A still apply).

2.02 WARM MIX ASPHALT MATERIALS

If use of warm mix asphalt (WMA) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

2.03 RECYCLED ASPHALT MATERIALS

When recycled asphalt materials (RAM) are used and they exceed 20% replacement of the total binder, the binder grades may need to be modified. Comply with Iowa DOT Materials I.M. 510.

A. Recycled Asphalt Pavement: If use of recycled asphalt pavement (RAP) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

B. Recycled Asphalt Shingles: If use of recycled asphalt shingles (RAS) is approved by the jurisdiction, comply with Iowa DOT Section 2303.

2.04 BINDER GRADES

A. Conventional Overlays: Use the specified binder grade.

B. Asphalt Interlayer: Use PG 58-34E meeting AASHTO T 321 with minimum 100,000 cycles to failure. Comply with Iowa DOT Materials I.M. 510A. Do not use RAP.

C. High Performance Thin Lift: Use PG 64-34E+ complying with requirements of PG 64-34E except that a minimum percent recovery of 90% when tested at 64°C per AASHTO T 350 at 3.2kPa is required. Comply with Iowa DOT I.M. 510A. Do not use RAS.

2.05 HIGH PERFORMANCE THIN LIFT

A. Mix Design:

Design Gyrations	50
Design Voids Target (based on %Gmm)	≤ 2.0
Film Thickness	8.0 to 15.0
Aggregate Quality	A
Minimum crushed content	50%
FAA minimum	40
Minimum sand equivalency	50
Friction Aggregate	Minimum 50% Type 4 or better

B. Replacement: Do not use more than 15% binder replacement. Do not use RAS.

2.05 HIGH PERFORMANCE THIN LIFT (CONTINUED)

C. Gradation:

Sieve Size	Minimum Percent Passing	Maximum Percent Passing
1 1/2”		
1”		
3/8”	91	100
No. 4		90
No. 8	27	63
No. 16		
No. 30		
No. 50		
No. 100		
No. 200	2	10

2.06 NOMINAL AGGREGATE SIZE FOR ASPHALT OVERLAYS

Nominal aggregate size dictates lift thickness. Minimum lift thickness should be at least 3 times the nominal maximum aggregate size to ensure aggregate can be aligned during compaction to achieve required density. Therefore, desired lift thickness can direct the decision on nominal aggregate size to use.

PART 3 - EXECUTION

3.01 ASPHALT OVERLAY

Comply with Section 7020, Iowa DOT Section 2303, Section 7040, and the following:

A. Preparation of Existing Pavement:

1. Remove pavement by milling as required by the contract documents. Mill to the depth, cross-section, or profile specified.

2. Sweep existing pavement with approved broom. Provide dust control during brooming.

3. If milling is not required, correct irregularities in existing pavement cross slope with partial patching, full-depth patching, and leveling base coat prior to placing the overlay. Use base or intermediate course mixes to correct irregularities. Surface course thickness per plan.

B. Special Requirements for Thin Lift Overlays and Asphalt Interlayer:

1. Apply tack coat prior to placement of thin lift overlay and asphalt interlayer. Comply with Section 7020.

2. Keep the production temperature of asphalt mixtures between 225°F and 335°F until placed on the grade.

3. Compact with static steel wheel roller.

4. Do not open to traffic until the entire mat has cooled below 150°F.

3.02 PROTECTION FROM TRAFFIC

Comply with Section 7020, 3.03.

3.03 DEFECTS OR DEFICIENCIES

Comply with Section 7020, 3.04.

3.04 PAVEMENT SMOOTHNESS

Comply with Section 7020, 3.05.

3.05 QUALITY CONTROL

A. General: Comply with Section 7020, 3.06.

B. Special Requirements for Thin Lift Overlays and Asphalt Interlayer:

1. Complete field voids for Class II compaction as defined in Iowa DOT Section 2303.

2. Sample and test from windrow or hopper. Apply Iowa DOT Article 2303.05, A, 3 for AAD acceptance. Air void target is based on approved JMF.

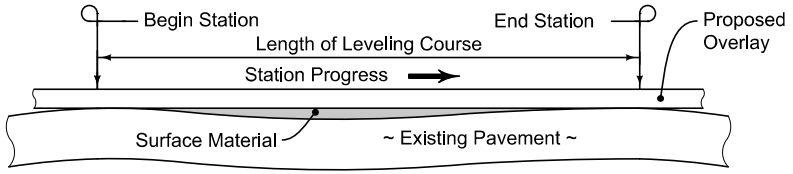
3. Take at least one cold feed each day for gradation control.

3.06 REMOVAL OF PAVEMENT

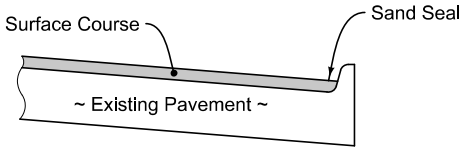
Comply with Section 7040.

END OF SECTION

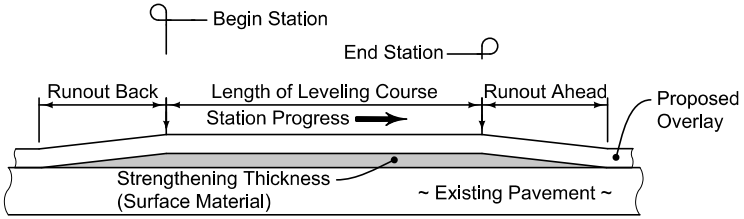
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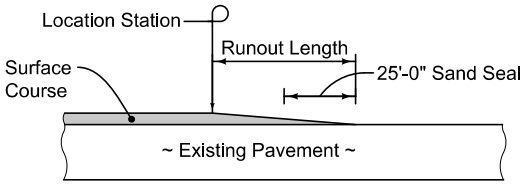
TYPICAL LEVELING COURSE



GUTTERLINE EDGE - MATCH

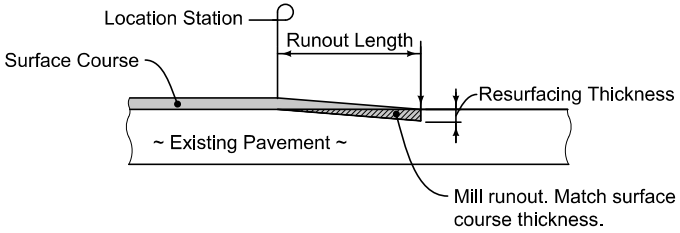


TYPICAL STRENGTHENING COURSE

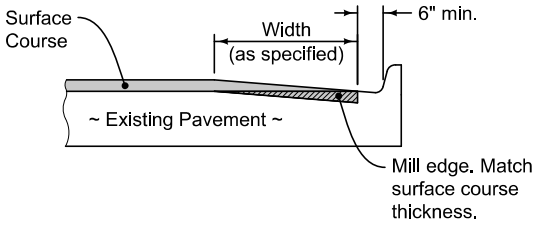


WEDGE SHAPED RUNOUT
(When Milling is not Specified)

RUNOUT LENGTH	
POSTED SPEED LIMIT (mph)	RUNOUT RATIO (ft. per inch)
45 or More	50
20 to 45	25



MILLED SURFACE NOTCH FOR RUNOUT



GUTTERLINE EDGE - NOTCH

SINGLE COURSE RESURFACING

FIGURE 7021.101

SHEET 1 OF 2

SUDAS

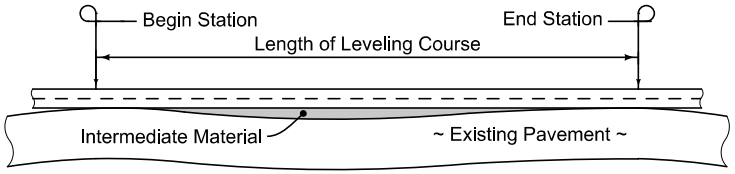
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7021.101

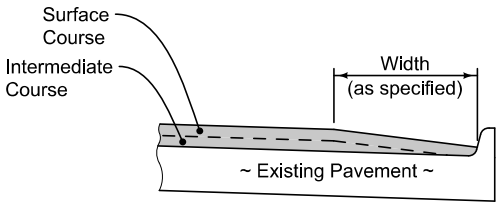
SHEET 1 of 2

SUDAS Standard Specifications

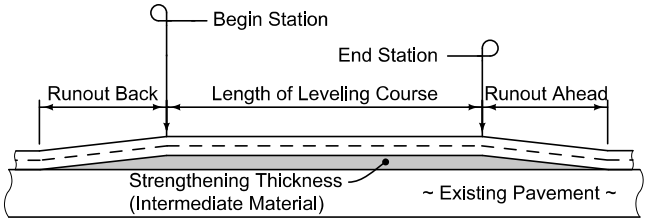
DETAILS FOR ASPHALT RESURFACING



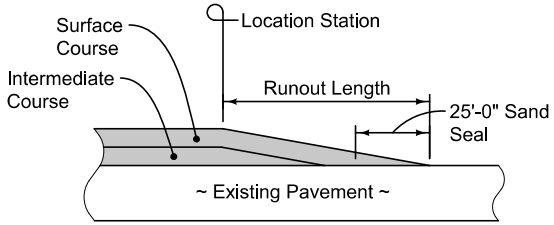
TYPICAL LEVELING COURSE



GUTTERLINE EDGE - MATCH

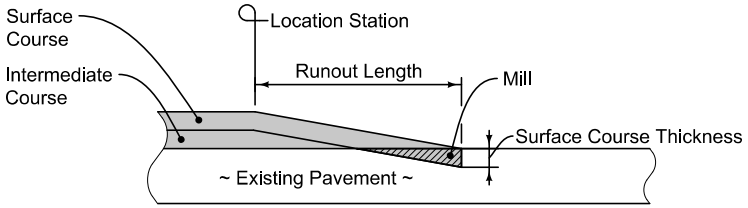


TYPICAL STRENGTHENING COURSE

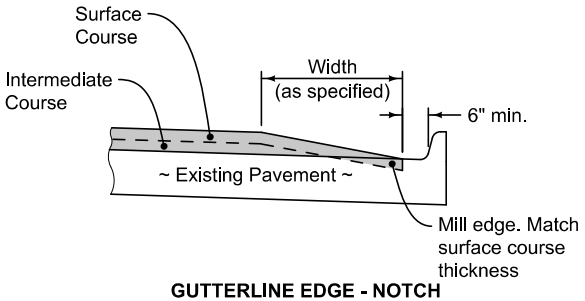


WEDGE SHAPED RUNOUT
(When Milling is not Specified)

RUNOUT LENGTH	
POSTED SPEED LIMIT (mph)	RUNOUT RATIO (ft. per inch)
45 or More	50
20 to 45	25



MILLED SURFACE NOTCH RUNOUT



GUTTERLINE EDGE - NOTCH

DOUBLE COURSE RESURFACING

FIGURE 7021.101 SHEET 2 OF 2

SUDAS

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7021.101

SHEET 2 of 2

SUDAS Standard Specifications

DETAILS FOR ASPHALT RESURFACING

SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of Sidewalks, Shared Use Paths, and Driveways

B. Installation of Sidewalks, Shared Use Paths, and Driveways

1.02 DESCRIPTION OF WORK

A. Remove existing sidewalks, shared use paths, and driveways.

B. Install shared use paths.

C. Install sidewalk.

D. Install driveway.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. PCC mix design.

B. Asphalt mix design.

C. Brick source, absorption, compressive strength; samples of brick showing texture and color.

D. Submit type and color of detectable warnings.

E. Results of required testing.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Portland Cement Concrete: See Section 7010.

B. Asphalt: See Section 7020.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Removal of Sidewalk, Shared Use Path, or Driveway:

1. **Removal of Sidewalk:**
   a. **Measurement:** Measurement will be in square yards for the area of sidewalk removed.
   b. **Payment:** Payment will be at the unit price per square yard for the area of sidewalk removal.
   c. **Includes:** Unit price includes, but is not limited to, sawing, hauling, and disposal of materials removed.

2. **Removal of Shared Use Path:**
   a. **Measurement:** Measurement will be in square yards for the area of shared use path removed.
   b. **Payment:** Payment will be at the unit price per square yard for the area of shared use path removal.
   c. **Includes:** Unit price includes, but is not limited to, sawing, hauling, and disposal of materials removed.

3. **Removal of Driveway:**
   a. **Measurement:** Measurement will be in square yards for the area of driveway removed.
   b. **Payment:** Payment will be at the unit price per square yard for the area of driveway removal.
   c. **Includes:** Unit price includes, but is not limited to, sawing, hauling, and disposal of materials removed.

B. Removal of Curb:

1. **Measurement:** Measurement will be in linear feet for removal of curb by grinding or sawing, measured along the back of curb.

2. **Payment:** Payment will be at the unit price per linear foot for the removal of curb.

3. **Includes:** Unit price includes, but is not limited to, hauling and disposal of materials removed.

C. Shared Use Paths:

1. **Measurement:** Each type and thickness of shared use paths will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each type and thickness of shared use path.

3. **Includes:** Unit price includes, but is not limited to, subgrade preparation, jointing, sampling, slope and smoothness testing and correction, and testing.

D. Special Subgrade Preparation for Shared Use Paths:

1. **Measurement:** Measurement will be in square yards for special subgrade preparation. Measured area will include 2 feet outside of the pavement on either side of the path.

2. **Payment:** Payment will be at the unit price per square yard for the area of special subgrade preparation.

3. **Includes:** Unit price includes, but is not limited to, water required to bring subgrade moisture content to within the required limits.

1.08 MEASUREMENT AND PAYMENT (Continued)

E. PCC Sidewalk:

1. **Measurement:** Each thickness of PCC sidewalk will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of PCC sidewalk.

3. **Includes:** Unit price includes, but is not limited to, minor grade adjustments at driveways and other intersections, subgrade preparation, formwork, additional thickness at thickened edges, jointing, sampling, slope and smoothness testing and correction, and testing.

F. Brick/Paver Sidewalk with Pavement Base:

1. **Measurement:** Measurement will be in square yards for the area of brick/paver sidewalk placed on a pavement base. The area of pavement base will not be measured separately.

2. **Payment:** Payment will be at the unit price per square yard for the area of brick/paver sidewalk.

3. **Includes:** Unit price includes, but is not limited to, subgrade preparation, pavement base, setting bed, neoprene asphalt adhesive for asphalt setting bed, setting the bricks/pavers, installing weep holes and associated materials, and sand/cement joint filler.

G. Detectable Warnings:

1. **Measurement:** Measurement will be in square feet for the area of detectable warnings installed. Paved area beneath detectable warnings will be measured with sidewalk or shared use path item.

2. **Payment:** Payment will be at the unit price per square foot for the area of detectable warnings installed.

3. **Includes:** Unit price includes, but is not limited to, steel bar supports and manufactured detectable warning panels.

H. Driveways:

1. **Paved Driveways:**
   a. **Measurement:** Each type and thickness will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
   b. **Payment:** Payment will be at the unit price for each type and thickness of driveway.
   c. **Includes:** Unit price includes, but is not limited to, excavation, subgrade preparation, jointing, sampling, and testing.

2. **Granular Surfacing for Driveways by Square Yards:**
   a. **Measurement:** Measurement will be in square yards for the thickness of granular surfacing placed.
   b. **Payment:** Payment will be at the unit price per square yard for each thickness of granular surfacing placed.
   c. **Includes:** Unit price includes, but is not limited to, excavation and preparation of subgrade.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. Granular Surfacing for Driveways by Tons:

a. Measurement: Measurement will be in tons for the thickness of granular surfacing placed.

b. Payment: Payment will be at the unit price per ton for each thickness of granular surfacing placed.

c. Includes: Unit price includes, but is not limited to, excavation and preparation of subgrade.

I. Sidewalk, Shared Use Path, and Driveway Assurance Testing:

1. Sidewalk Assurance Testing:

a. The Contractor will not be responsible for concrete compression or asphalt density testing unless otherwise specified in the contract documents.

b. If the contract documents specify that the Contractor is responsible for concrete compression and asphalt density testing, performed by an independent testing laboratory hired by the Contractor, measurement and payment will be as follows:

1) Measurement: Lump sum item; no measurement will be made.

2) Payment: Payment will be at the contract lump sum price.

c. The Contractor will be responsible for payments associated with all retesting resulting from failure of initial tests.

2. Shared Use Path Assurance Testing:

a. The Contractor will not be responsible for concrete compression or asphalt density testing unless otherwise specified in the contract documents.

b. If the contract documents specify that the Contractor is responsible for concrete compression and asphalt density testing, performed by an independent testing laboratory hired by the Contractor, measurement and payment will be as follows:

1) Measurement: Lump sum item; no measurement will be made.

2) Payment: Payment will be at the contract lump sum price.

c. The Contractor will be responsible for payments associated with all retesting resulting from failure of initial tests.

3. Driveway Assurance Testing:

a. The Contractor will not be responsible for concrete compression or asphalt density testing unless otherwise specified in the contract documents.

b. If the contract documents specify that the Contractor is responsible for concrete compression and asphalt density testing, performed by an independent testing laboratory hired by the Contractor, measurement and payment will be as follows:

1) Measurement: Lump sum item; no measurement will be made.

2) Payment: Payment will be at the contract lump sum price.

c. The Contractor will be responsible for payments associated with all retesting resulting from failure of initial tests.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT CONCRETE

A. Use Class A or C concrete for sidewalks and driveways and Class C for shared use paths with materials complying with Section 7010. Use coarse aggregate of Class 2 durability or better.

B. Comply with the following for PCC mixes for sidewalks, shared use paths, and driveways unless otherwise approved by the Engineer.

Table 7030.01: PCC Mixes

	Machine Finish	Hand Finish
Type of Concrete	Class A or C	Class A or C
Slump Minimum	1/2 in.	1/2 in.
Slump Maximum	2 1/2 in.	4 in.
Percent Air Content		
• Target	7%	7%
• Minimum	6%	6%
• Maximum	8 1/2%	8 1/2%

2.02 ASPHALT

Comply with Section 7020 for mix design.

A. Use Low Traffic (LT), 1/2 inch or 3/8 inch mix.

B. For shared use paths adjacent to pavement that also functions as the pavement shoulder, use Low Traffic (LT), 1/2 inch mix.

C. Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28S or 58-34S.

2.03 BRICKS/PAVERS

A. Clay Bricks: Use 8 inch by 4 inch by 2 1/4 inch thick clay paving bricks with straight edges or a maximum chamfer of 1/8 inch manufactured to comply with ASTM C 902, Class SX, Type I. Color selection and surface texture as approved by the Engineer.

B. Concrete Pavers: Supply as specified in the contract documents. Use pavers with straight edges or a maximum chamfer of 1/8 inch.

2.04 SETTING BED FOR BRICKS/PAVERS

A. Asphalt:

1. Mixture: Proportion mix using 7% asphalt binder and 93% fine aggregate. Apportion each ton in the approximate ratio of 145 pounds asphalt binder to 1,855 pounds sand. Maintain mix temperature at approximately 250°F during placement.

2. Asphalt Binder: Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28 or 64-22.

3. Fine Aggregate: Use clean, hard sand with durable particles free from adherent coating, lumps of clay, alkali salts, and organic matter. Use sand that is uniformly graded from coarse to fine with all passing the No. 4 sieve and meeting AASHTO T 27.

2.04 SETTING BED FOR BRICKS/PAVERS (CONTINUED)

B. Pre-mixed High Performance Cold Mix: If allowed, substitute a pre-mixed high performance cold mix product for the asphalt setting bed generally meeting the asphalt mixture requirements noted above.

C. Sand: Use clean, hand sand free from deleterious materials. Use sand meeting ASTM C 33 that is uniformly graded with all passing the No. 4 sieve and 3% or less passing the No. 200 sieve.

2.05 NEOPRENE MODIFIED ASPHALT ADHESIVE FOR BRICKS/PAVERS

A. Mastic (Asphalt Adhesive):

Solids (Base):	74% to 76%
Pounds per Gallon:	8 to 8 1/2 pounds
Solvent:	Mineral spirits with a flash point above 100° F

B. Base (2% Neoprene, 10% Asbestos-free Fiber, 88% Asphalt):

Melting Point:	200° F minimum according to ASTM D 36
Penetration:	23 to 27 according to ASTM D 5
Ductility:	1250 mm minimum according to ASTM D 113 @ 25° C, and a rate of 50 mm/minute

2.06 BRICK/PAVER JOINT FILLER

Dry sand-cement mixture consisting of one part masonry cement complying with ASTM C 91 and three parts sand complying with ASTM C 144 and passing the No. 16 sieve. Provide colored cement as specified in the contract documents.

2.07 DETECTABLE WARNINGS

Use manufactured detectable warning panels with a non-slip surface and raised truncated domes. Comply with the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (also known as PROWAG) for contrast and dimension requirements. Also comply with Iowa DOT Materials I.M. 411.

2.08 GRANULAR DRIVEWAY SURFACING

Class A crushed stone or Class C gravel complying with Iowa DOT Section 2315.

2.09 ISOLATION AND EXPANSION JOINT SEALANT

Use a polyurethane, self-leveling sealant complying with ASTM C 920. Application temperature range of 40 to 120°F. Minimum elongation 700%.

PART 3 - EXECUTION

3.01 REMOVALS

A. Remove sidewalks, shared use paths, driveways, bricks, and curbs to the removal limits specified in the contract documents.

B. Saw pavement full depth in straight lines to the specified removal limits.

C. Remove to the specified removal limits without damage to adjacent property, trees, utilities, or pavement that are to remain in place.

D. Salvage and stockpile all bricks removed.

E. Grind or saw existing curbs at locations specified in the contract documents to install sidewalks, shared use paths, and driveways.

F. Dispose of rubble and debris resulting from removal operations.

3.02 SUBGRADE PREPARATION

A. Shared Use Paths:

1. Subgrade Preparation: Comply with Iowa DOT Section 2109.

2. Special Subgrade Preparation:
a. Construct subgrade to final elevation.
b. Scarify and mix the top 6 inches of subgrade material to a width equal to that of the proposed pavement, plus 2 feet on each side.
c. Compact loose subgrade material with Type A compaction complying with Section 2010.
d. Proof roll compacted subgrade according to Section 2010.

B. Sidewalks and Driveways:

1. Remove all vegetation and roots from ground surface.

2. Construct grade to final subgrade elevation.
a. Cut area: Remove all material that will be displaced by the sidewalk.
b. Fill area: Scarify the surface to be covered with embankment to a depth of at least 6 inches and compact. Construct embankment in lifts of 6 inches or less and compact each lift. Tamp surface with a mechanical tamper until firm and unyielding.

3. Remove all soft, spongy, or yielding spots and fill the void with suitable backfill material.

3.03 ADJUSTMENT OF FIXTURES

A. Adjust fixtures to conform to the finished pavement surface. Cooperate and coordinate with the utility agency to ensure proper fixture adjustment.

B. Comply with Sections 5020, 6010, or 8010 as appropriate.

3.04 PCC SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS

Construct sidewalks and shared use paths to the line and running slope specified in the contract documents. Unless otherwise specified in the contract documents, the maximum cross slope is 2.0%, target cross slope is 1.5%, and minimum cross slope is 1.0%.

A. Form Setting: Comply with Section 7010 with the following additional requirements and exceptions.

1. Slip form paving equipment may be allowed in lieu of setting forms, if approved by the Engineer.

2. Wood forms are allowed.

3. Use of an automated subgrade trimmer is not required.

4. Set forms true to line and grade and hold them rigidly in place by stakes placed outside the forms and flush with or below the top edge of the forms.

5. Measure or stake as required to construct project elements. If either of the following is met and construction survey is not a bid item, the Contracting Authority will verify that form work complies with the design requirements:
   a. The tolerance between the design running slope and the maximum allowable running slope is less than 1.0%.
   b. The tolerance between the design cross slope of the sidewalk, turning space, or shared use path and the maximum allowable cross slope is less than 0.5%.

   If adequate tolerances are contained in the design, the Contracting Authority will not verify the form work for the construction of sidewalks or shared use paths. If field adjustments cause changes that will bring the facility into the range of tolerances shown above, notify the Engineer prior to construction.

B. Concrete Pavement Placement:

1. Shared Use Paths: Comply with Section 7010.

2. Sidewalk:
   a. Maintain moist subgrade in front of paving operation
   b. Deposit concrete on the subgrade as required to minimize rehandling to prevent segregation.
   c. Hand spread with shovels, not rakes.
   d. Place concrete as required to slightly overfill the space between the forms.
   e. For thicknesses less than 5 inches, consolidate by knifing with hand tools. When thickness is 5 inches or greater, consolidate with hand or mechanical vibrators meeting Section 7010, 3.01, C, 3. Smooth by use of a straightedge.
   f. Do not contaminate freshly mixed concrete with earth or other foreign materials.

3. Driveways: Comply with Figures 7030.101 and 7030.102 and Section 7010. The use of a paving machine is not required.

C. Finishing:

1. Shared Use Paths and Driveways:
   a. Comply with Section 7010.
   b. Provide a burlap drag or broom finish.

3.04 PCC SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS (Continued)

2. Sidewalks:
a. Use a wood float to depress the large aggregate and create a dense surface.
b. Allow concrete to set until all shine has disappeared from the surface.
c. Smooth with a metal trowel until surface is free from defects and blemishes.
d. Construct joints by sawing or by using a jointer or groover tool.
e. Finish edges of sidewalk or driveway with an edging tool having a radius of approximately 1/2 inch. Ensure tool marks do not appear on the finished surface.
f. Brush with a soft broom at right angles to the side forms to provide a non-skid surface.

D. Curing: Cure according to Section 7010.

E. Form Removal: Comply with Section 7010.

F. Jointing:

1. Construction Joints:
a. Locate construction joints to provide uniform joint spacing.
b. Place a construction joint at the close of each day's work or when depositing of concrete is stopped for 45 minutes or more.
c. Form construction joint by using a header board. Set perpendicular to the surface and at right angles to the centerline.

2. Transverse Contraction Joints:
a. Shared Use Paths:
1) Space transverse joints equal to the width of the shared use path, or as specified in the contract documents.
2) Saw contraction joints according to Section 7010.
b. Sidewalks and Driveways:
1) Space sidewalk contraction joints equal to the width of the sidewalk.
2) Space driveway contraction joints so panel length does not exceed 12 feet.
3) Form transverse contraction joints to a depth of 1 1/4 inches with a pointed trowel or jointing tool. In lieu of forming, joints may be sawed within 12 hours of placement with a 1/8 inch blade saw to a depth of 1/3 the pavement thickness. Use a straightedge if joints are sawed with a hand-held saw.

3. Longitudinal Contraction Joints:
a. Shared Use Paths and Sidewalks: Saw joint to 1/8 inch wide and to a depth of 1/3 the pavement thickness.
b. Driveways:
1) Space longitudinal contraction joints so panel width does not exceed 12 feet.
2) Form longitudinal contraction joints to a depth of 1 1/4 inches with a pointed trowel or jointing tool. In lieu of forming, joints may be sawed with a 1/8 inch blade saw to a depth of 1/3 the pavement thickness. Use a straightedge if joints are sawed with a hand-held saw.

4. Isolation Joints:
a. Install isolation joints where sidewalks, shared use paths, or driveways abut roadway pavement, parking lots, buildings, and structures.
b. For a sidewalk constructed with a driveway, install an isolation joint on the property side of the sidewalk and a 'C' or 'E' joint on the street side of the sidewalk.
c. Install a 1/2 inch or 3/4 inch thick strip of preformed resilient joint material, according to Section 7010, to the full depth of concrete. Trim any isolation joint material protruding above the finished work to the level of the abutting concrete.
d. If the isolation joint is to be sealed, place the preformed material 1/2 inch below the level of the abutting concrete.

3.04 PCC SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS (Continued)

5. Joint Sealing:

a. Do not seal construction or contraction joints in sidewalks, shared use paths, or driveways.

b. If sealing of expansion or isolation joints is specified in the contract documents, trim preformed joint material to a depth of 1/2 inch below the concrete surface. Ensure the joint is clean and dry. Install joint sealant per manufacturer's recommendations.

3.05 ASPHALT SHARED USE PATHS AND DRIVEWAYS

Construct sidewalks and shared use paths to the line and running slope specified in the contract documents. Unless otherwise specified in the contract documents, the maximum cross slope is 2.0%, target cross slope is 1.5%, and minimum cross slope is 1.0%. Comply with Section 7020.

3.06 BRICK/PAVER SIDEWALKS WITH A PAVEMENT BASE

A. General:

1. Comply with Figure 7030.203.

2. Use a cross-section and patterns as specified in the contract documents or approved by the Engineer.

3. Do not use broken bricks or materials with stained faces in the paving areas.

4. Construct the concrete base to comply with PCC sidewalk construction specifications.

B. Setting Bed:

1. Place 3/4 inch depth control bars on the base to serve as guides for the striking board. Shim depth control bars as necessary to adjust bedding thickness and to ensure the top surface of pavers will be at the required finished grade.

2. Place bedding material between the parallel depth control bars. Pull striking board over bars several times. After each pass, spread fresh bedding material over low or porous spots to produce a smooth and even setting bed. After placing and smoothing each section, advance depth control bars to next section. After removal of depth control bars and shims, carefully fill any depressions that remain.

3. While still hot, roll the asphalt setting bed with a power roller to a nominal depth of 3/4 inch.

4. Ensure the joints in the concrete base do not project through the asphalt setting bed.

5. Apply neoprene modified asphalt adhesive over the top surface of the cooled asphalt setting bed with notched trowel with serration not exceeding 1/16 inch. Allow adhesive to dry to the touch before placing pavers.

C. Weep Holes:

1. Install 2 inch diameter, 12 inch long, PVC pipe even with the top of the asphalt setting bed at the locations identified on the plans.

2. Fill pipe with 3/4 inch clean rock and cover weep hole with engineering fabric.

3. Install minimum of 12 inch deep and 12 inch wide reservoir of clean 3/4 inch rock around the pipe below the PCC sidewalk base or extend the rock reservoir to the pavement subdrain.

3.06 BRICK/PAVER SIDEWALKS WITH A PAVEMENT BASE (Continued)

D. Bricks/Pavers:

1. Place the bricks/pavers by hand in straight courses with hand tight joints and uniform top surface.

2. Sweep dry joint filler into joints until the joints are completely filled.

3. Fog surface lightly with water to cure cement.

4. Clean any cement stains from bricks/pavers surface. Remove stains from other concrete surfaces.

E. Protection: Protect newly laid bricks/pavers at all times using panels of plywood. Panels can be advanced as work progresses; however, keep the plywood protection in areas that will be subjected to movement of materials, workers, and equipment. Take precautions in order to avoid depressions and protect brick/paver alignment until cured and ready for pedestrian or vehicle traffic.

3.07 DETECTABLE WARNING INSTALLATION

Set detectable warning panels in fresh concrete according to the manufacturer's recommendations and Figure 7030.210.

3.08 SLOPE AND SMOOTHNESS TESTING

A. Slope for Sidewalks, Curb Ramps, Turning Spaces, and Shared Use Paths:

1. Complete slope measurements and documentation according to Iowa DOT Materials I.M. 363.

2. At no additional cost to the Contracting Authority, remove and replace all sections not meeting PROWAG requirements as detailed on Figure 7030.204.

B. Smoothness for Shared Use Paths and Driveways:

1. Check finished surface with a 10 foot straightedge placed parallel to the centerline. Mark areas showing high spots of more than 1/4 of an inch in 10 feet.

2. If directed by the Engineer, correct marked areas by grinding down with an approved grinding tool to an elevation where the area will not show deviations in excess of 1/8 inch.

3.09 GRANULAR DRIVEWAY SURFACING

Comply with Iowa DOT Section 2315.

3.10 CLEANING

A. Remove all litter and construction materials or tools immediately after the end of the curing period.

B. Remove excess dirt from the site.

C. Broom clean completed sidewalks, shared use paths, and driveways.

3.11 MATERIAL TESTING

A. General: When testing is specified in the contract documents as the Contractor's responsibility, provide testing using the services of an independent testing laboratory approved by the Engineer.

B. Concrete Compression Tests: When the concrete volume placed on a single day exceeds 20 cubic yards, comply with the following test requirements. When deficiencies are encountered, comply with Section 7010, 3.07, E.

1. Prepare at least two test cylinders per day.

2. If the concrete volume placed on a single day exceeds 200 cubic yards, prepare two test cylinders for each 200 cubic yards placed.

3. Provide 7 and 28 calendar day tests according to ASTM C 39. Minimum compressive strength is 2,000 psi at 7 days and 4,000 psi at 28 days.

C. Asphalt Density and Thickness Tests: When the area of asphalt placed on a single day exceeds 100 square yards, comply with the following test requirement. When deficiencies are encountered, comply with Section 7020, 3.04, A.

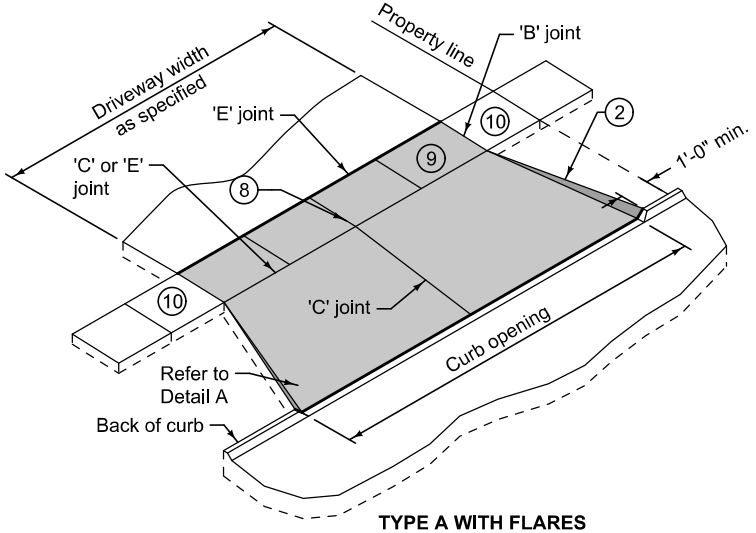
1. Prepare at least two cores per day.

2. If the area of asphalt placed on a single day exceeds 2,000 square yards, prepare two cores for each 2,000 square yards placed.

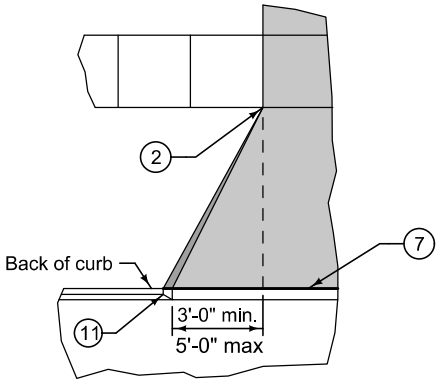
3.12 SIDEWALK AND CURB RAMP COMPLIANCE

Compliance with cross slopes and grades, as well as all other elements, for sidewalks and curb ramps is crucial. If the construction cannot be completed as specified in the contract documents, it may be necessary to adjust slopes within the accepted legal limitations. Contact the Engineer prior to placement of the concrete if changes from the values specified in the contract documents are being made.

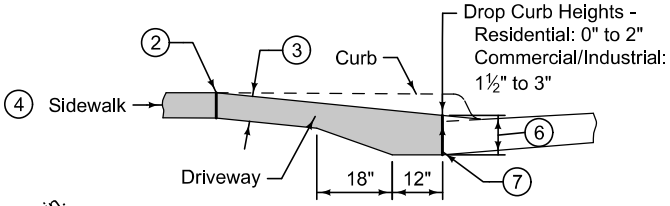
END OF SECTION



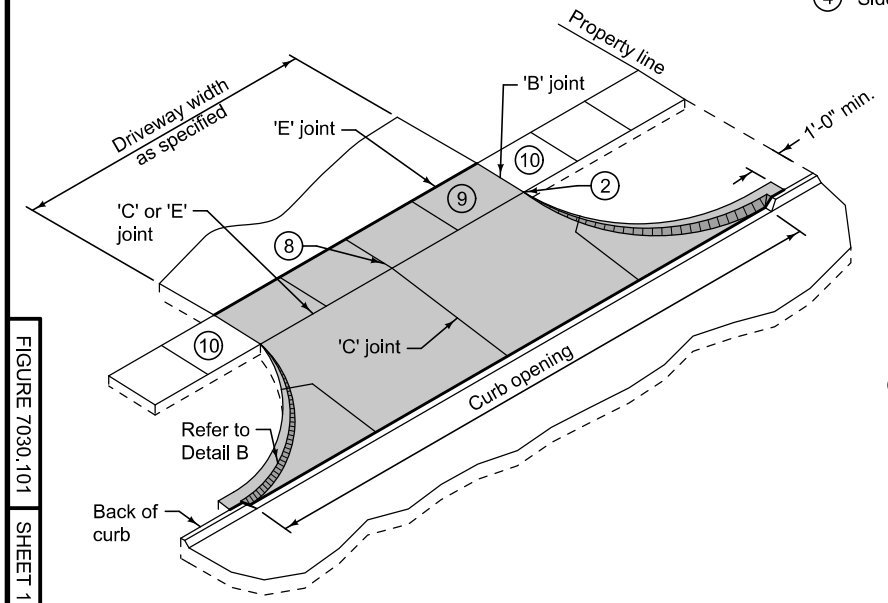
TYPE A WITH FLARES



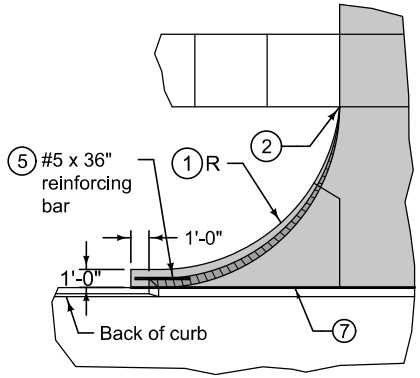
DETAIL A
(Residential/Agricultural Only)



TYPICAL SECTION



TYPE A WITH RADII



DETAIL B

1. Driveway radius (R).
   Residential: 10 foot minimum,15 foot maximum.
   Commercial and industrial: As specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb across sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. Center reinforcing bar vertically in the pavement.
6. Match thickness of adjacent roadway, 8 inches minimum.
7. Provide 'E' joint at back of curb unless 'B' joint is specified.
8. For alleys, invert the pavement crown 2% toward center of alley.
9. Target cross slope of 1.5% with a maximum cross slope of 2.0%. If specified in the contract documents, construct the sidewalk through the driveway 5 feet wide to serve as a passing space.
10. If cross slope of adjacent sidewalk panel exceeds 2.0%, remove and replace to transition from existing sidewalk to sidewalk through driveway. If elevation change requires a curb ramp, comply with Figure 7030.205; verify need for detectable warning panel with Engineer.
11. Transition street curb at minimum 1:1 slope to meet driveway curb.

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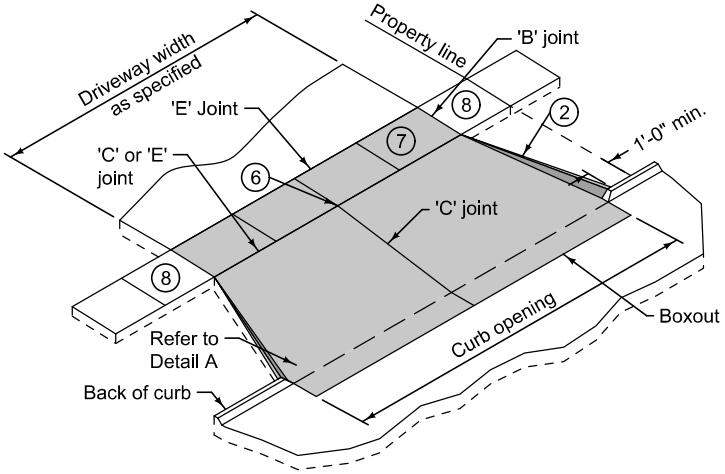
7030.101

SHEET 1 of 1

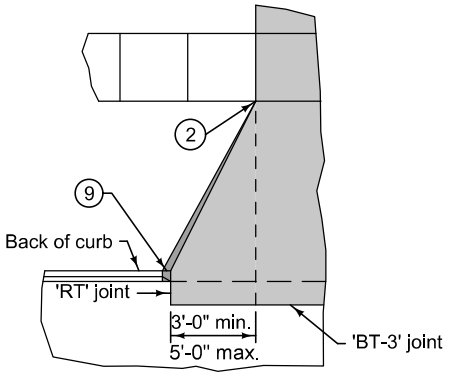
SUDAS Standard Specifications

CONCRETE DRIVEWAY, TYPE A

FIGURE 7030.101 | SHEET 1 OF 1

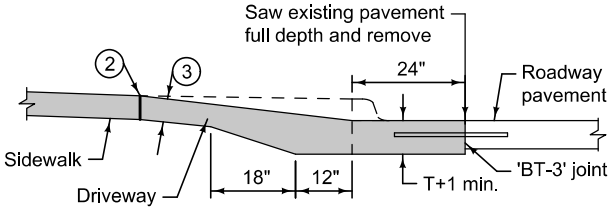


TYPE B WITH FLARES

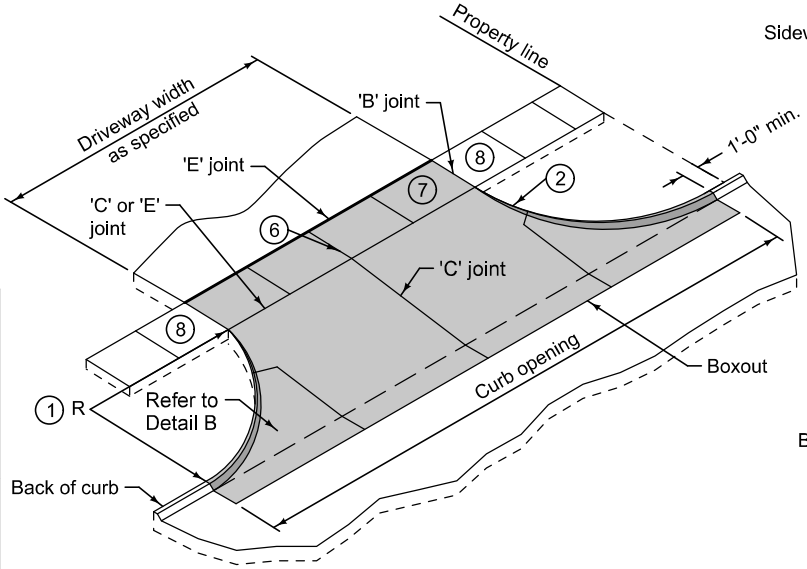


DETAIL A

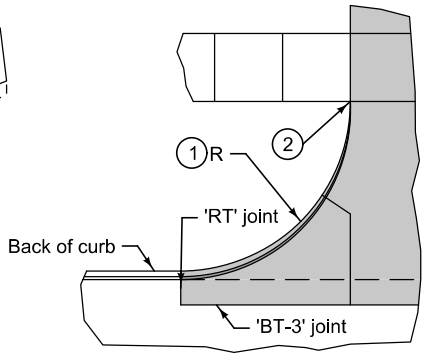
(Residential/Agricultural Only)



SECTION A-A



TYPE B WITH RADII



DETAIL B

1. Driveway radius (R).
   Residential: 10 foot minimum, 15 foot maximum.
   Commercial and industrial: As specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb cross sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. If longitudinal joint is located 48 inches or less from the back of curb, extend boxout to joint line. Full depth saw cut is still required.
6. For alleys, invert the pavement crown 2% toward the center of the alley.
7. Target cross slope of 1.5% with a maximum cross slope of 2.0%. If specified in the contract documents, construct the sidewalk through the driveway 5 feet wide to serve as a passing space.
8. If cross slope of adjacent sidewalk panel exceeds 2.0%, remove and replace to transition from existing sidewalk to sidewalk through driveway. If the elevation change requires a curb ramp, comply with Figure 7030.205; verify need for detectable warning panel with Engineer.
9. Transition street curb at minimum 1:1 slope to meet driveway curb.

FIGURE 7030.102

SHEET 1 OF 1

SUDAS

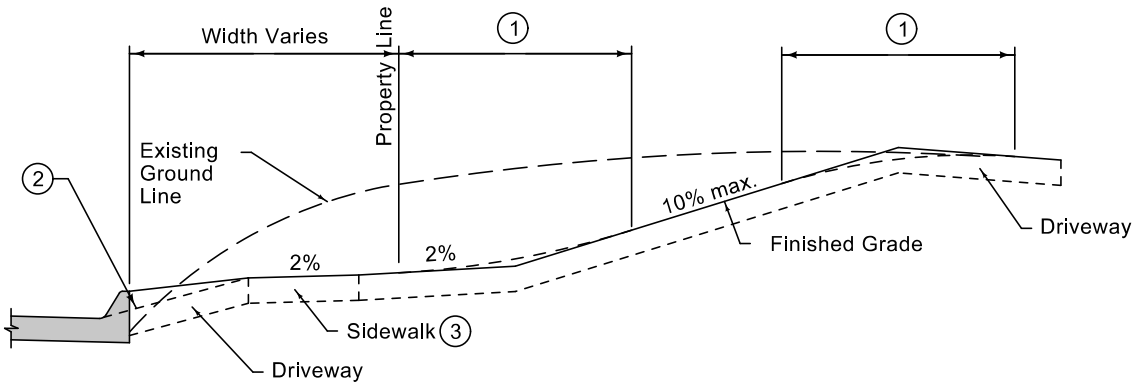
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7030.102

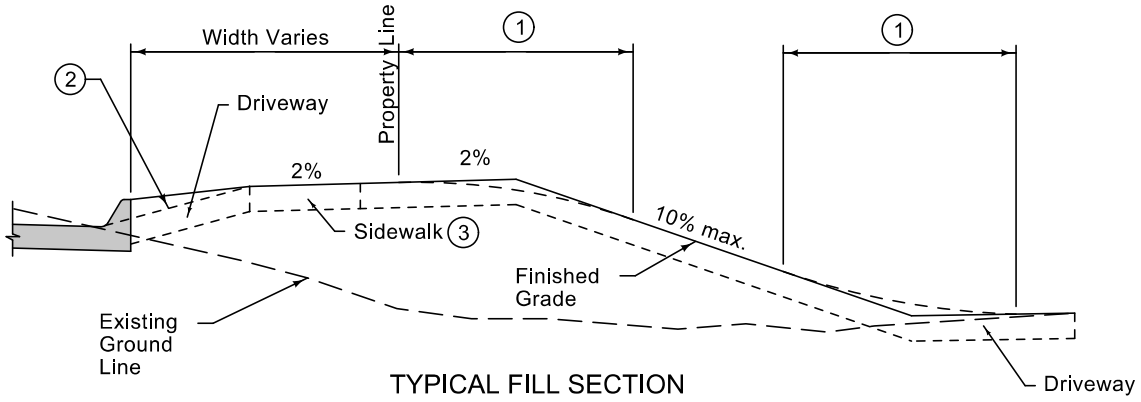
SHEET 1 of 1

SUDAS Standard Specifications

CONCRETE DRIVEWAY, TYPE B



TYPICAL CUT SECTION



TYPICAL FILL SECTION

1. 10 foot vertical curve required for 5% or greater change in grade.
2. Slope varies. See contract documents.
3. Target cross slope of 1.5% with a maximum cross slope of 2.0%.

FIGURE 7030.103

SHEET 1 OF 1

SUDAS

REVISION
2 10-20-15

7030.103

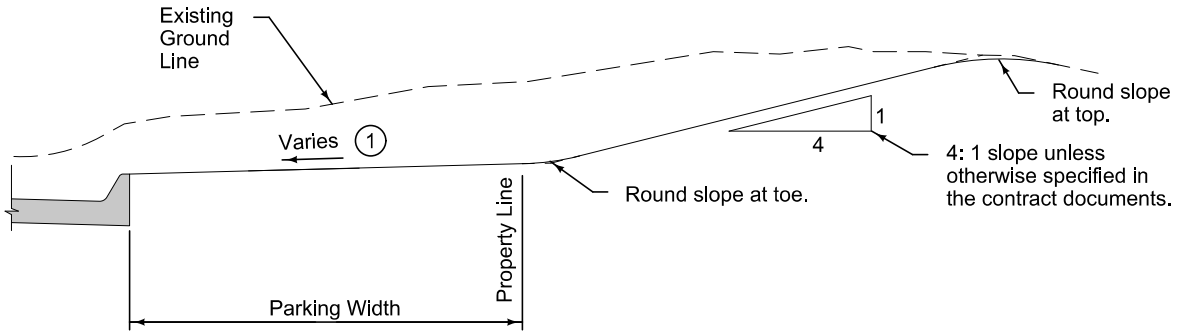
SHEET 1 of 1

SUDAS Standard Specifications

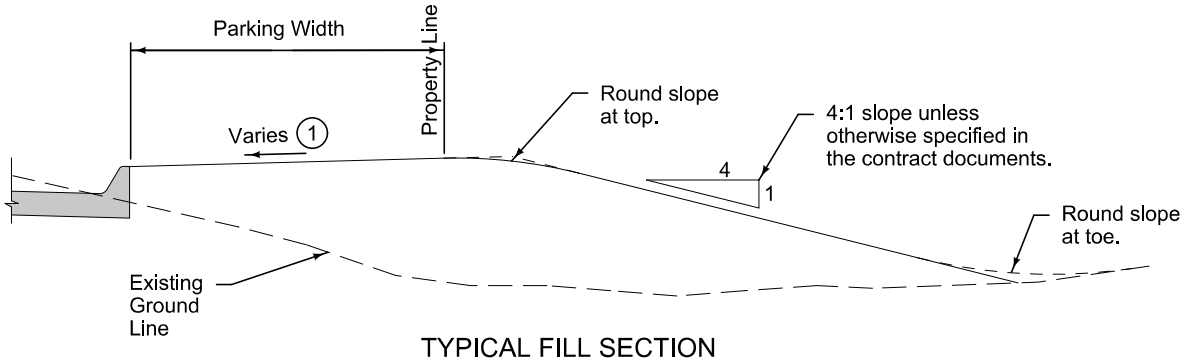
DRIVEWAY GRADING

(1) Parking Slope:
If parking width is less than 10 feet wide, slope at 1/4 inch per foot.

If parking width is 10 feet wide and greater, slope at 1/2 inch per foot.



TYPICAL CUT SECTION



TYPICAL FILL SECTION

FIGURE 7030.104 | SHEET 1 OF 1

SUDAS

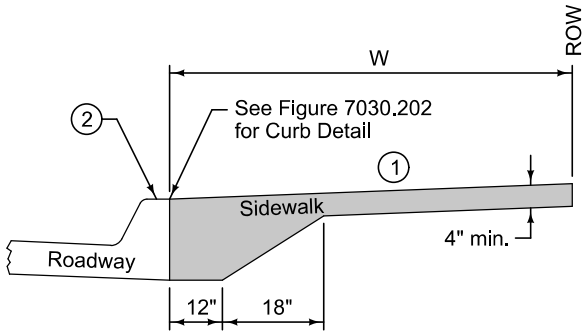
REVISION	
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7030.104

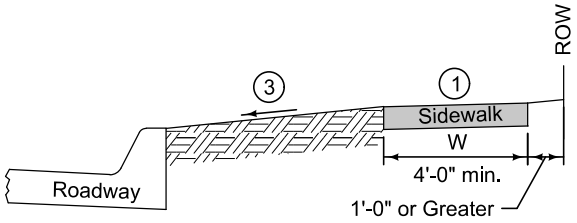
SHEET 1 of 1

SUDAS Standard Specifications

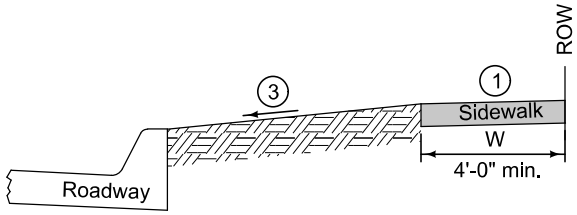
RIGHT-OF-WAY GRADING



CLASS A SIDEWALK
(Sidewalk extends from back of curb to ROW)



CLASS B SIDEWALK



CLASS C SIDEWALK

(1) Target cross slope of 1.5% with a maximum cross slope of 2.0% (including sidewalk through driveway).

(2) Ensure top of curb slopes to street for drainage.

(3) Parking Slopes:
If parking width is less than 10 feet wide, slope at ¼ inch per foot.

If parking width is 10 feet wide and greater, slope at ½ inch per foot.

Special grade may be specified in the contract documents.

W = Sidewalk width as specified in the contract documents.

FIGURE 7030.201 | SHEET 1 OF 1

SUDAS

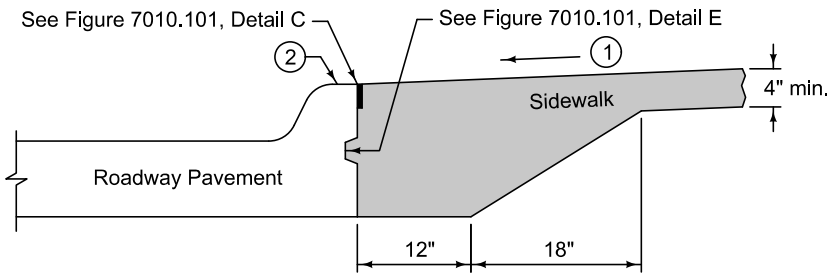
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7030.201

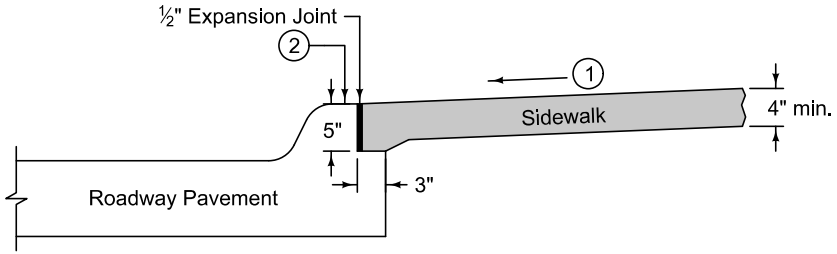
SHEET 1 of 1

SUDAS Standard Specifications

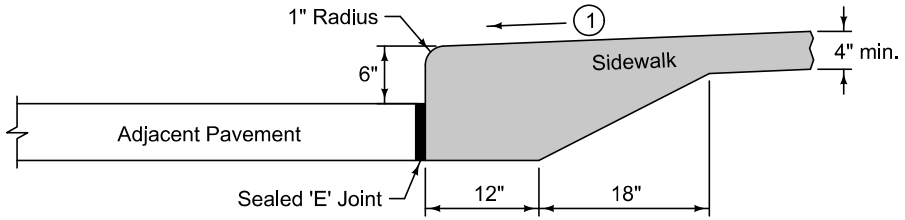
CLASSES OF SIDEWALKS



DETAIL 1



DETAIL 2



DETAIL 3

For new sidewalk with new curb and gutter, comply with Detail 1 or Detail 2. Comply with Detail 3 for new sidewalk adjacent to existing pavement or when specified in the contract documents.

(1) Target cross slope of 1.5% with a maximum cross slope of 2.0%.

(2) Ensure top of curb slopes to street for drainage.

FIGURE 7030.202

SHEET 1 OF 1

SUDAS

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7030.202

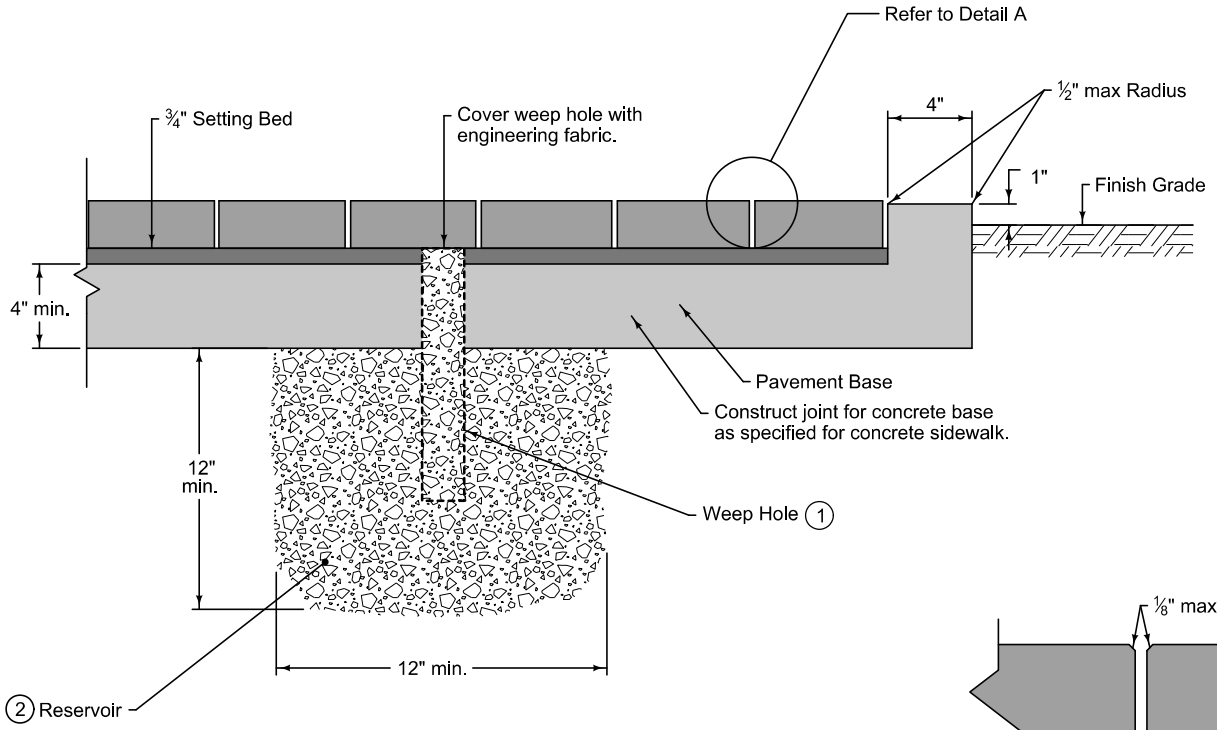
SHEET 1 of 1

SUDAS Standard Specifications

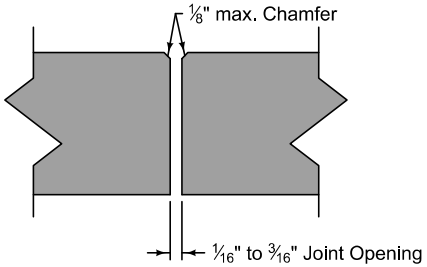
CURB DETAILS FOR CLASS A SIDEWALK

Install brick/paver sidewalk with pattern specified in the contract documents.

1. Install 2 inch diameter, 12 inch long, PVC pipe even with the top of the asphalt setting bed at locations specified. Fill pipe with 3/4 inch clean rock.
2. Fill reservoir with 3/4 inch clean rock. Extend reservoir to subdrain if present.



BRICK/PAVER SIDEWALK WITH PAVEMENT BASE



Detail A

FIGURE 7030.203 | SHEET 1 OF 1

SUDAS

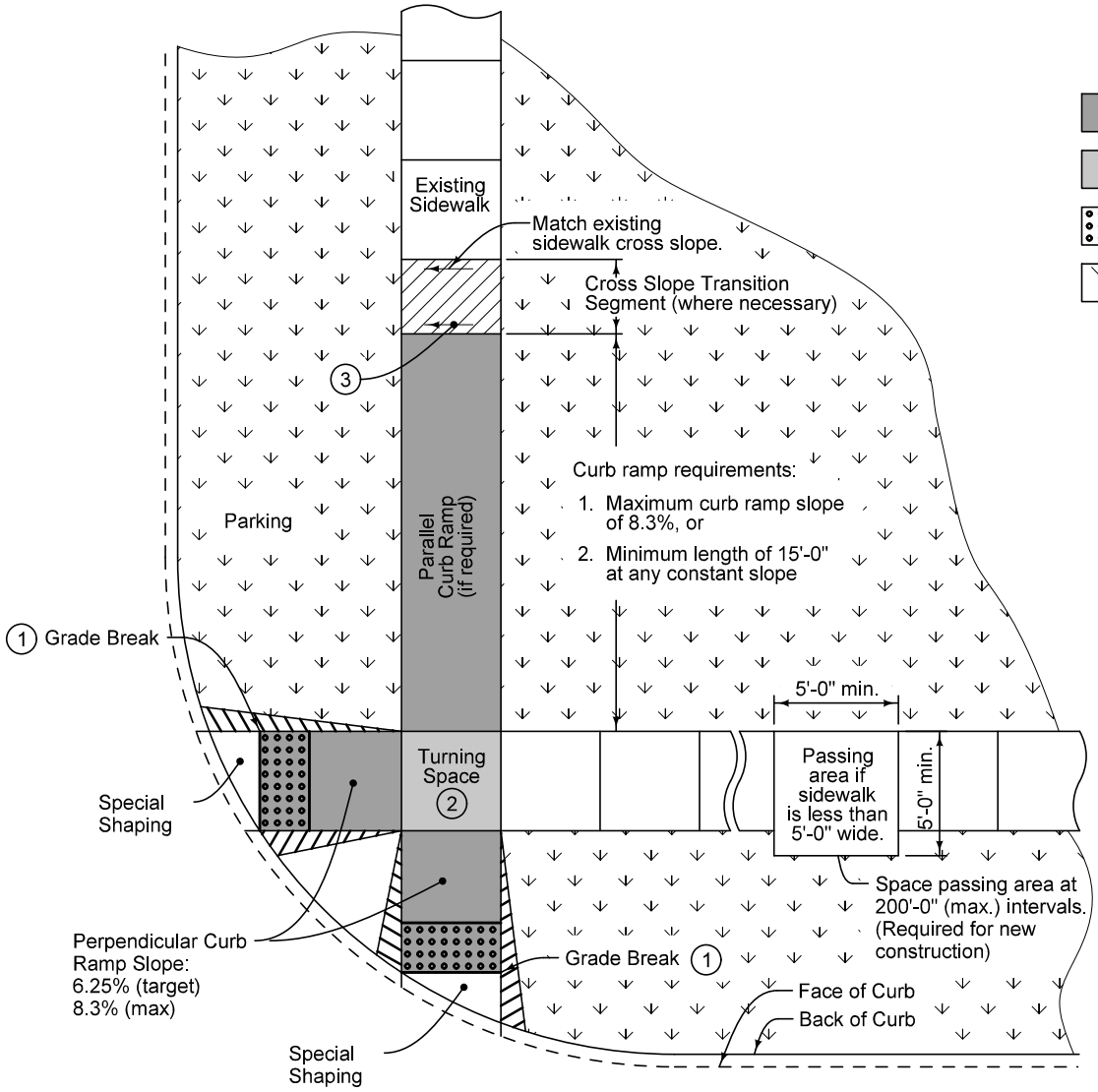
REVISION	
2	10-16-18

7030.203

SHEET 1 of 1

SUDAS Standard Specifications

BRICK/PAVER SIDEWALK



Key

- Curb Ramp
- Turning Space
- Detectable Warning
- Grass

1. Match pedestrian street crossing slope, or flatter.
2. Minimum 4 feet by 4 feet. Target cross slope of 1.5% with a maximum cross slope of 2.0%.
3. Target cross slope of 1.5% with a maximum cross slope of 2.0%.

FIGURE 7030.204 | SHEET 1 OF 1

SUDAS

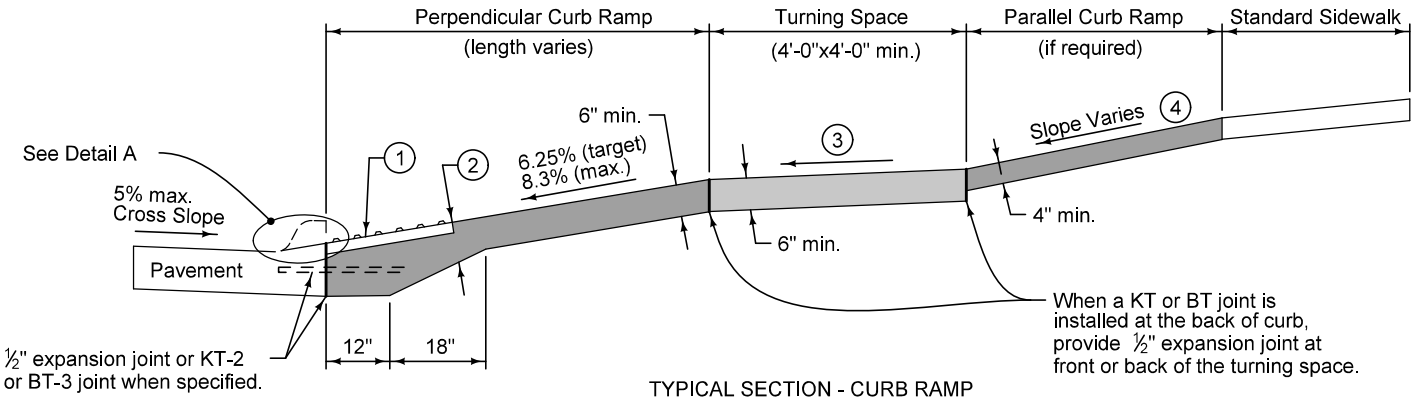
REVISION 3 10-20-15

7030.204

SHEET 1 of 1

SUDAS Standard Specifications

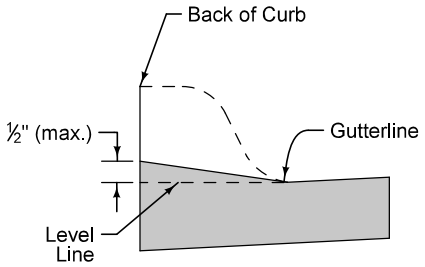
GENERAL FEATURES OF AN ACCESSIBLE SIDEWALK



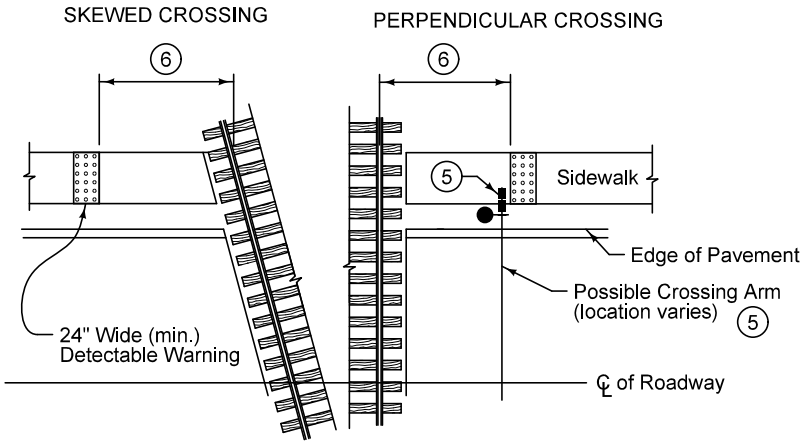
TYPICAL SECTION - CURB RAMP

Key

- Curb Ramp
- Turning Space
- Detectable warning



DETAIL A



DETECTABLE WARNING LOCATION AT RAILROAD CROSSING

1. Provide a minimum 2 foot width of detectable warning surfaces in the direction of pedestrian travel across the full width of the curb ramp or turning space, exclusive of curbs or flares.
2. Provide a minimum of 6 inches of concrete below the detectable warning panel.
3. Minimum 4 feet by 4 feet. Target cross slope of 1.5% with a maximum cross slope of 2.0%.
4. If normal sidewalk elevation cannot be achieved with the perpendicular ramp between the street and landing due to limited ramp length, provide a parallel ramp to make up the elevation difference between the landing and the standard sidewalk.

   The length of the parallel ramp is not required to exceed 15 feet, regardless of the resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.
5. If crossing gate conflicts with location of detectable warning or if pedestrian crossing gate is provided, place detectable warning panel in advance of the crossing gate.
6. Locate front edge of detectable warning panel 12 to 15 feet from centerline of nearest rail. Orient truncated domes parallel to the direction of pedestrian travel.

FIGURE 7030.205 | SHEET 1 OF 1

SUDAS

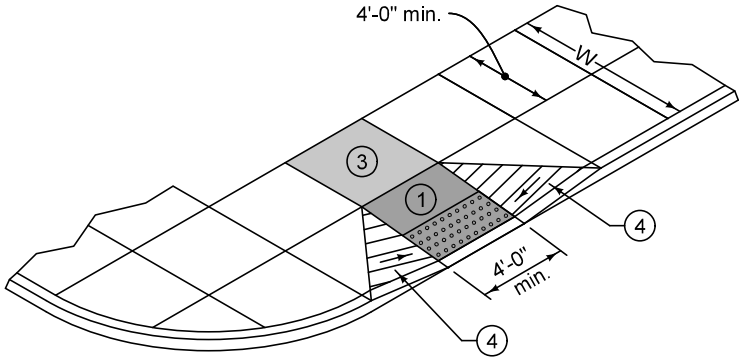
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1	10-20-15

7030.205

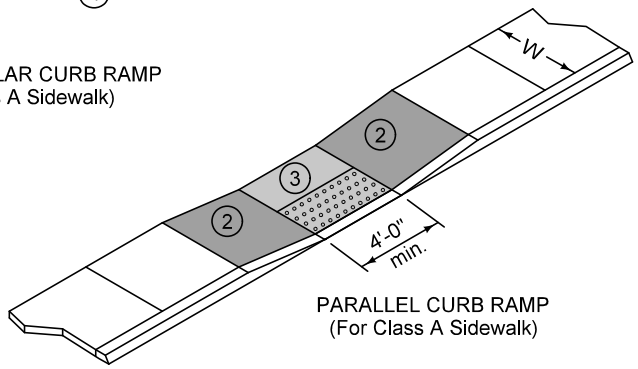
SHEET 1 of 1

SUDAS Standard Specifications

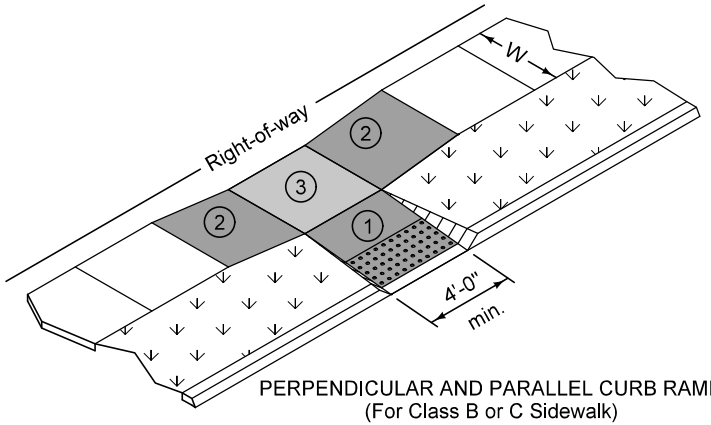
GENERAL SIDEWALK AND CURB RAMP DETAILS



PERPENDICULAR CURB RAMP
(For Class A Sidewalk)



PARALLEL CURB RAMP
(For Class A Sidewalk)



PERPENDICULAR AND PARALLEL CURB RAMP
(For Class B or C Sidewalk)

Key

- Curb Ramp
- Turning Space
- Detectable Warning

1. Perpendicular Curb Ramp: Target running slope of 6.25% with maximum running slope of 8.3%. Match pedestrian street crossing cross slope at back of curb. At mid-block crossings, cross slope may exceed 2.0% to match roadway grade.
2. Parallel Curb Ramp: Target cross slope of 1.5% with a maximum cross slope of 2.0%. The length of the parallel ramp is not required to exceed 15 feet, regardless of resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.
3. Turning Space: Target slope of 1.5%, with a maximum slope perpendicular to the travel directions of 2.0%. At mid-block crossings, cross slope of landing may exceed 2.0% to match roadway grade. Minimum 4 feet by 4 feet.
4. Flare (10:1 max.) required if ramp is contiguous with sidewalk.

FIGURE 7030.206 | SHEET 1 OF 1

SUDAS

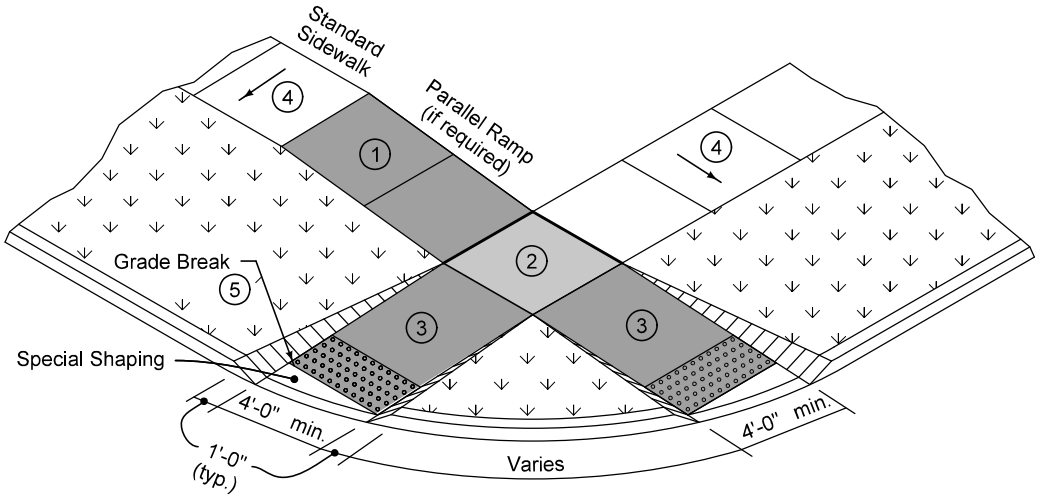
REVISION
New 10-16-12

7030.206

SHEET 1 of 1

SUDAS Standard Specifications

CURB RAMPS OUTSIDE OF INTERSECTION RADIUS



1. Parallel Curb Ramp: If normal sidewalk elevation cannot be achieved with the perpendicular ramp between the street and landing due to limited ramp length, provide a parallel ramp to make up the elevation difference between the landing and the standard sidewalk.

   The length of the parallel ramp is not required to exceed 15 feet, regardless of the resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.

2. Turning Space: Target slope of 1.5% with maximum slope perpendicular to the travel directions of 2.0%. Minimum 4 feet by 4 feet.

3. Perpendicular Curb Ramp: Target running slope of 6.25% with maximum running slope of 8.3%.

4. Target cross slope of 1.5% with a maximum cross slope of 2.0%.

5. Match pedestrian street crossing cross slope or flatter.

Key

- Curb Ramp
- Turning Space
- Detectable warning
- Grass

SUDAS

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New	10-16-12

7030.207

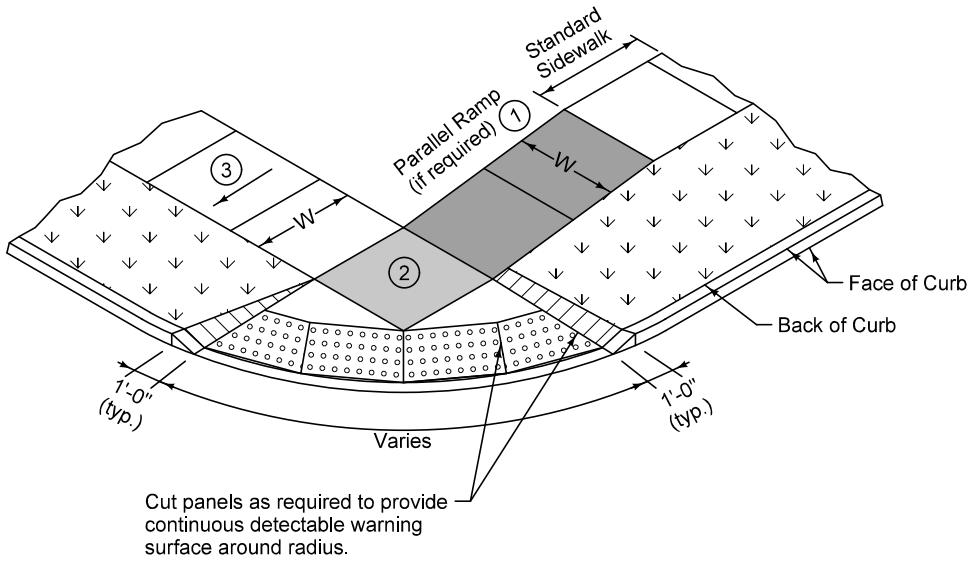
SHEET 1 of 1

SUDAS Standard Specifications

CURB RAMP FOR
CLASS B OR C SIDEWALK

FIGURE 7030.207

SHEET 1 OF 1



1. Parallel Curb Ramp: If normal sidewalk elevation cannot be achieved with the perpendicular ramp between the street and landing due to limited ramp length, provide a parallel ramp to make up the elevation difference between the landing and the standard sidewalk.

   The length of the parallel ramp is not required to exceed 15 feet, regardless of the resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.

2. Turning Space: Target slope of 1.5% with maximum slope perpendicular to the direction of travel of 2.0%. Minimum 4 feet by 4 feet.

3. Target cross slope of 1.5% with a maximum cross slope of 2.0%.

Key

- Curb Ramp
- Turning Space
- Detectable warning
- Grass

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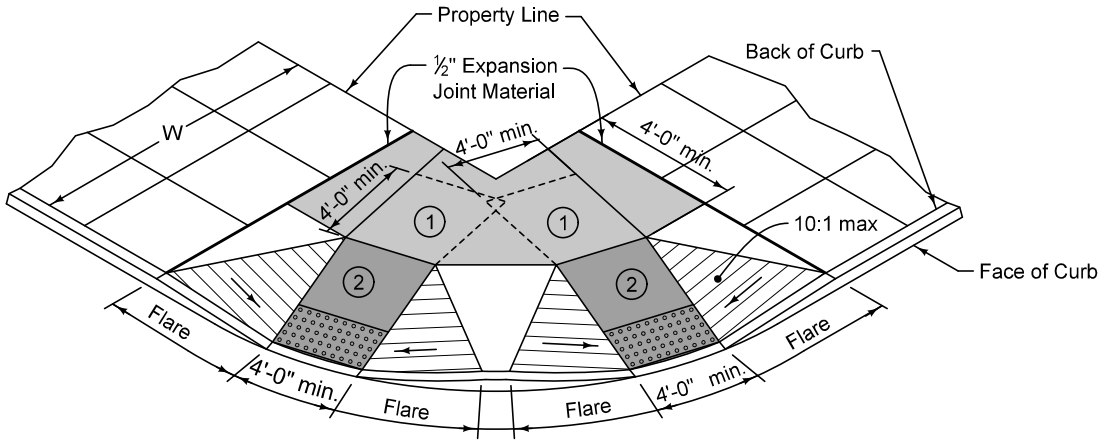
7030.208

SHEET 1 of 1

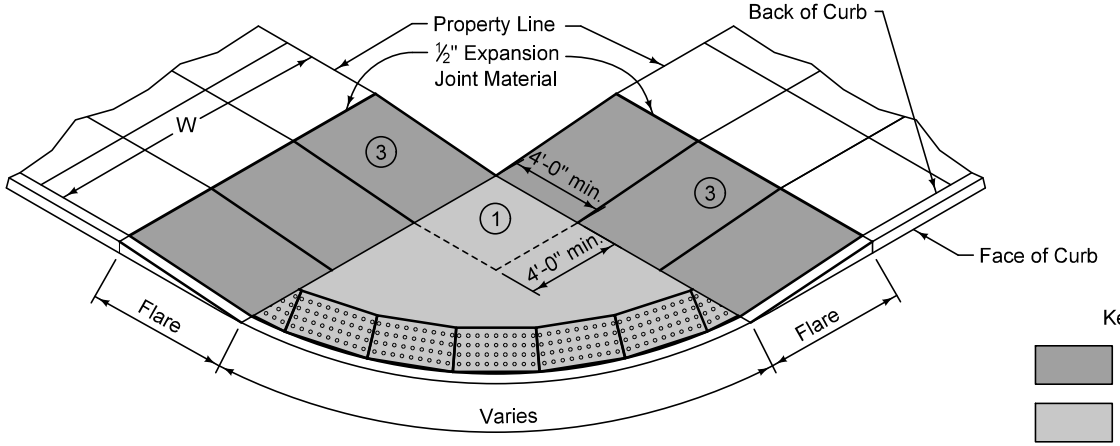
SUDAS Standard Specifications

ALTERNATIVE CURB RAMP FOR CLASS B OR C SIDEWALK

FIGURE 7030.208 | SHEET 1 OF 1



CLASS A SIDEWALK CURB RAMP



CLASS A SIDEWALK CURB RAMP ALTERNATIVE

Key

- Curb Ramp
- Turning Space
- Detectable Warning

1. Turning Space: Target slope of 1.5% with maximum slope perpendicular to the travel direction of 2.0%. Minimum 4 feet by 4 feet (turning spaces may overlap).
2. Perpendicular Curb Ramp: Target running slope of 6.25% with maximum running slope of 8.3%.
3. Parallel Curb Ramp: Target running slope of 6.25% with maximum running slope of 8.3%. The length of the parallel ramp is not required to exceed 15 feet, regardless of the resulting slope. Do not exceed 8.3% for parallel ramps shorter than 15 feet.

FIGURE 7030.209 | SHEET 1 OF 1

SUDAS

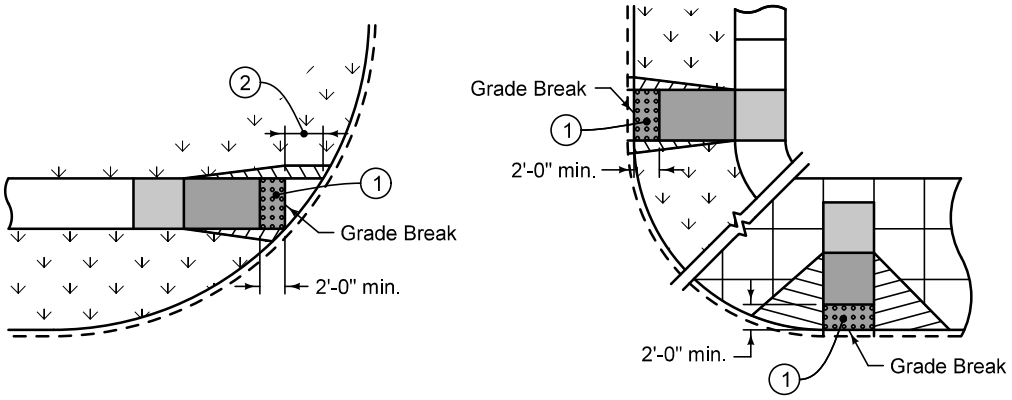
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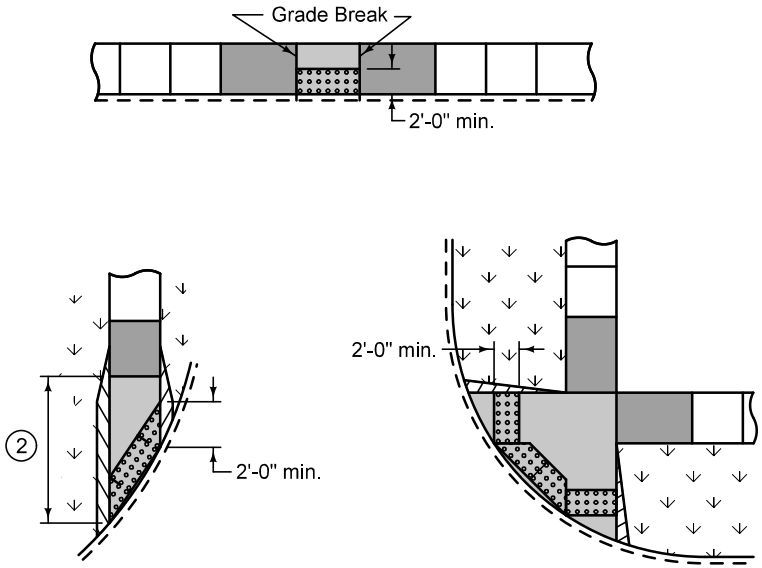
SHEET 1 of 1

SUDAS Standard Specifications

CURB RAMPS FOR CLASS A SIDEWALK



PERPENDICULAR RAMPS



PARALLEL RAMPS

Provide a minimum 2 foot width of detectable warning surfaces in the direction of pedestrian travel across the full width of the curb ramp or turning space, exclusive of curbs or flares.

(1) When detectable warning is located on curb ramp surface, orient domes in the direction of pedestrian travel.

(2) When the distance between the grade break and the back of curb is less than 5 feet, place detectable warning surface at the bottom of the curb ramp.

Where one corner of the curb ramp is more than 5 feet from the back of curb, construct curb ramp as a parallel curb ramp. Move grade break back as required to place detectable warning on turning space at the back of curb.

Key

- Curb Ramp
- Turning Space
- Detectable Warning

SUDAS

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New 10-16-12

7030.210

SHEET 1 of 1

SUDAS Standard Specifications

DETECTABLE WARNING PLACEMENT

FIGURE 7030.210

SHEET 1 OF 1

PAVEMENT REHABILITATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Full and Partial Depth PCC Patches

B. Full and Partial Depth Asphalt Patches

C. Full Depth Composite Patches

D. Diamond Grinding

E. Milling

F. Cleaning and Filling Joints and Cracks

G. Curb and Gutter Replacement

H. Dowel Bar Retrofit

I. Core Hole Cutting and Replacement

1.02 DESCRIPTION OF WORK

A. Construct full depth PCC, asphalt, and composite patches.

B. Construct partial depth PCC and asphalt patches.

C. Grind existing PCC pavement surface for profile improvement using a diamond grinder.

D. Mill the surface of asphalt or PCC pavement to improve the surface profile and cross-section in preparation for resurfacing.

E. Clean and fill longitudinal and transverse joints and random cracks in PCC and asphalt pavement.

F. Remove existing pavement and curb and gutter.

G. Install epoxy coated dowel bars on transverse joints and cracks.

H. Cutting and replacement of pavement cores.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. PCC mix design.

B. Asphalt mix design.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. PCC: See Section 7010.

B. Asphalt: See Section 7020

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Full Depth Patches:

1. **Measurement:** Measurement will be in square yards for each type and thickness of full depth patch. Patches less than 2 square yards in area will be considered 2 square yards.

2. **Payment:** Payment will be made at the unit price per square yard for each type and thickness of full depth patch.

3. **Includes:** Unit price includes, but is not limited to, sawing, removing, and disposing of existing pavement and reinforcing; restoring the subgrade; furnishing and installing tie bars and dowel bars; furnishing and placing the patch material, including the asphalt binder and tack coat; forming and constructing integral curb; surface curing and pavement protection; joint sawing and filling; and placing backfill and restoring disturbed surfaces.

B. Subbase Over-excavation:

1. **Measurement:** Measurement will be in tons of subbase material placed for authorized over-excavation.

2. **Payment:** Payment will be made at the unit price per ton of subbase material.

3. **Includes:** Unit price includes, but is not limited to, removal of existing subbase or subgrade, disposal of materials removed, furnishing and placing subbase material, and any additional excavation required for subbase placement.

C. Partial Depth Patches:

1. **Measurement:** Measurement will be in square feet for each type of partial depth patch. Patches less than 1 square foot in area will be considered 1 square foot.

2. **Payment:** Payment will be made at the unit price per square foot for each type of partial depth patch.

3. **Includes:** Unit price includes, but is not limited to, sawing, removing, and disposing of existing pavement; furnishing tack coat or bonding agent; furnishing and placing the patch material; curing; joint filling (PCC patches only); placing backfill; and restoring disturbed surfaces.

1.08 MEASUREMENT AND PAYMENT (Continued)

4. **Extra Payment:** When partial depth patches are constructed to full depth at the direction of the Engineer, payment will be at 2 times the unit price per square foot for each type of partial depth patch.

D. Crack and Joint Cleaning and Filling, Hot Pour:

1. **Measurement:** Measurement will be in linear feet measured along the cracks or joints.

2. **Payment:** Payment will be made at the unit price per linear foot of crack and joint cleaning and filling.

3. **Includes:** Unit price includes, but is not limited to, furnishing crack and joint filler material and routing, sawing, cleaning, and filling joints or cracks.

E. Crack Cleaning and Filling, Emulsion:

1. **Crack Cleaning and Filling, Emulsion:**
   a. **Measurement:** Measurement will be in linear feet measured along the cracks. Map cracked areas will not be measured.
   b. **Payment:** Payment will be made at the unit price per linear foot of crack cleaning and filling.
   c. **Includes:** Unit price includes, but is not limited to, furnishing emulsified crack filler material, cleaning cracks, placing soil sterilant, and filling cracks.

2. **Asphalt for Crack Filling:**
   a. **Measurement:** Measurement will be in tons of asphalt used for filling cracks greater than 1 inch. Quantity will be based upon scale tickets. Mixture not used in the work will be deducted based upon scaled weights.
   b. **Payment:** Payment will be made at the unit price per ton for asphalt used in filling cracks over 1 inch.
   c. **Includes:** Unit price includes, but is not limited to, cleaning, applying tack coat, and furnishing and placing asphalt for crack filling.

F. Diamond Grinding:

1. **Measurement:** Measurement will be in square yards for the area of diamond grinding.

2. **Payment:** Payment will be made at the unit price per square yard of diamond grinding.

3. **Includes:** Unit price includes, but is not limited to, diamond grinding pavement, testing for smoothness according to the contract documents, and removal of slurry and residue from the project site.

G. Milling:

1. **Measurement:** Measurement will be in square yards for the area of milling.

2. **Payment:** Payment will be made at the unit price per square yard of milling.

3. **Includes:** Unit price includes, but is not limited to, milling pavement; furnishing water; and salvaging, stockpiling, and removing cuttings and debris.

1.08 MEASUREMENT AND PAYMENT (Continued)

H. Pavement Removal:

1. **Measurement:** Measurement will be in square yards. No deduction in area will be made for manholes, storm sewer intakes, valve boxes, or other structures less than 2 square yards in area. Pavement removal for patching is included as part of the patching item and will not be measured separately.

2. **Payment:** Payment will be made at the unit price per square yard.

3. **Includes:** Unit price includes, but is not limited to, sawing, breaking, removing, and disposing of existing pavement and reinforcing steel.

I. Curb and Gutter Removal:

1. **Measurement:** Measurement will be in linear feet measured along the back of curb.

2. **Payment:** Payment will be made at the unit price per linear foot of curb and gutter removed.

3. **Includes:** Unit price includes, but is not limited to, sawing, breaking, removing, and disposing of existing curb and gutter.

J. Dowel Bar Retrofit:

1. **Measurement:** Each size of dowel bars satisfactorily placed will be counted.

2. **Payment:** Payment will be made at the contract unit price for each size of dowel bar.

3. **Includes:** Unit price includes, but is not limited to, cutting the slots, preparing the slots, placing and grouting the bars, and curing the surface.

K. Core Hole Cutting and Replacement:

1. **Measurement:** Measurement will be by count of the number of core holes replaced.

2. **Payment:** Payment will be made at the contract unit price per core hole replaced.

3. **Includes:** Unit price includes but is not limited to, cutting the core hole, vacuum excavation, furnishing and placing backfill material and pavement, or replacing the pavement core using waterproof bonding material, if specified.

L. Sampling and Testing: Required sampling and testing for pavement repair and rehabilitation work is incidental to other project costs and will not be paid for separately.

PART 2 - PRODUCTS

2.01 MATERIALS

A. PCC:

1. **Standard Patching:** Use Class C mix complying with Section 7010. Comply with Iowa DOT Materials I.M. 401. Construct all patches as standard patches unless otherwise specified in the contract documents.

2. **High Early Strength Patching:** Use Class M mix complying with Section 7010. Do not use calcium chloride unless otherwise specified in the contract documents.

3. **Partial Depth Patching:** Use a coarse aggregate in concrete mix complying with Iowa DOT Article 4109.02, Gradation No. 5 in the Aggregate Gradation Table.

B. Asphalt: Provide a minimum Low Traffic (LT) mixture complying with Section 7020, unless otherwise specified in the contract documents. Provide mixture with an asphalt binder meeting or exceeding PG 58-28S.

C. Crack and Joint Filler Material:

1. **Hot Pour Crack and Joint Filler:** Comply with Iowa DOT Section 4136.

2. **Emulsified Asphalt Crack Filler:** Provide CRS-2 or CRS-2P emulsions complying with Iowa DOT Section 4140.

3. **Asphalt for Filling Cracks:**
   a. Provide a 3/4 inch, 1/2 inch, or 3/8 inch asphalt mixture complying with Section 7020, or a similar mixture from a commercial source subject to approval from the Engineer.
   b. Upon approval of the Engineer, a high performance bituminous cold premix may be used, depending on the availability of the specified asphalt.

4. **Blotting Material:** Provide sand complying with Iowa DOT Sections 4124 or 4125, or similar sand approved by the Engineer.

5. **Soil Sterilant:** Provide soil sterilant as specified in the contract documents.

D. Primer or Tack Coat Bitumen: Comply with Iowa DOT Article 2303.02.

E. Epoxy for Bonding Dowel and Tie Bars: Comply with Iowa DOT Materials I.M. 491.11.

F. Tie Bars and Dowel Bars: Provide epoxy coated bars complying with Iowa DOT Section 4151 or glass fiber reinforced polymer bars complying with Iowa DOT Section 4156.

G. Subbase Material: Unless otherwise specified in the contract documents, use modified subbase complying with Section 2010.

H. Liquid Curing Compound: Comply with Iowa DOT Section 4105.

I. Sand-cement Grout: Provide a sand-cement grout mixture with a ratio of one part water to one part sand and two parts cement.

J. Preformed Compression Relief Material: Provide 1/4 inch polystyrene, 1/4 inch polyethylene, 1/4 inch Styrofoam, or 3/16 inch waxed coated cardboard.

2.01 MATERIALS (Continued)

K. Epoxy Coated Dowel Bars: Comply with Figure 7010.101 and Iowa DOT Section 4151 for the length and diameter specified. Uniformly coat dowel bars with approved bond breaker according to Iowa DOT Article 4151.02, B. Include tight fitting nonmetallic end caps that allow a minimum of 1/4 inch movement at each end.

L. Dowel Chairs: Prevent movement of the dowel bar during grout placement with epoxy coated or nonmetallic dowel chair devices which provide a minimum clearance of 1/2 inch between the bottom of the bar and the surface upon which the bar is placed and also between the bar and the end walls of the slot.

M. Caulking Filler: Any commercial caulk designed as a concrete sealant that is compatible with the grout material being used.

N. Foam Core Inserts: Provide 3/8 inch ± 1/8 inch thick closed cell foam core board filler faced with film, foil, or poster board material on both sides.

O. Rapid Set Patch Material:

1. Provide a shrinkage compensated rapid set patch material meeting Iowa DOT Materials I.M. 491.20 and the following strength requirements:
   - 3 hour minimum compressive strength of 3,000 psi according to ASTM C 39.
   - 24 hour minimum compressive strength of 5,000 psi according to ASTM C 39.

2. Use grout material from packaged bags or proportioned on site from bulk cementitious materials.
   a. Extend packaged bags with pea gravel, proportioned and mixed according to the manufacturer's recommendations. Fine aggregate additions and water in excess of the manufacturer's recommendations are not allowed.
   b. Use bulk cementitious materials equivalent in composition to the cementitious materials used in packaged bags and proportioned with fine aggregate and water and extended with pea gravel to produce a mixture equivalent to the packaged bag mix meeting the manufacturer's recommendations. Water in excess of the manufacturer's recommendations is not allowed.
      c. Supply fine aggregates meeting Iowa DOT Section 4110.

3. Provide pea gravel with a minimum Class 2 durability meeting the requirements of Iowa DOT Article 4112.03, B and Article 4109.02, Gradation No. 9 in the Aggregate Gradation Table.

4. Use water meeting the requirements of Iowa DOT Section 4102. Potable water obtained from a municipal supply, suitable for drinking, may be accepted without testing.

P. Backfill Material:

1. CLSM or foamed cellular concrete, per Section 3010, 2.06, if required by the Jurisdiction.

2. Class I granular material meeting Section 3010, 2.02, A or pea gravel complying with Iowa DOT Article 4109.02, Gradation No. 21.

Q. Waterproof Bonding Material: Meet ASTM C 928 with a minimum bond strength of 1,500 psi at one day and 2,000 psi at 7 days. Carry an AASHTO H-25 truck load within 1 hour when temperature is 50° F.

PART 3 - EXECUTION

3.01 GENERAL

A. Conduct all operations to minimize inconvenience to traffic. Confine operations to one traffic lane, unless the road is to be closed to traffic. Minor encroachment into the adjacent lane, such as for sawing and installing forms, will be acceptable with the use of a flagger according to MUTCD.

B. Do not remove pavement for either full depth or partial depth patching unless the patch can be completed before the end of the working day.

C. Construct full depth and partial depth patches to the dimensions specified in the contract documents or as marked by the Engineer in the field. Construct all full depth patches to full panel width.

D. Make saw cuts parallel or perpendicular to the centerline.

E. Remove and dispose of materials not designated for salvage.

F. Restore the area outside the pavement by placing and compacting backfill material, placing topsoil, and sodding or seeding as specified in the contract documents.

G. For pavement patches in areas removed to determine utility locations, replace pavement according to Figures 7040.101, 7040.102, 7040.103, and 7040.107 as directed by the Jurisdiction.

3.02 FULL DEPTH PATCHING

A. Pavement Removal:

1. Saw pavement to full depth at the edges of the patch. A second saw cut, 2 inches inside the initial saw cut, may be required to prevent damage to adjacent pavement.

2. Do not damage pavement that is to remain. Do not use heavy equipment adjacent to new concrete until the opening strength is achieved.

B. Restoring Subgrade or Subbase:

1. Excavate 2 inches below the bottom of the existing pavement. If more than 2 inches is excavated, place and compact new subbase material as required to bring the subbase to a level 2 inches below the bottom of the existing pavement. Correct unauthorized over-excavation at no additional cost to the Contracting Authority.

2. Compact the exposed subgrade or subbase by a minimum of four complete passes with a plate-type vibratory compactor with a minimum force rating of 3,500 pounds.

3. When unstable material or excessive moisture is encountered, the Engineer may order removal and replacement of the unstable material.
   a. Remove existing unstable subgrade or subbase, or both, to the depth directed by the Engineer.
   b. Place and compact new subbase material as required to bring the subbase to a level 2 inches below the bottom of the existing pavement.

C. Placing PCC Patches:

1. Equipment: Comply with Iowa DOT Article 2301.03, A, specifications on equipment for standard concrete pavement.

3.02 FULL DEPTH PATCHING (Continued)

2. **Tie Bars and Dowel Bars:** Comply with Section 7010 and the figures in Sections 7010 and 7040.
   a. When there is a common line between two adjacent patches, a bent bar may be placed in a keyway and later straightened.
   b. Coat dowel bars extending into the patch area with a bond breaker. Do not coat tie bars.

3. **Forms:** Comply with Section 7010, 3.02, D, as well as the following.
   a. Use forms on all exposed edges and along the centerline for patches that extend into an adjacent lane, unless full pavement width patches are constructed.
   b. Rigid wood forms may be used in lieu of steel.

4. **Placing, Consolidation, and Finishing the Concrete:**
   a. Moisten the subbase or subgrade.
   b. Except for preplanned joints, place the patch continuously until the patch is completed.
   c. When a delay of 45 minutes cannot be avoided, construct a day's work ('DW') joint.
   d. Carefully place concrete into the patch area to avoid segregation; spread into place and consolidate with a mechanical vibrator. Place full lane width patches over 25 feet in length with a suitable finishing machine that has at least one vibrating screed. Avoid excessive vibrating.
   e. Finish patches per Section 7010, 3.02, I.
   f. For joints with tie bars, tool the edge. For joints with dowel bars, saw to a depth of approximately 1 1/8 inch, leaving an opening of at least 3/8 inch in width to provide a reservoir for joint filler.
   g. Texture the patch to match the adjacent surface.

5. **Curing:** Comply with Section 7010, 3.02, J. Cure the concrete, including exposed vertical edges, immediately after the concrete has been finished and the surface water has evaporated.

6. **Joints:** Construct and fill joints according to Section 7010, 3.02. Place joints at locations specified in the contract documents.

7. **Pavement Protection:** Comply with Section 7010, 3.04.

8. **Use of Pavement:** Comply with opening strength requirements of Section 7010, 3.05. Maturity testing is not required.

D. Placing Asphalt Patches:

1. Use equipment complying with Iowa DOT Article 2303.03. Use of a paving machine is not required.

2. Apply tack coat to the vertical edges of the remaining pavement at a rate of 0.10 to 0.15 gallons per square yard.

3. Place asphalt patch mixture in lifts that will not exceed 3 inches in thickness after compaction, with the top lift not exceeding 2 inches in thickness when compacted.

4. Compact each lift while hot by rolling or compacting with a vibratory compactor. Subsequent lifts may be placed as soon as the preceding lift has been properly compacted.

3.02 FULL DEPTH PATCHING (Continued)

5. Smooth the final lift with a steel-tired finish roller. Ensure the final compacted surface is level with, or no more than 1/8 inch above, the adjacent pavement and has a smooth riding surface. If the patch becomes distorted for any reason, smooth the surface by blading, scraping, grinding, filling, or other approved means.

6. Do not extend patch material beyond the edge of the existing pavement; remove patch material that extends outside the patch limits.

7. Do not open to traffic until the mixture has cooled sufficiently to provide stability.

3.03 PARTIAL DEPTH PATCHING

A. Pavement Removal:

1. Ensure all patches are square or rectangular in shape.

2. For removal by the saw and chip method, cut at the designated removal limits to a minimum depth of 2 inches and a maximum depth of T/2 or the top of the dowels in PCC pavement. For PCC patches, taper the sides of the removal area 30 to 60 degrees from vertical using a pneumatic hammer to eliminate the polished face.

3. Using a 15 pound maximum size pneumatic hammer, remove the deteriorated pavement down to sound pavement. A 30 pound pneumatic hammer may be used if it does not result in damage to the patch area and edges.

4. In lieu of sawing and removal with a pneumatic hammer, the designated patch area may be milled to the prescribed depth. Milling equipment must provide tapered edges 30 to 60 degrees from vertical for PCC patches. Chip out secondary spalling resulting from milling at no additional cost to the Contracting Authority.

5. Remove pavement to the appropriate depth. Do not damage steel reinforcement during the removal process on PCC pavements. Damaged steel will be the responsibility of the contractor. If the end of a dowel bar is exposed, cut and remove the bar. Place duct tape, form oil, grease or use other method approved by the Engineer as a bond breaker on dowels not removed. If the required depth to sound pavement exceeds the maximum T/2 removal depth, construct a full depth patch.

B. PCC Patch Placement:

1. Clean removal area by sandblasting or water blasting, followed by airblasting, until the area is clean and dry. Ensure the compressed air used for cleaning is oil and moisture free. Place concrete the same day as cleaning.

2. Install preformed compression relief material in joints or cracks or tool the joint in the plastic concrete. Use material equal in width to the adjacent joint or crack at the patch boundary. For wide openings, use multiple thicknesses. Compression relief material is to extend at a minimum of 1/4 inch below the bottom of the patch so as to completely separate all patching material on both sides and 3 inches beyond the patch boundaries. If tooling of the joint is specified, complete a relief saw cut to the full depth of the patch plus 1/4 inch as soon as the concrete has reached proper set.

3. Thoroughly coat the bottom and sides of the patch area with a cement grout immediately prior to placement of concrete. Do not allow grout to set prior to placement of concrete. Remove grout set by sandblasting and reapply.

3.03 PARTIAL DEPTH PATCHING (Continued)

4. Deposit concrete in the patch; finish patch from the center outward. Ensure concrete does not infiltrate into existing cracks or joints.

5. Apply joint filler material to expansion joints. At the interface between the patch and the slab, apply sand-cement grout to fill and seal the edge. Position the grout so 1 inch is over the surrounding pavement and 3 inches are over the patch.

6. Texture the patch similar to the adjacent surface.

7. Cure patch according to Section 7040, 3.02.

8. Fill joints according to Section 7040, 3.06. Complete filling within 5 calendar days after patch is placed.

C. Asphalt Patch Placement:

1. Clean removal area by airblasting until the area is clean and dry. Ensure the compressed air used for cleaning is moisture free.

2. Cover the entire removal area with tack coat at a rate of 0.10 to 0.15 gallons per square yard.

3. Place asphalt patch mixture in lifts that will not exceed 3 inches in thickness after compaction, with the top lift not exceeding 2 inches in thickness when compacted.

4. Compact each lift while hot by rolling with an adequately weighted pneumatic tire roller or by tamping with a mechanical tamper. Succeeding lifts may be placed as soon as the preceding lift has been properly compacted.

5. Smooth the final lift with a steel-tired finish roller. Ensure the final compacted surface is level with, or no more than 1/8 inch above, the adjacent pavement and has a smooth riding surface. If the patch becomes distorted for any reason, smooth the surface by blading, scraping, grinding, filling, or other approved means.

6. Do not open to traffic until the mixture has cooled sufficiently to provide stability.

3.04 DIAMOND GRINDING

A. Use equipment complying with Iowa DOT Article 2532.03, A.

B. Grind and texture the entire surface of the pavement parallel to the centerline until the pavement surface on both sides of transverse joints and all cracks are in the same plane with no greater than 1/16 inch difference between adjacent sides of joints and cracks and the pavement surface meets the required smoothness. Feather grind into existing structures such as manholes and water valves in a manner that eliminates abrupt edges or drops and provides a uniform texture.

C. Ensure the ground surface is of uniform texture. In each lane, ensure at least 95% of the area in each 100 foot section has a newly textured surface. Depressed pavement areas due to subsidence or other localized causes and areas containing feathering due to pavement structures will be exempted from texturing requirements.

D. Except at joints and cracks, ensure grinding depth does not exceed 1/2 inch. At joints and cracks, ensure grinding depth does not exceed 3/4 inch.

3.04 DIAMOND GRINDING (Continued)

E. For multiple passes, ensure overlaps do not exceed 1 inch. Begin at the crown of the roadway, proceeding toward the pavement edge with each subsequent pass. Ensure each subsequent pass is at least as deep as the previous pass in order to provide transverse drainage. All passes are to begin and end at the same station location. Ensure no unground areas are left between passes. For grinding adjacent to an unground turn lane or other pavement surface, feather smoothly from the edge of the ground surface to the unground surface leaving no more than a 1/8 inch ridge. If street surface to be ground includes a curb and gutter section, extend grinding to within 4 inches of the curb face and feather to provide proper drainage.

F. Assemble and adjust the grinding head as necessary during the project to produce the following tolerances on pavements with the indicated coarse aggregates. Both the distance between grooves and the texture depth must be within the specified range to be in compliance. Assemble the grinding head to produce the tolerances indicated below for the type of coarse aggregate in the pavement.

	Crushed Stone	Gravel/Quartzite
Width of Land Area Between Grooves*	0.090” to 0.110”	0.080” to 0.095”
Texture Depth**	Target of 1/8” with average between 1/16” and 3/16”	

*Based on an average of a minimum of ten measurements across the ground width for one pass.
**Based on an average of a minimum of six measurements across the ground width for one pass.

G. Prior to enforcement of the tolerances listed above, a test area 300 feet long and the width of the grinding head will be allowed for a new head that has been restacked, provided a surface texture in reasonable conformance with the specifications, as determined by the Engineer, is being produced.

H. Ensure the transverse slope of the ground pavement is uniform to a degree that there are no depressions or misalignment of slope greater than 1/4 inch in 12 feet when tested by string line or straightedge placed perpendicular to the centerline.

I. Continuously remove all slurry or residue resulting from the grinding operations with a well-maintained vacuum system and remove from the project limits. Ensure residue from grinding operations does not flow across lanes occupied by public traffic or into gutters, storm sewers, ditches, or other drainage facilities.

J. Measure smoothness with a 10-foot straightedge. Regrind high spots to ensure no surface deviations greater than 1/8 inch remain. When profilograph testing is specified in the contract documents, comply with Iowa DOT Materials I.M. 341 and the following requirements:

1. Prior to performing any grinding work, provide a control profilogram for each lane and/or segment over 50 feet in length that is to be ground. Ensure pavement is relatively clean and free of debris prior to establishing the control profilogram.

2. Ensure each segment of the finished ground surface has a final profile index less than or equal to 35% of the control profilogram trace or 22 inches per mile, whichever is greater, and does not include any bumps exeeding 1/2 inch in 25 feet.

3. Depressed pavement areas due to subsidence or other localized causes and areas where the maximum cut restricts further grinding will be excluded from testing with the profilograph when approved by the Engineer.

K. Recheck smoothness following any regrinding activities to ensure compliance with the above requirements.

3.05 MILLING

A. Use equipment complying with Iowa DOT Article 2531.03, A.

B. Mill the entire pavement area designated to the depth specified in the contract documents. Mill in straight lines. Make sufficient passes, or cuts, such that all irregularities or high spots are eliminated.

C. Control milling operations to provide a surface that is true within a nominal tolerance of 1/4 inch and 1/4 inch at longitudinal joints where adjacent passes meet. The profile may be inspected by checking with a 10 foot surface checker placed parallel to the centerline. Correct variations greater than 1/4 inch.

D. Load cuttings directly into dump trucks and remove the remaining small cuttings and debris from the street. Sweep the scarified surface with a rotary broom before opening to traffic. Unless otherwise specified in the contract documents, all materials removed are property of the Contractor.

E. Do not operate metal tracked equipment on streets, other than those being milled.

F. Ensure excessive dust does not become airborne during construction. Additional water may be required at any time for dust control.

G. Mill around manholes and utility valves. Correct any damage to manholes or valves by the milling operation at no additional cost to the Contracting Authority.

H. Do not leave a vertical drop of more than 2 inches at the centerline or lane line overnight. Taper the ends of milled sections subject to traffic to provide a uniform and gradual transition.

3.06 CRACK AND JOINT CLEANING AND FILLING, HOT POUR

A. General:

1. Use equipment complying with Iowa DOT Articles 2541.03 (asphalt) and 2542.03 (PCC).

2. Rout or saw joints and cracks with an average opening of 3/8 inch or less to provide a minimum sealant reservoir of 3/8 inch wide by a nominal 1/2 inch deep.

B. Crack and Joint Cleaning:

1. Clean cracks or joints of existing joint filler material, backer rod, vegetation, dirt, and other foreign material.

2. Clean joints or cracks by air blasting or by other methods as necessary to remove debris.

3. If specified in the contract documents, clean wet sawn joints with high pressure water immediately after sawing to remove residue produced by the sawing operation.

4. When cleaned joints or cracks are contaminated before being filled, clean them again before filling.

C. Crack and Joint Filling:

1. Ensure cracks and joints are dry prior to placement of filler material.

3.06 CRACK AND JOINT CLEANING AND FILLING, HOT POUR (Continued)

2. Heat, handle, and apply joint filler material to the proper level as specified in the contract documents and as recommended by the manufacturer.
   a. PCC Pavement: Do not overfill joint or crack with filler material. Immediately remove filler material placed on the pavement surface.
   b. Asphalt Pavement: Slightly overfill the entire crack reservoir with filler material. Smooth with a narrow V-shaped squeegee immediately after placement of the filler material to within 1/2 inch on each side of the crack edge.

3. Place joint filler material when the pavement and ambient air temperatures are 40°F or higher. When near this minimum, additional air blasting or drying time, or both, may be necessary to ensure a satisfactory bond to the joint surfaces.

4. Lanes may be opened to traffic only after the filler material has set sufficiently so it will not pick up under traffic. Blotting material may be applied to the filler material, but only after the surface has set to avoid penetration of the blotting material into the filler material.

3.07 CRACK CLEANING AND FILLING, EMULSION

Use emulsified asphalt for filling cracks in asphalt surfaces only. Do not use on PCC pavements.

A. General:

1. Clean cracks with either high pressure air or water equipment. Do not use water when freezing temperatures exist or are forecasted.

2. Ensure vegetation is removed from cracks. Alternative cleaning methods may be necessary to remove vegetation.

3. When specified in the contract documents, apply a soil sterilant in crack prior to placing the filler material.

4. For filling cracks, use a hand operated wand or pouring pot, capable of placing the filler material into the crack and filling to the adjacent surface. Use a spout or nozzle small enough to place the filler material into the crack without soiling the adjacent surface.

5. Immediately after placement of the filler material, tightly spread the emulsion using a 2 inch, or less, V-shaped rubber-edged squeegee. Take proper measures to hold the filler in place and prevent runout at edge of pavement or at low areas.

B. Cracks Wider Than 1 inch:

1. Clean the cracks of loose and spalled material, sand, and other foreign debris to a depth of 3 inches using high pressure water.

2. When specified in the contract documents, utilize additional methods to clean cracks of old crack filler.

3. Blow the cleaned cracks free of water with high pressure air.

4. Lightly apply a tack coat to the crack surfaces.

3.07 CRACK CLEANING AND FILLING, EMULSION (Continued)

5. Fill the cracks with asphalt.
   a. Ensure mix is warm and pliable when placed.
   b. Rod and tamp the mix into place level with the adjacent surface.
   c. Place mixture prior to filling cracks with emulsion.

6. Place a thin application of emulsion over the asphalt and tightly spread with a squeegee.

C. Cracks 1/4 inch to 1 inch in Width:

1. Clean the cracks of loose and spalled material, sand, and other foreign debris with high pressure air or high pressure water. Clean crack down to sound material, but a depth greater than 3 inches will not be required.

2. When specified in the contract documents, utilize additional methods to clean cracks of old crack filler.

3. Fill cracks with emulsion filler material.

D. Cracks Less Than 1/4 inch in Width:

1. Clean sufficiently to remove sand and other foreign debris.

2. Fill cracks with emulsion filler material.

E. Map-cracked (Alligator) Areas:

1. Cover area with emulsion filler material.

2. Spread emulsion over area with squeegee, working emulsion into cracks. Provide a thin, smooth application.

3. Promptly cover the filler material with a light application of blotter material.

3.08 PAVEMENT REMOVAL

A. Saw full depth at pavement removal limits.

B. Extend pavement removal limits to existing joint lines as directed by the Engineer.

C. Protect existing pavement, beyond removal limits, from damage. Remove to a new saw line and replace, at no additional cost to the Contracting Authority, all concrete broken or damaged beyond the removal limits designated by the Engineer.

3.09 CURB AND GUTTER REMOVAL

A. Saw longitudinally along the existing gutter joint or at a location directed by Engineer. Saw transversely at the curb and gutter removal limits.

B. Remove existing curb and gutter without damaging the existing pavement to remain.

3.10 DOWEL BAR RETROFIT

A. Cutting and Preparing Slots:

1. Cut slots to the required width and depth with gang saw capable of cutting a minimum of three slots in each wheel path simultaneously. Multiple cuts in each slot may be required.

2. Use 30 pound maximum pneumatic hammers operated at a 45 degree angle or less to remove concrete from the slots. Prevent damage to surrounding concrete. Smooth and level the bottom of the slots with a lightweight bush hammer.

3. Sandblast or waterblast to clean exposed surfaces of slot and fill transverse contraction joint on the bottom and sides of the slot with caulking filler.

B. Placing Dowel Bars:

1. Set dowel bars at the depth shown on the plans with chair devices.

2. Ensure dowel bars are parallel to the centerline of the pavements and to the pavement surface.

3. Place dowel bars within 1/4 inch of required alignment.

4. Center dowel bars over transverse joints or cracks so a minimum of 6 inches extends into adjacent panel.

5. Cut foam core material and place at center of dowel bar so the material is flush with the pavement surface or slightly recessed and in line with the joint or crack. Maintain foam core material in vertical position, tight to the slot edges during grout placement.

C. Grouting:

1. Thoroughly moisten all surfaces of the slot immediately prior to filling with grout. Remove any excess water with compressed air.

2. Produce grout with a portable mixer and place immediately after mixing and before grout has attained initial set. Do not retemper grout with water.

3. Place grout according to manufacturer's recommendations. Consolidate with hand held vibrator. If pavement is to be diamond ground place grout 1/8 inch higher than surrounding pavement. Place grout flush if the pavement is not to be ground.

4. Thoroughly coat grout with white pigment curing compound immediately after placement.

D. Re-establish Joints or Cracks: After grout has attained sufficient strength, re-establish joint or crack above the foam core insert within 8 hours of grout placement by means of sawing. If foam board is visible, sawing is not required.

3.11 CORE HOLE CUTTING AND REPLACEMENT

A. Cutting Core:

1. Place a temporary mark on the pavement core and adjacent pavement if the core is to be reinstalled. Maximum diameter is 12 inches.

2. Utilize a diamond bit with the vertical alignment of core hole saw perpendicular to the horizon. Include a center core hole or another mechanism to extract the core without damage.

3. Cut the full depth of the existing pavement. Protect core from damage if it is expected to be re-used.

4. Vacuum or hydro excavate to expose the buried infrastructure. Maintain vertical sides.

B. Backfill: Place backfill using suitable native soil compacted to 95% Standard Proctor Density according to Section 3010, granular material compacted to 65% Relative Density, CLSM, or foamed cellular concrete to the elevation required in Figure 7040.107.

C. Pavement Core Replacement: Comply with Figure 7040.107 and the following.

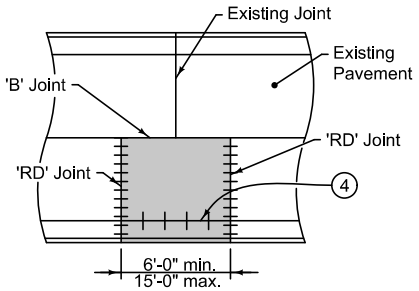
1. If allowed by the Jurisdiction, replace pavement core utilizing waterproof bonding material. Mix and place bonding material according to the manufacturer's recommendations to fill the annular space around the core and the original slab. Ensure reinstalled core is in its original orientation and is flush and level with the adjacent pavement. Remove excess bonding material.

2. For PCC pavement install rebar pins and place low slump concrete to match elevation of existing pavement.

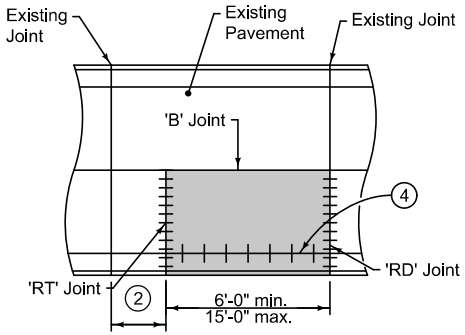
3. For asphalt pavements, use standard traffic surface, 1/2 inch mix, and PG 58-28S binder. Maximum lift thickness is 2 inches. If allowed by the Engineer, replace core with low slump concrete or pre-mixed high performance cold mix generally meeting the asphalt mixture noted above. Match elevation of existing pavement.

END OF SECTION

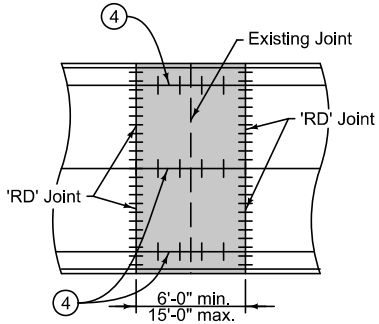
GUTTERLINE JOINTING



ONE PANEL WIDTH PATCH WITH OPPOSING JOINT

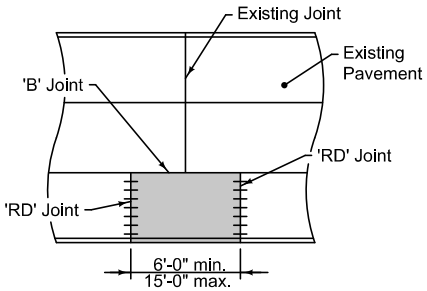


ONE PANEL WIDTH PATCH NO OPPOSING JOINT

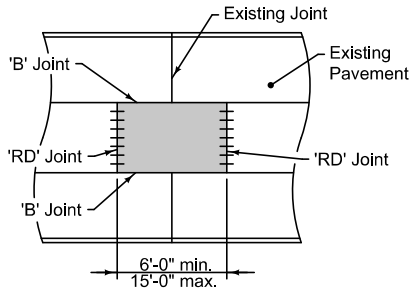


FULL ROADWAY WIDTH PATCH

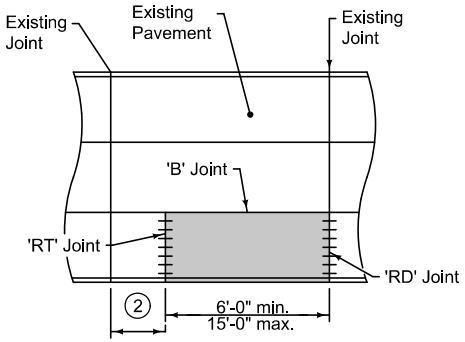
THIRD POINT JOINTING (1)



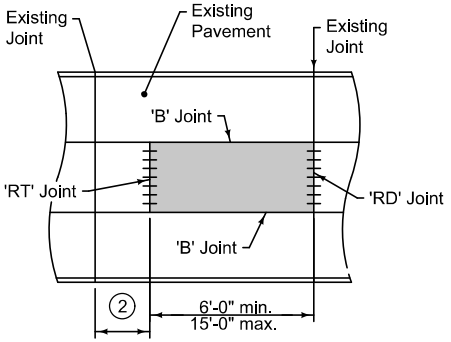
OUTSIDE PANEL PATCH WITH OPPOSING JOINT



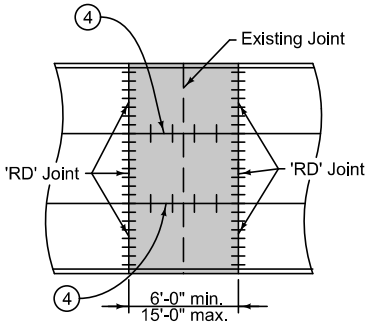
CENTER PANEL PATCH WITH OPPOSING JOINTS



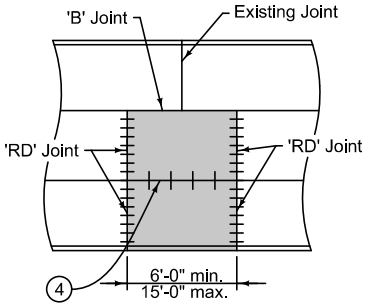
OUTSIDE PANEL PATCH NO OPPOSING JOINT



CENTER PANEL PATCH NO OPPOSING JOINT



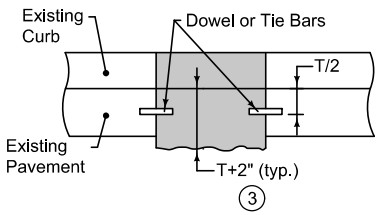
FULL ROADWAY WIDTH PATCH



ADJACENT PANELS PATCH

1. Patches on roadways with quarter point jointing will be similar to third point jointing details.
2. Minimum distance between existing joint and patch is 6 feet. If distance is less than 6 feet, extend patch to existing joint.
3. If subgrade or subbase material is required below patch, bring material to a level 2 inches below bottom of existing pavement.
4. BT, KT, or L joint depending on pavement thickness and pouring sequence.

LONGITUDINAL SECTION THRU PCC PATCH



SUDAS

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7040.101

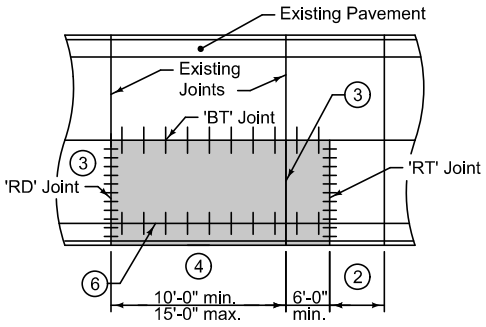
SHEET 1 of 1

SUDAS Standard Specifications

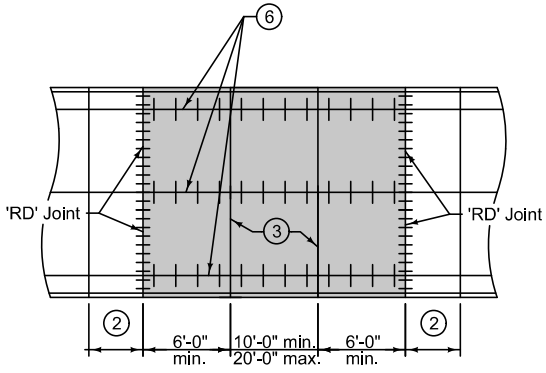
FULL DEPTH PCC PATCHES
LESS THAN OR EQUAL TO 15' LONG

FIGURE 7040.101 | SHEET 1 OF 1

GUTTERLINE JOINTING

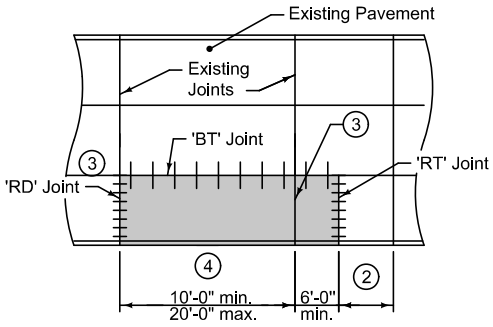


ONE PANEL WIDTH PATCH

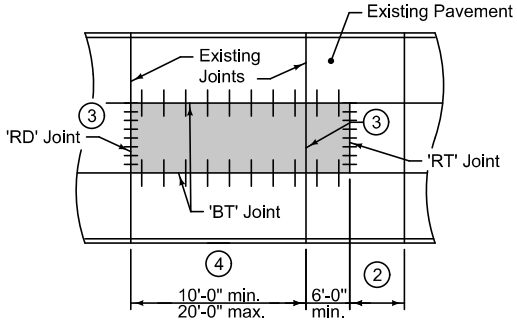


FULL ROADWAY WIDTH PATCH

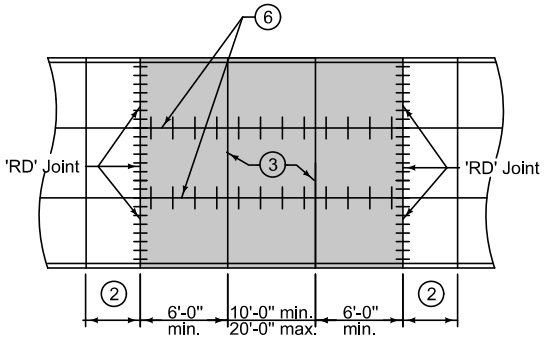
THIRD POINT JOINTING (1)



OUTSIDE PANEL PATCH



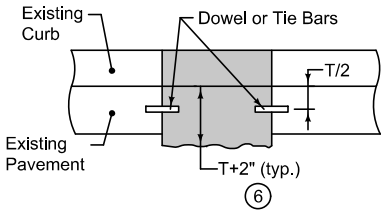
CENTER PANEL PATCH



FULL ROADWAY WIDTH PATCH

1. Patches on roadways with quarter point jointing will be similar to third point jointing details.
2. Minimum distance between existing joint and patch is 6 feet. If distance is less than 6 feet, extend patch to existing joint.
3. Match existing joint type and locations. If specified, replace existing 'C' joints with 'CD' joints.
4. If existing joint spacing is greater than 20 feet, add a 'CT' joint at mid-panel.
5. If subgrade or subbase material is required below patch, bring material to a level 2 inches below bottom of existing pavement.
6. BT, KT, or L joint depending on pavement thickness and pouring sequence

LONGITUDINAL SECTION THRU PCC PATCH



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7040.102

SHEET 1 of 1

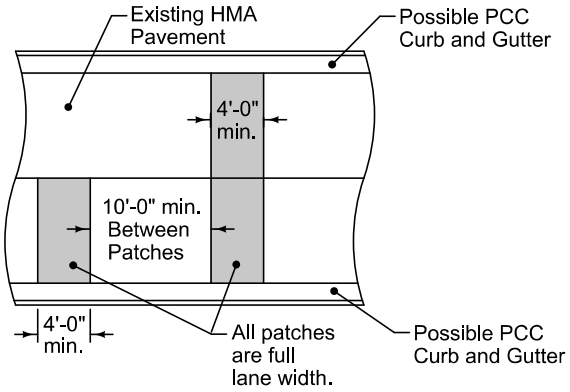
SUDAS Standard Specifications

FULL DEPTH PATCHES GREATER THAN 15' LONG

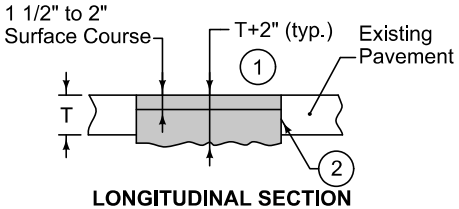
FIGURE 7040.102 | SHEET 1 OF 1

(1) If subgrade or subbase material is required below patch, bring material to a level 2 inches below bottom of existing pavement.

(2) When removing pavement, saw to full depth or 10 inches, whichever is less.



HMA PATCHES



LONGITUDINAL SECTION THRU HMA PATCH

FIGURE 7040.103

SHEET 1 OF 1

SUDAS

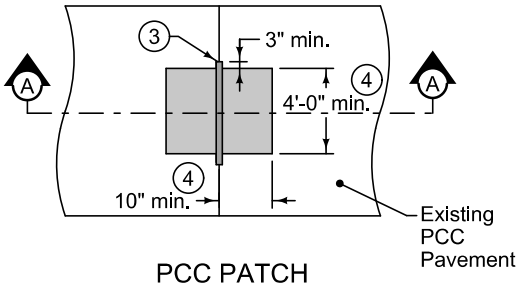
REVISION 2 10-17-17

7040.103

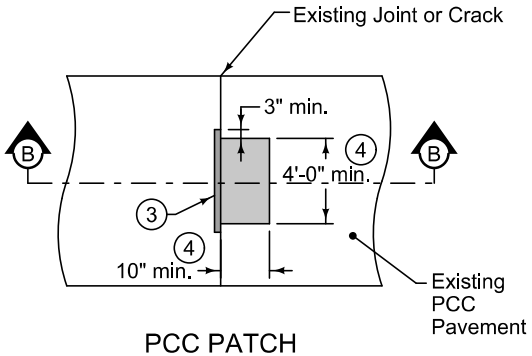
SHEET 1 of 1

SUDAS Standard Specifications

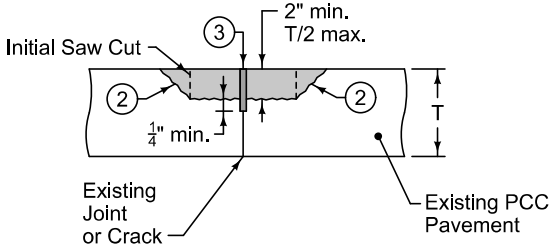
FULL DEPTH HMA PATCHES



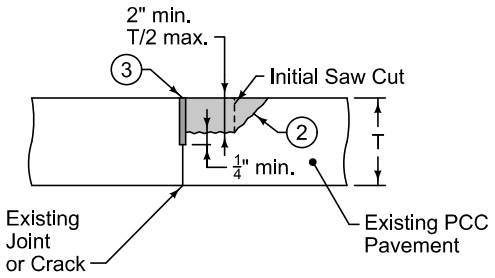
PCC PATCH
ACROSS JOINT



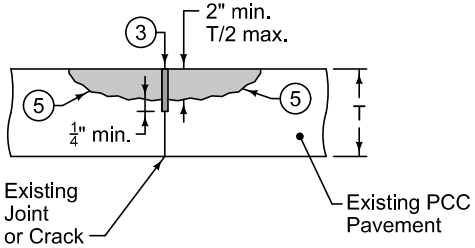
PCC PATCH
ABUTTING JOINT



SECTION A-A
(Option 1: Sawed Edges)

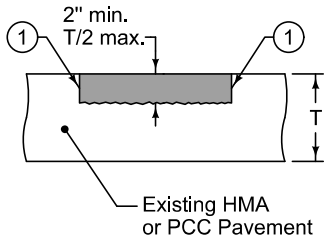


SECTION B-B



SECTION A-A
(Option 2: Milled Edges)

1. Vertical saw cut (typical). Apply tack coat to sides and bottom.
2. Taper the sides of the removal area 30 to 60 degrees from vertical. Apply cement grout to sides and bottom.
3. Saw and seal existing joint.
4. Extend patch limits at least 3 inches beyond distressed area.
5. When milled removal is allowed, sawed vertical edges are not required. Apply cement grout to milled area.



HMA PATCH

FIGURE 7040.104 | SHEET 1 OF 1

SUDAS

REVISION	
1	10-17-17

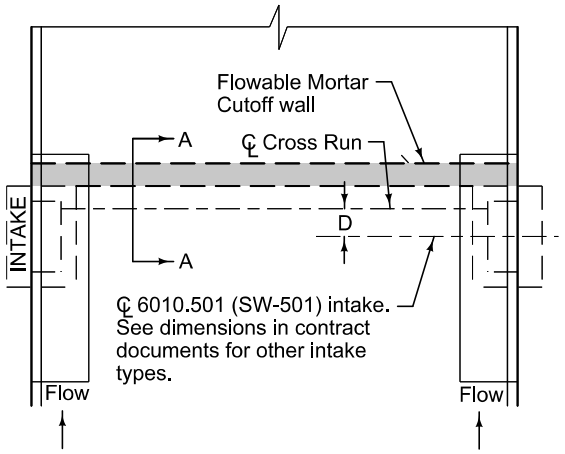
7040.104

SHEET 1 of 1

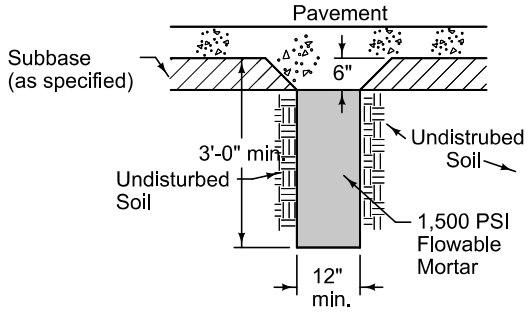
SUDAS Standard Specifications

PARTIAL DEPTH PATCHES

Length of cutoff wall to be back of curb to back of curb.

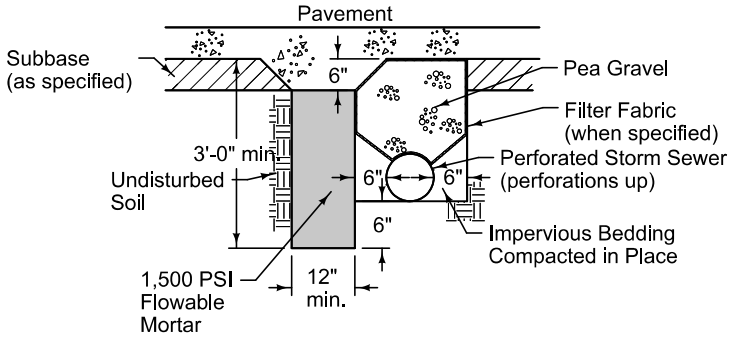


PLAN VIEW
(Flowable mortar cutoff wall and cross run location.)

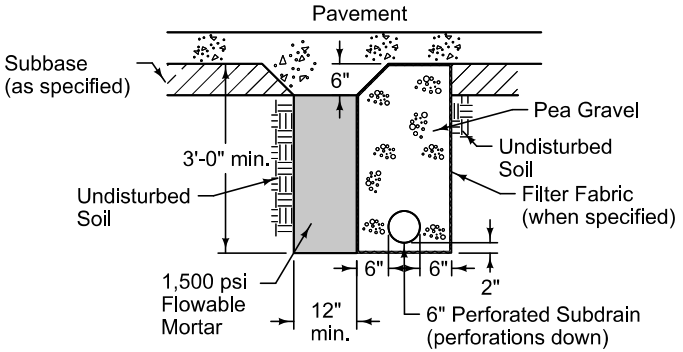


FLOWABLE MORTAR CUTOFF WALL
(Without Sewer)

DISTANCE FROM ℄ INTAKE TO ℄ CROSSRUN	
Size	D
15" RCP	0.7'
15" CMP	0.8'
18" RCP	0.5'
18" CMP	0.7'



SECTION A-A
(Flowable mortar cutoff wall and storm sewer)



FLOWABLE MORTAR CUTOFF WALL
(With Subdrain)

FIGURE 7040.105 | SHEET 1 OF 1

SUDAS

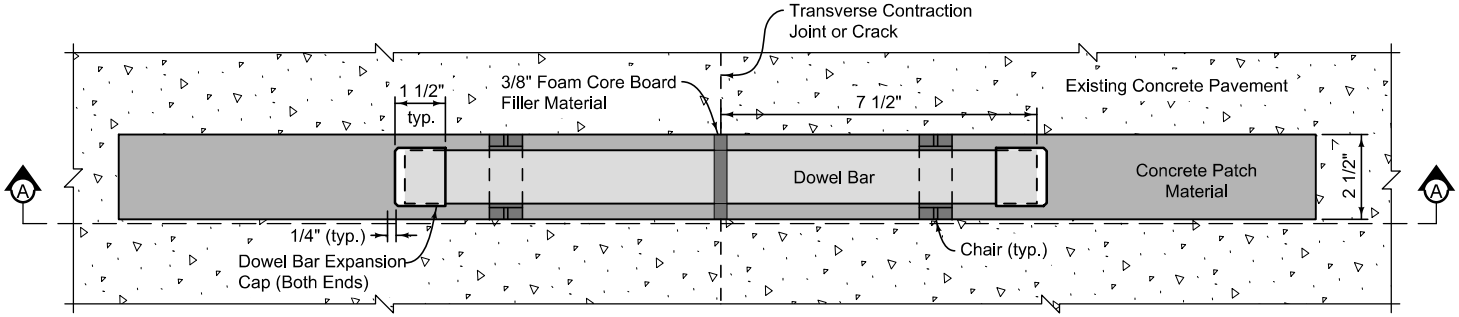
REVISION	
1	2022 Edition

7040.105

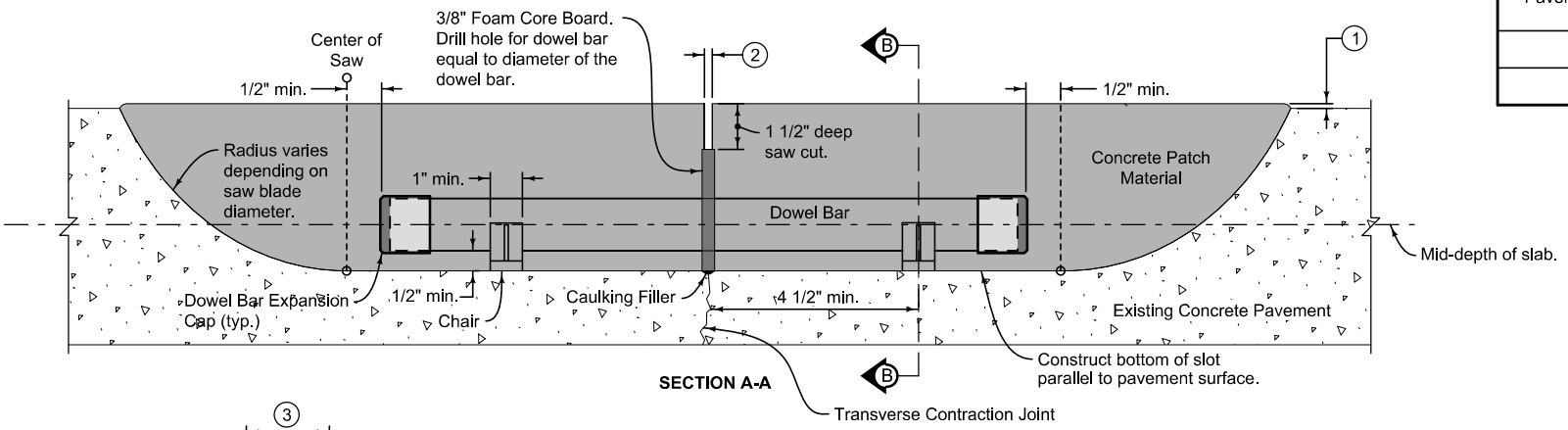
SHEET 1 of 1

SUDAS Standard Specifications

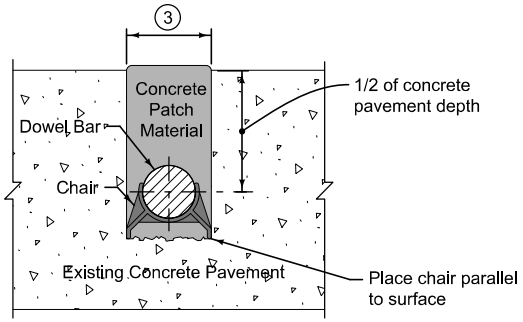
FLOWABLE MORTAR CUTOFF WALL



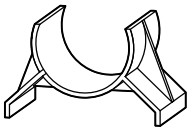
PLAN VIEW



SECTION A-A



SECTION B-B



CHAIR DETAIL

1. Extend concrete patch material 1/8" above existing concrete surface for projects to be diamond ground; construct flush if diamond grinding is not required.
2. Sawcut joint width 3/16" min to 5/16" max. Saw after concrete patch material has set.
3. Cut slot width equal to chair width (min) to chair width + 1/8" (max).

DOWEL BAR DIAMETER	
Pavement Thickness (inches)	Diameter (inches)
8 to 9½	1¼
>10	1½

FIGURE 7040.106 | SHEET 1 OF 1

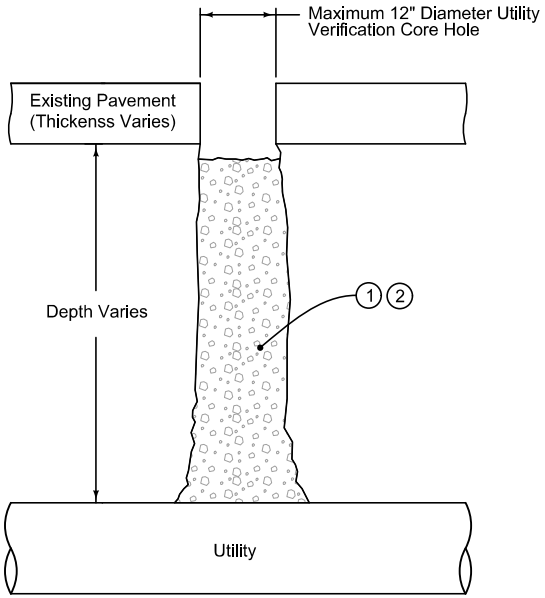
SUDAS | INTERIM | REVISION NEW 01-01-26

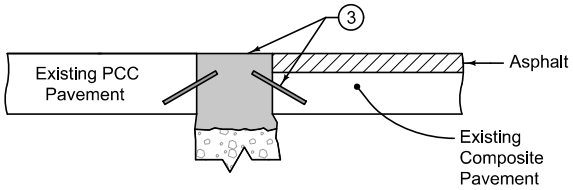
FIGURE 7040.106 | STANDARD ROAD PLAN | PR-106 | SHEET 1 of 1

REVISIONS:

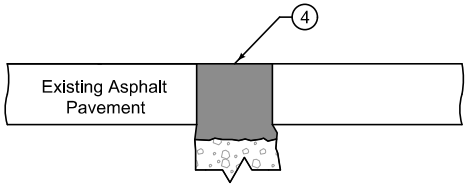
SUDAS DIRECTOR | DESIGN METHODS ENGINEER

DOWEL BAR RETROFIT

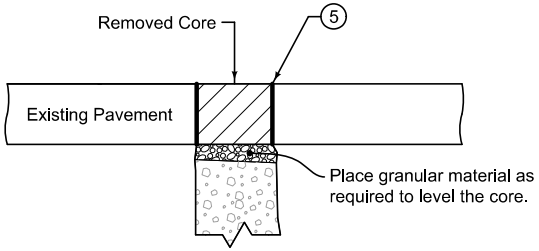




PCC CORE HOLE REPAIR



ASPHALT CORE HOLE REPAIR



CORE REPLACEMENT
(Reinstatement of Removed Core)

For pedestrian ramps damaged by subsurface utility exploration (SUE) core holes, replace the entire ramp according to Section 7030. For pavements damaged by SUE core holes, provide patches according to Figures 7040.101 or 7040.103. If allowed by the Engineer, repair core holes as shown.

1. Fill vacuum excavated SUE hole with CLSM to an elevation within 2 inches of the bottom of the pavement.
2. When allowed by the Engineer, fill utility verification hole with Class I bedding stone, pea gravel, or suitable native materials. Place backfill materials in 4 inch maximum lifts and compact each lift.
3. For PCC core hole repairs, drill four, 5 inch long, 5/8 inch diameter holes into the sides of the core hole at a 30 to 45 degree angle. Grout four 8 inch long #4 reinforcing bars into holes. Fill core holes with low slump concrete, tamp to remove air voids, screed level with existing pavement and texture to match existing pavement.
4. For asphalt core hole repairs, place asphalt mixture in 2 inch lifts and compact. If allowed by the Engineer, replace core with low slump concrete as noted above or pre-mixed high performance cold mix generally meeting the asphalt mixture specified. Match elevation of existing pavement.
5. When allowed by the Engineer, the removed core may be replaced back in the core hole. If the removed core is intact, stable, and free of fractures, replace core back in hole and fill annular space with approved bonding material.

SUDAS

REVISION
New | 2021 Edition

7040.107

SHEET 1 of 1

SUDAS Standard Specifications

UTILITY CORE HOLE REPAIR

FIGURE 7040.107 | SHEET 1 OF 1

ASPHALT STABILIZATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

Asphalt Stabilization for existing unpaved roadways

1.02 DESCRIPTION OF WORK

Asphalt stabilization consists of a mixture of emulsified asphalt, imported mineral aggregate, and existing roadway material; properly proportioned, mechanically mixed, spread evenly on the surface specified, compacted in place and surfaced to the thickness, width, and crown specified in the plans.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Asphalt Stabilization:

1. **Measurement:** Measurement will be in square yards for asphalt stabilization.

2. **Payment:** Payment will be at the unit price per square yard of asphalt stabilization.

3. **Includes:** Unit price includes, but is not limited to, furnishing and spreading imported material, applying and incorporating asphalt stabilization, blending of the materials, grading and compacting the blended materials, and final clean up.

B. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

C. Re-shaping Ditches: Comply with Section 2010 for Class 10, Class 12 or Class 13 Excavation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Asphalt Emulsion: Comply with the slow setting cationic emulsified asphalt; CSS-1 per ASTM D 2397.

B. Aggregate: Pitrun gravel, crushed stone, or reclaimed material as specified in the contract documents.

PART 3 - EXECUTION

3.01 EQUIPMENT

Comply with Iowa DOT Section 2001 for all equipment, tools, and machines used in the performance of this work.

A. Motor Grader: Include attachments for scarifying, shaping, ditching, grading, and sloping. A basic motor grader does not weigh less than 22,000 pounds.

B. Asphalt Distributor: Ensure the tank is insulated and range in capacity from 500 to 1,500 gallons. The truck mounted asphalt distributor must have a circulating system, spray bar (fully circulating), and calibration controls.

C. Pug-mill Mixer: Use a road reclaiming machine or similar tractor mounted or towed mechanical mixers for blending, emulsion, and roadway aggregates.

D. Rollers: A vibratory type roller compactor, minimum static weight 10,000 pounds, and minimum dynamic force of 15,000 pounds is recommended. Rollers must be capable of compacting a 6 inch lift of blended asphalt stabilized material to a minimum density of 95% of maximum Standard Proctor Density.

3.02 RE-SHAPING DITCHES

A. Remove excess and undesirable material from side ditches and properly dispose of material.

B. Shape ditches as shown on typical cross-section. Do not place excess material excavated from ditch on the roadway but dispose of material off of the roadway.

3.03 PREPARE / PLACE BASE MATERIAL

A. Reclaim present surface material by pulverizing the existing roadway surface to a minimum depth of 4 inches or the depth specified by the Engineer for the full length and width of the designated roadway.

B. Spread the imported aggregate as uniformly as possible on center 15 feet of roadway at the rate of 10 pounds per square foot for the full length of designated roadway.

3.04 SURFACE FIXTURE ADJUSTMENT

Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with Section 6010, 3.04 for manhole adjustments and Section 5020, 3.04 for water fixture adjustments.

3.05 APPLICATION AND MIXING OF ASPHALT EMULSION

A. Do not apply asphalt stabilization during rainfall, when excessive moisture content exists, when the air temperature is below 50^{o} F in the shade, or during night conditions.

B. Incorporate asphalt emulsion with a pug-mill mixer, road reclaimer, or similar machine, capable of thoroughly mixing and/or incorporating the emulsion in a single pass.

C. Alternately, a distributor truck may be used to apply the asphalt emulsion. Apply one-half of the required emulsion. Thoroughly blade mix to incorporate the emulsion into the aggregate. Once the emulsion is worked into the aggregate, windrow the mixture and apply the second half of the emulsion and incorporate as noted above.

D. Adjust the application rate to obtain a minimum of 3% residual asphalt.

3.06 GRADE AND COMPACT MATERIAL

A. Blade blended material on the roadway to form a uniform mat over the final design cross-section.

B. Obtain final cross-section and smoothness by compaction with a sheepsfoot and subsequent rolling with vibratory and pneumatic rollers and alternating final blade shaping. Continue rolling until compacted to a minimum of 95% of maximum Standard Proctor Density.

C. Following compaction, open roadway to traffic.

3.07 SURFACE TREATMENT

After a minimum of 48 hours, re-close the roadway and apply the surface treatment specified in the contract documents. Comply with Section 7060, Bituminous Seal Coat; Section 7070, Emulsified Asphalt Slurry Seal; or Iowa DOT Article 2306, Bituminous Fog Seal. Blot fog seal with sand prior to reopening of the roadway to prevent tracking of the asphalt emulsion.

END OF SECTION

BITUMINOUS SEAL COAT

PART 1 - GENERAL

1.01 SECTION INCLUDES

Bituminous Seal Coat Surface

1.02 DESCRIPTION OF WORK

Includes preparation of surface, heating of bituminous materials and placing of the seal coat bitumen, spreading aggregate, and rolling the aggregate.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Bituminous Seal Coat by Area:

1. **Measurement:** Measurement will be in square yards for bituminous seal coat.

2. **Payment:** Payment will be at the unit price per square yard of bituminous seal coat.

3. **Includes:** Unit price includes, but is not limited to, surface preparation including protection of street fixtures; furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts; and final clean up.

B. Bituminous Seal Coat by Units:

1. **Cover Aggregate:**
   a. **Measurement:** Measurement will be in tons of cover aggregate. If sand is required for bleeding control, it will be measured the same as cover aggregate.
   b. **Payment:** Payment will be at the unit price per ton of cover aggregate. If sand is required for bleeding control, it will be paid at 75% of the unit price as cover aggregate.
   c. **Includes:** Unit price includes, but is not limited to, surface preparation including protection of street fixtures; furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts; and final clean up.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Binder Bitumen:

a. Measurement: Measurement will be in gallons of binder bitumen furnished and incorporated, including street surface, fillets, and turnouts.

b. Payment: Payment will be at the unit price per gallon of binder bitumen furnished and incorporated.

c. Includes: Unit price includes, but is not limited to, furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts; and final clean up.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregates: Use an aggregate cover that is washed and composed of crushed, hard durable gravel, crushed stone, or mixture with abrasion loss by AASHTO T 96 not exceeding 40%. Gradation complying with the following:

Percent Passing										
Sieve Size	1/2”		3/8”		1/4”		No. 4		Sand	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
3/4”	100									
1/2”	97	100	100							
3/8”	40	90	90	100	100				100	
1/4”							100			
No. 4	0	30	10	55	55	85	85	100		
No. 8	0	15	0	20	0	10	10	40	60	90
No. 30			0	7			0	85		40
No. 200	0	2	0	1.5	0	1.5	0	1.5	0	1.5

B. Bituminous Material: Unless the contract documents specify a specific grade, use cationic emulsion CRS-2P binder bitumen complying with Iowa DOT Section 4140. Other grades include CRS-2 according to Iowa DOT Section 4140 or HFRS-2 complying with AASHTO T 59.

Use cut back asphalt MC-800 or MC 3000, meeting Iowa DOT Section 4138, if specified in the contract documents.

Use grade CSS-1, CSS-1H, or SS-1H, meeting Iowa DOT Section 4140, if specified in the contract documents for dust control. Dilute with water prior to application. Use an initial dilution rate of seven parts water to one part emulsion.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Aggregate Spreaders:

1. Spreader:
- Self propelled, mounted on pneumatic tires, with a width of spread not less than 12 feet.
- Capable of spreading aggregate specified above at a rate desired from 3 to 50 pounds per square yard of surface covered without contact of the wheels of the spreader with the treated surface until the aggregate has been spread.
- Sufficient power to propel itself at uniform speed on gradients up to 6%.
- Have cutoff plates to allow the width of spread to be reduced in increments of 1 foot from the maximum width down to 4 feet wide.

2. Hopper: Minimum capacity of 5 tons.

B. Bitumen Distributors:
- Mount on dependable motor trucks equipped with pneumatic tires.
- Provided with burners with heating coils and an accurate thermometer indicating temperature of the bitumen in the tank.
- Supply bitumen to spray bars to produce an even spray at rates varying from 0.03 gallon to 0.5 gallon per square yard in a smooth uniform coating at a forward speed of up to 20 mph.
- Adjust the spray bars vertically and provide a total spray width of no less than 12 feet.
- When emulsion binder bitumen is used, use a distributor spray bar equipped with nozzles specifically designed to apply emulsion.
- Before the work is started, provide the Engineer with a written statement indicating the size or part number of the nozzles recommended by the manufacturer and certifying the nozzles are installed on the distributor.
- Operate distributors according to manufacturer's instructions for use for spray bar height above surface, nozzle size, angle of spray fan, and tables of rates of distribution in gallons per square yard for tachometer readings. Verify distributor before using.

C. Brooms: A power-driven rotary or pick-up broom is required for cleaning surfaces before the bitumen is applied.
- Driven by an auxiliary motor or by power take-off.
- When using a power broom to remove loose aggregate from a newly seal coated surface, ensure it is capable of exerting uniform down pressure (for the full width of the broom and without vibration or bounce) sufficient to remove loose aggregate without dislodging particles that are stuck in the binder bitumen.

D. Rollers:
- Self-propelled, pneumatic tire rollers, with tires no smaller than 7.50 by 15 size.
- Load rollers to produce a compressive force of no less than 200 pounds per inch width of the roller.
- Ensure tire inflation is no less than 60 psi.
- Do not use steel rollers unless authorized by the Engineer.

3.02 SURFACE PREPARATION

A. Hard Surfaced Streets:

1. If specified, complete patching and joint filling according to Section 7040.

2. Immediately before bitumen is applied, clean the entire surface to be treated, as well as the adjacent gutters, of all foreign material, including dust and weeds.

3. Sweep, clean, and perform work required to produce a clean surface. If the power broom fails to remove dust from depressions and pockets, use hand brooms.

4. Remove the material that was cleaned from the surface. This material becomes the property of the Contractor.

5. Use a suitable covering to protect the items below from being soiled by bitumen. Leave the protective covering in place until the bitumen has set and no splashing occurs under traffic.
   - Curbs and handrails of bridges
   - Guardrails
   - Headwalls of culverts
   - Pavements
   - Curbs and gutters
   - Manholes and utility accesses
   - Intakes
   - Water and gas valves
   - Railroad flangeways
   - Other installations requiring protection

6. Place suitable covering, as required, to prevent cover aggregate from entering intakes or other similar structures during placement and while brooming excess cover aggregate.

B. Rock Surfaced Streets: Comply with Section 7050.

3.03 HEATING BITUMINOUS MATERIAL

Heat bituminous materials to the temperature that allows uniform spreading. It is estimated that temperatures between the following limits will produce the desired viscosity. Material that has been damaged by overheating will be rejected.

Designation	Temperature
CRS-2	125-185
CRS-2P	125-185
HFRS-2	125-185
MC 800	175-255
MC 3000	215-290
MC 70	145-165

3.04 SPREADING BITUMINOUS MATERIAL

A. General: Do not apply seal coats after September 15 unless temperatures in the shade are 60°F and rising and the work is approved by the Engineer. Do not spread until the distributor has been tested to ensure a uniform distribution of bitumen. Minimize longitudinal overlap of adjacent bitumen applications. Spread between 95% and 105% of the bituminous material the Engineer prescribes. Correct the rate of application for temperature to deliver the desired volume at 60°F.

3.04 SPREADING BITUMINOUS MATERIAL (Continued)

B. Spreading Binder Bitumen: Do not place seal coat on a wet surface or in night conditions. Apply bitumen to the prepared base at the rate shown in the table below, if not otherwise specified in the contract documents.

Aggregate	Application rate (Gal/SY)
1/2”	0.27
3/8”	0.24
1/4”	0.21
No. 4	0.18
Sand	0.15

Close adjacent applications of bitumen with a minimum longitudinal lap. For CRS-2P and CRS-2, spread the binder bitumen on an area no greater than can be covered with aggregate and initially rolled within 2 minutes. Place the bitumen spreader and aggregate spreader as close as possible, but no more than 150 feet apart. Do not allow the length of spread to be greater than can be completely rolled within 30 minutes after the bitumen spread has been completed. Maintain initial roller coverage as close to the aggregate spreader as possible, not to exceed 200 feet.

For HFRS-2 emulsions, allow a slight skim to be formed on the surface before spreading aggregate.

C. Joints:

1. Secure binder bitumen distribution at the specified rate of application using paper placed at the start of each distributor run. Use commercial grade building paper that is approved by the Engineer and is no less than 36 inches wide.

2. When the end of the run joins newly placed seal coat, place paper at that joint also. Cut the joint straight along the off edge of the paper. Remove the seal coat material on the paper adjacent to the off edge from the roadbed surface. Ensure a smooth ride is obtained.

D. Spreading Cover Aggregate: Promptly after spreading bitumen on any section, spread cover aggregate of the size specified uniformly over the treated area as noted in the table below, if not otherwise specified in the contract documents.

Aggregate	Application Rate (lbs/SY)
1/2”	24
3/8”	21
1/4”	18
No. 4	18
Sand	18

E. Maintenance During Construction Period: If bleeding occurs during construction, cover area with 15 pounds of sand per square yard to control bleeding. Rolling is not required.

3.05 ROLLING

A. Complete initial pass of pneumatic tired roller within 2 minutes after spreading the cover aggregate. Complete rolling operations within 30 minutes after binder bitumen has been sprayed. Operate rollers at a speed of no more than 5 mph.

B. Five passes of a roller is required for cover aggregate; one pass is required for sand applied as cover.

3.05 ROLLING (Continued)

C. Do not apply succeeding applications of binder bitumen until rolling operations are completed for the previous course.

3.06 TWO COURSE SEAL COATS

A. First Course Construction: Complete as specified above.

B. Second Course Construction:

1. Preparation of Roadbed:

a. After completing the first course, prepare the roadbed for the second course either:
- With a vacuum machine, or
- By lightly brooming the full surfaced width with the power sweeper to remove all loose material.

b. After cleaning, roll the entire surface once with a roller.

c. Complete the preparation of the roadbed in sections just prior to application of bitumen for the second course.

2. Spreading Binder Bitumen: Spread bitumen on the prepared surface at the rate specified in the contract documents.

3. Spreading Cover Aggregate: Spread cover aggregate of the size specified over the treated area at the rate specified in the contract documents, promptly after spreading bitumen on any section of roadbed.

3.07 CLEAN UP

After final rolling operation, use a sweeper with a dust suppressant system to pick up loose aggregate. Complete clean up as directed by the Engineer, but no more than 21 days after application. For rural-type pavements, the Engineer may determine that sweeping is not necessary.

END OF SECTION

EMULSIFIED ASPHALT SLURRY SEAL

PART 1 - GENERAL

1.01 SECTION INCLUDES

Emulsified Asphalt Slurry Seal

1.02 DESCRIPTION OF WORK

Includes the requirements for surface treatment of an existing pavement with an application of an emulsified asphalt slurry seal. In addition, the work may involve the following items:

A. Slurry Leveling: Use fine slurry mixtures to fill shallow depressions in the pavement and over cracks.

B. Strip Slurry Treatment: Applications of fine or coarse slurry mixtures as specified in the contract documents

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Keep the various aggregate products separate, and make adequate provisions to prevent intermingling. Handle stockpiling and processing in a manner that will ensure uniform incorporation of the aggregate into the mix.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Emulsified Asphalt Slurry Seal by Area:

1. Measurement: Measurement will be in square yards for emulsified asphalt slurry seal.

2. Payment: Payment will be at the unit price per square yard of emulsified asphalt slurry seal.

3. Includes: Unit price includes, but is not limited to, surface preparation and furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Emulsified Asphalt Slurry Seal by Units:

1. Aggregate:

a. Measurement: Measurement will be in tons of aggregate.

b. Payment: Payment will be at the unit price per ton.

c. Includes: Unit price includes, but is not limited to, surface preparation and furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts.

2. Asphalt Emulsion:

a. Measurement: Measurement will be in gallons of asphalt emulsion furnished and incorporated, including street surface, fillets, and turnouts.

b. Payment: Payment will be at the unit price per gallon of asphalt emulsion furnished and incorporated.

c. Includes: Unit price includes, but is not limited to, surface preparation and furnishing and placing of materials, including fillets at intersecting streets, driveways, and turnouts.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Asphalt Emulsion: Use a Grade CSS-1H (AASHTO M 208) or SS-1H (AASHTO M 140) emulsified asphalt meeting the requirements of Iowa DOT Section 4140.

B. Aggregate:

- Mineral aggregate consisting of natural or manufactured sand, slag, crusher fines, and others, or a combination thereof.
- Smooth-textured sand not exceeding 50% of the total combined aggregate.
- Clean and free from vegetable matter and other deleterious substances.
- When tested according to ASSHTO 96, shows a loss of no more than 40.
- When specified, use crushed aggregates meeting the requirements of Iowa DOT Section 4124.

Mineral fillers such as portland cement, limestone dust, fly ash, and others are considered part of the blended aggregate; use in minimum required amounts. Only use fillers if needed to improve the workability of the mix or gradation of the aggregate.

C. Mixture Gradation: Use composite aggregate, excluding mineral filler that complies with the following gradation limits for the specified slurry mixture required:

1. Fine Slurry Mixture: Use aggregate meeting the requirements of Iowa DOT Article 4109.02, Gradation No. 22 of the Aggregate Gradation Table.

2. Coarse Slurry Mixture: Use aggregate meeting the requirements of Iowa DOT Article 4109.02, Gradation No. 23 of the Aggregate Gradation Table.

D. Water: Use water that is potable and free of harmful soluble salts in the slurry mixture.

2.02 COMPOSITION OF THE SLURRY MIX

A. Blend the amount of asphalt emulsion with the aggregate as specified in the contract documents and as adjusted in the field.

B. A minimum amount of water may be added as necessary to obtain a fluid and homogeneous mixture. Mix until the consistency is such that it “rolls” in the spreader box in a continuous mass.

C. Slurry that segregates in the spreader box, so that flowing of liquids (water and emulsion) is evident, is not acceptable.

D. Provide the Engineer with a copy of the certified gradations of aggregate proposed for use.

E. Asphalt Binder Content:

1. Estimated Asphalt Residue Content: 7% to 14% of the dry weight of the aggregate.

2. Mixture Design Film Thickness: 7.5 microns (target value) with a ± 0.75 microns permissible range.

F. Handling and Sampling Slurry Materials:

1. Stockpiling of Aggregate:
   a. Take precautions to prevent stockpile contamination with oversized rock, clay, silt, or moisture in excess of which would interfere with the amount of asphalt emulsion required in producing the desired homogeneous slurry mixture.

2.02 COMPOSITION OF THE SLURRY MIX (Continued)

b. Place the stockpile in a well drained area. Do not allow the aggregate to become segregated.
c. Control the moisture in the aggregate to be within ± 1.5% of the moisture content of the aggregate at the time of calibration.

2. Storage:
   a. Provide suitable storage facilities for the asphalt emulsion. Use a container equipped to prevent water from entering the emulsion.
   b. Provide suitable and adequate heat to prevent freezing and to facilitate handling of the asphalt emulsion.

3. Sampling: Furnish samples of materials during the process of the work as directed by the Engineer.

2.03 MIX DESIGN

A. General: Develop the mix design for the slurry mixture using the services of an independent testing laboratory that is certified by the International Slurry Surfacing Association (ISSA). Verify the functioning of the set regulating additives and present certified test results for the Engineer's approval prior to the work commencing. The Engineer will verify the laboratory tests required in ISSA A105 have been conducted.

B. Proportions: Meet following limits.

Mineral Aggregate, dry weight lb/sq yd	15 to 25
Emulsified Asphalt Residue, % by weight of aggregate	7.5 to 13.5%
Latex Base Modifier (if required)	As required with % by weight of binder, min. of 5.0
Mix Set Additive	As required
Mineral Filler, % by weight of aggregate	0.5 to 2.0% depending on weather conditions

C. Compatibility: Verity the compatibility of the aggregate, emulsified asphalt, mineral filler, and other additives with the mix design. Meet the following requirements for ISSA A105:

ISSA Test No.	Description	Specifications
ISSA TB-139	Wet Cohesion @ 30 minutes min. (set) @ 60 minutes min. (traffic)	 12 kg-cm min. 20 kg-cm min. or Near Spin min.
ISSA TB-109	Excess Asphalt by LWT Sand Adhesion	50 gm/sq ft max.
ISSA TB-114	Wet Stripping	Pass (90% min.)
ISSA TB-100	Wet-Track Abrasion Loss One-hour Soak	 75 gm/sq ft max.
ISSA TB-113	Mix Time @ 77°F	Controllable to 180 seconds, min.
ISSA TB 106	Consistency	0.79-1.18 inches
ISSA TB 113	Mix Time at 77°F	Controllable to 180 seconds, min.

Check the mixing test and set time test at the highest temperatures expected during construction.

2.03 MIX DESIGN (Continued)

D. Submittal: In the mix design, report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effect). Clearly show the proportions of aggregate, mineral filler (minimum and maximum), water (minimum and maximum), additive usage, and asphalt emulsion based on the dry weight of the aggregate.

For the aggregate blend in the mix design, provide the test results for AASHTO T 176 with the mix information to the Engineer. The Engineer's review and approval will be required for aggregate test values below 45.

E. Approval: Show the percentages of each individual material required in the laboratory report. Obtain approval from the Engineer for the mix design prior to its use. After approval, substitutions will not be allowed unless approved by the Engineer. Maintain continuous control of the emulsified asphalt to dry aggregate proportioning to conform to the approved mix design within a tolerance of ± 2 gal/ton.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Slurry Mixing Equipment:

1. Use a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water, control additives, and asphalt emulsion to the mixing chamber, and discharging the thoroughly mixed product on a continuous basis.

2. Pre-wet the aggregate immediately prior to mixing with the emulsion. Use a pugmill capable of thoroughly blending all ingredients together.

3. When required, use a mixing machine equipped with an approved fines feeder that provides an accurate metering device, or method, to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed.

4. Use an aggregate feed to the mixer equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.

5. Use a positive displacement type emulsion pump equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.

6. For adding water to the mixer, use a pump equipped with a valve to establish the required water flow.

7. Mechanically tie all controls to ensure accurate proportioning of all materials at all times, including starts and stops. On some machines, this can be a simultaneous start and stop of all materials. On other machines, depending on where the materials are introduced into the mixing chamber, the feeds must be properly synchronized.

8. Use a one-lever or one-button operation with no means for the operator to adjust the mix proportions, except for the water.

9. Use revolution counters that count 0.1 revolutions on mechanisms that turn less than 100 rpm.

10. Attach a metering device to the slurry machine for the addition of additive to the mixture or any component material. Use a device that has positive, quick-acting controls, is easily calibrated, and maintains accurate and uniform flow.

11. Provide a means for calibrating the mixer. Calibrate and properly mark the controls for proportioning each material to be added to the mix. Use equipment with controls placed so they are readily accessible for calibration and so the Engineer may determine the amount of each material being used at any time. A minimum of three aggregate gate settings will be required for calibration and, if changes in emulsion delivery are necessary, a minimum of three pump changes will be required.

12. Use a mixing machine that:
    - Is equipped with a water pressure system and fog type spray bar adequate for complete fogging of the surface preceding spreading equipment,
    - Is controllable to an application range of 0.05 gallon per square yard, and
    - Provides sufficient machine storage capacity to properly mix and apply a minimum of 5 tons of the slurry, except when the mixing machine is operated in a continuous manner and is supplied by separate nurse type equipment.

3.01 EQUIPMENT (Continued)

B. Slurry Spreading Equipment:

1. Full Width, Slurry Wedge, Strip Slurry Treatment:

a. Use a mixer machine with an attached mechanical type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. Maintain the squeegee to prevent loss of slurry on varying grades and crown. Include a steering device and a flexible strike off.

b. Use a spreader box capable of placing the slurry mixture to the width specified in the contract documents. Use a spreader box equipped with vertical adjustment devices attached to horizontal support devices (such as runners) located a minimum of 6 inches inside both ends at the side of the box. This is to ensure uniform distribution on varying grades and crowns. Use vertical adjustment devices of sufficient weight (mass) to keep the horizontal support devices in contact with the roadway surface during operation. Use flexible strike off material of sufficient stiffness to produce the desired texture and rate of application.

c. Keep the spreader box clean. Do not allow build up of asphalt and aggregate on the box.

2. Slurry Leveling: Use metal lutes of varying widths for spreading the slurry mixture in the depressed areas. Ensure the face of each lute is indented (arched) slightly (1/8 inch to 3/16 inch) to aid in controlling the spread.

C. Cleaning Equipment: Use power brooms, power blowers, air compressors, water flushing equipment, or hand brooms for cleaning the surface and cracks.

D. Auxiliary Equipment: Furnish hand squeegees, shovels, and other equipment as necessary to perform the work.

E. Screening Unit: Use a screening unit to remove objectionable oversize and foreign material that may be encountered. Screen material before loading the slurry machine and/or weighing for payment.

3.02 SURFACE PREPARATION

A. If specified, complete pavement patches and joint or crack filling per Section 7040.

B. Immediately prior to applying the slurry, clean the surface of all loose material, mud spots, vegetation, and other objectionable material.

C. Any standard cleaning method used to clean pavements such as power brooms, compressed air, high-pressure water, and hand tools will be acceptable, except water flushing will not be allowed in areas where considerable cracks are present in the pavement surface. The surface preparation is subject to approval of the Engineer prior to placement of the slurry material.

D. Use a suitable covering to protect the items below from being soiled by bitumen. Leave the protective covering in place until the bitumen has set.

- Pavements adjacent to the beginning and end of placement.
- Manholes and Utility accesses.
- Intakes.
- Water and gas valves.
- Railroad flange ways.
- Other installations requiring protection.

3.03 APPLYING SLURRY MATERIAL

A. When directed by the Engineer, fog the surface of the pavement with water immediately preceding the pass of the spreader. Apply the water fog at such a rate that the entire surface is damp (approximately 0.05 gallon per square yard) with no apparent flowing water in front of the slurry box.

B. Ensure the slurry mixture is of the desired consistency such that it “rolls” in the spreader in a continuous mass prior to deposit on the surface. Do not exceed 4 minutes for the total time of mixing.

C. Ensure a sufficient amount of slurry is carried in all parts of the spreader at all times so complete coverage is obtained. Avoid overloading of the spreader. Apply the slurry seal at a rate of 10 to 18 pounds per square yard for fine aggregate and 15 to 22 pounds per square yard for coarse aggregate or as specified in the contract documents. Spread the paving mixture to fill minor cracks and shallow potholes and leave a uniform surface. Verify the application rate from daily readings taken from the proportioning devices during the progress of the work.

D. No lumping, balling, or unmixed aggregate is allowed. No segregation of the emulsion and aggregate fines from the coarse aggregate is allowed. If the coarse aggregate settles to the bottom of the mix, remove the slurry from the pavement.

E. Avoid buildup on longitudinal or transverse joints.

F. Apply a burlap drag to the surface when specified in the contract documents.

G. Apply strip slurry treatment parallel to the centerline, edge line, or other reference using a guide extending at least 3 feet ahead of the application equipment.

H. A mechanical device, such as an auger, may be used to distribute the slurry in the spreader box. The use of a mechanical device in the slurry distribution box for strip slurry treatment and slurry wedge application will generally not be required.

I. Ensure the finished product is uniform in color and composition. Do not leave streaks, such as those caused by oversized aggregate, in the finished surface. If excess streaking develops, the job will be stopped until the Contractor proves to the Engineer that the situation has been corrected. Excessive streaking is defined as more than four drag marks greater than 1/2 inch wide and 4 inch long, or 1 inch wide and 3 inches long, in any 30 square yard area. No transverse ripples or longitudinal streaks of 0.25 inch in depth will be allowed, when measured by placing a 10 feet straightedge over the surface.

J. Ensure the slurry seal possesses sufficient stability so that premature breaking of the material in the spreader box does not occur. Ensure the mixture is homogeneous during and following mixing and spreading. It must be free of excess water or emulsified asphalt and free of segregation of the emulsified asphalt and aggregate fines from the coarser aggregate. Do not spray water directly into the laydown box while placing slurry seal material.

K. Provide a smooth, neat seam where two passes meet. Immediately remove excess material from the ends of each run. Repair any damage to, or irregularities in, the slurry seal, as directed by the Engineer. Make all repairs with a paver box, except areas designated as hand work areas.

3.03 APPLYING SLURRY MATERIAL (Continued)

L. Those areas inaccessible to the spreader box and approved by the Engineer may be designated as hand work areas. Use approved squeegees to spread slurry in areas inaccessible to the slurry machine. Adjustments to the additive will be allowed to provide a slower setting time when hand spreading is needed. If hand spreading is necessary, pour the mixture in a small windrow along one edge of the surface to be covered and then spread uniformly by a hand squeegee or lute. Ensure hand work areas have an appearance consistent with the areas placed with a spreader box.

M. Remove the slurry seal mix from all areas, such as manholes, gutters, and intersections, as directed by the Engineer. On a daily basis, remove any debris associated with the performance of the work.

N. Check the yield of the application after the first 1,000 feet and throughout each day's paving, with a minimum of three tests per day. Furnish the yield check results to the Engineer daily.

O. Submit a daily "run sheet" for each day's work as soon as all the data is available. On the run sheet, provide a breakdown of the actual meter numbers and quantities of all materials actually used each day, as well as the respective locations.

3.04 SLURRY LEVELING

A. Ensure the surface to which the slurry leveling is to be applied is moist and clean of dust and foreign material. Scraping and sweeping may be necessary.

B. Spread the slurry leveling mixture in depressions at and over cracks in the pavement. Spread to the full width of the depression. Level the slurry with a metal lute of the proper width to provide a smooth riding surface. Ensure the slurry leveling is neat in appearance. Do not allow spillage around and between leveled areas. Keep excess material at the pavement edge to a minimum. Scatter excess material across the adjacent shoulder.

C. Allow the slurry leveling to cure until the area may be open to traffic without pick up or raveling of the leveling mixture.

D. Ensure the cured slurry has a homogeneous appearance and a uniform texture, fills all cracks in the application area, and adheres to the surface.

3.05 LIMITATIONS

A. Schedule slurry placement to ensure the traffic lanes are opened to traffic 30 minutes before sundown of the same working day. When traffic is maintained, keep the entire roadbed free of construction equipment during non-working hours.

B. Place slurry mixture between May 1 and October 15, when the temperature is at least 50°F and rising, and the forecast for the next 24 hours is above 40°F.

C. When this work is done in conjunction with crack cleaning and filling, clean and fill cracks before performing slurry work. The application of slurry and the crack cleaning and filling activity may be done as one coordinated operation.

D. When placing a strip slurry treatment, both edges of the slurry box must run on the pavement surface.

E. When the installation of strip slurry treatment is required at a pavement centerline or lane line, the Engineer may require such placement in two separate applications.

3.06 CURING AND OPENING TO TRAFFIC

Allow the treated area to cure until it may be opened to traffic without pick up or raveling of the slurry mixture. Repair or replace any damaged caused to the slurry surface by premature opening to traffic at no additional cost to the Contracting Authority.

END OF SECTION

PERMEABLE INTERLOCKING PAVERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Subgrade Preparation

B. Placement of Storage Aggregate

C. Placement of Filter Aggregate

D. Placement of Bedding Course

E. Placement of Permeable Interlocking Pavers

F. Quality Control

G. Protection of the Pavement

1.02 DESCRIPTION OF WORK

Construct permeable interlocking pavement for mitigation of stormwater runoff.

1.03 SUBMITTALS

A. Sample Pavers: Representative of the type and color proposed for the project.

B. Installation Instructions: Manufacturer's published installation instructions.

C. Material Certification: Submit certification letter from paver manufacturer indicating compliance with the ASTM specifications and the contract documents.

D. Bedding, Filter, and Storage Aggregates: Submit 5 pound samples of each aggregate type. Include aggregate type, source, gradation, and compacted void content.

E. Project Details: Include schedule, construction procedures, and quality control plan that describes material staging; paving direction; details of placement and compaction of the storage, filter, and bedding aggregate; and the paver installation procedures.

F. Involved Parties: Submit a list of all subcontractors, material suppliers, and testing laboratories.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Install a 5 foot by 5 foot mock-up paver area on the prepared substrate to determine joint sizes, lines, laying patterns, paver edge treatments, colors, and texture of the project. If approved by the Engineer, it may be incorporated into the project.

1.08 MEASUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Comply with Section 2010, 1.08, E.

B. Engineering Fabric:

1. **Measurement:** Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.

2. **Payment:** Payment will be made at the unit price per square yard of engineering fabric.

3. **Includes:** Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

C. Underdrain:

1. **Measurement:** Each type and size of pipe installed will be measured in linear feet from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts; the vertical height of observation wells; and lengths of elbows, tees, wyes, and other fittings will be included in the length of pipe measured.

2. **Payment:** Payment will be made at the unit price of each type and size of pipe.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing pipe, cleanouts, observation wells, and pipe fittings.

D. Storage Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.

2. **Payment:** Payment will be made at the unit price per ton of storage aggregate.

3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, placing, and compacting storage aggregate.

E. Filter Aggregate:

1. **Measurement:** Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.

2. **Payment:** Payment will be made at the unit price per ton of filter aggregate.

3. **Includes:** Unit price includes, but is not limited to, furnishing, hauling, placing filter, and compacting aggregate.

1.08 MEASUREMENT AND PAYMENT (Continued)

F. Permeable Interlocking Pavers:

1. **Measurement:** Measurement will be in square yards for the area of each type of permeable interlocking pavers installed. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be made at the unit price per square yard of each type of permeable interlocking pavers.

3. **Includes:** Unit price includes, but is not limited to, testing, furnishing and placing bedding course, furnishing and installing permeable interlocking pavers, furnishing and placing joint/opening fill material, refilling joint after 6 months, and pavement protection.

G. PCC Edge Restraint:

1. **Measurement:** Measurement will be in linear feet for each type and size of PCC edge restraint. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per linear feet for each type and size of PCC edge restraint.

3. **Includes:** Unit price includes, but is not limited to, final trimming of subgrade or subbase, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, and boxouts for fixtures.

PART 2 - PRODUCTS

2.01 ENGINEERING FABRIC

Comply with Iowa DOT Section 4196, requirements for subsurface drainage.

2.02 UNDERDRAIN

A. Provide slotted or perforated pipe(s) complying with the requirements for Type 1 Subdrain in Section 4040.

B. Provide 6 inch diameter collector pipes unless otherwise specified in the contract documents.

C. Provide 4 inch diameter lateral pipes unless otherwise specified in the contract documents.

2.03 AGGREGATE

Provide crushed stone with 90% fractured faces. Wash all stone materials to ensure less than 2% passing the No. 200 sieve.

A. Storage Aggregate: Aggregate complying with Iowa DOT Section 4122, Gradation No. 13a, Class 2 durability.

B. Filter Aggregate: Aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability.

C. Bedding/Joint/Void Filler Aggregate: Crushed stone complying with Iowa DOT Section 4125, Gradation No. 29.

2.04 PERMEABLE INTERLOCKING PAVERS

A. Interlocking Concrete Pavers: Comply with ASTM C 936 for minimum 3 1/8 inch thick pavers.

B. Clay Brick Pavers: Comply with ASTM C 1272 for minimum 2 3/4 inch thick, Type F brick for PX applications.

2.05 PCC EDGE RESTRAINT

Provide PCC edge restraint complying with Section 7010. A PCC edge restraint may be standard curb and gutter section, a vertical curb section, or a narrow concrete slab.

PART 3 - EXECUTION

3.01 PRE-INSTALLATION PROTECTION

A. Complete grading, utility installation, and other earth disturbing operations prior to excavating for the permeable paver system.

B. Prior to placing permeable interlocking pavers, stabilize the drainage area or install sediment control practices upstream to protect the area from sediment in stormwater runoff from disturbed soil.

3.02 SUBGRADE PREPARATION FOR PERMEABLE INTERLOCKING PAVERS

A. Excavate area to the elevations and grades specified in the contract documents.

B. When underdrain is specified, excavate a minimum 12 inch wide by 8 inch deep trench at locations specified in the contract documents.

C. Where fill materials are required, compact materials to 95% of maximum Modified Proctor Density. Do not over compact.

D. Fill and lightly re-grade any areas damaged by erosion, ponding, or traffic compaction prior to placing the engineering fabric.

3.03 ENGINEERING FABRIC

A. Install engineering fabric over completed subgrade, including trench for underdrain when specified.

B. Overlap adjacent strips of fabric a minimum of 12 inches.

C. Extend fabric up the sides of the subbase trench to the bottom of the proposed pavement.

3.04 UNDERDRAIN

A. Underdrain Collector Pipes:

1. Place 2 inches of filter aggregate in the bottom of the underdrain trench over engineering fabric.

2. Begin underdrain collector installation at the outlet and continue upgrade.

3. Lay underdrain collector pipe to the proper line and grade. Place pipe with perforations down.

4. Place filter aggregate over installed pipe in layers no more than 6 inches thick. Thoroughly tamp each layer with mechanical tampers.

5. Provide cleanouts where specified in the contract documents. Comply with Figure 4040.232.

6. Connect underdrain collector to outlet. Comply with Figure 4040.233. Install rodent guard on all underdrain pipe 6 inches or smaller.

7. Install underdrain cleanout pipes and observation wells as specified in the contract documents.

3.04 UNDERDRAIN (Continued)

B. Underdrain Lateral Pipes:

1. Place 2 inches of filter aggregate over the bottom of the prepared subgrade at lateral pipe locations specified in the contract documents.

2. Lay underdrain lateral over filter aggregate to the proper line and grade. Place pipe with perforations down.

3. Connect underdrain laterals to underdrain collector with wye or tee fitting.

4. Install plug or cap on upstream end of lateral pipe.

5. Place additional filter aggregate along each side of the lateral pipe to the springline of the pipe.

3.05 STORAGE AGGREGATE

A. Place storage aggregate in 6 inch maximum lifts to the thickness specified in the contract documents. If underdrain system is specified, take care not to damage or displace pipe during placement of storage aggregate.

B. Compact each lift with a vibratory drum roller with a minimum of two passes in vibratory mode and two passes in static mode until no visible movement can be seen in the aggregate layer. Do not crush aggregate. Do not operate compaction equipment directly over underdrain, until a minimum of 12 inches of storage aggregate is placed over the underdrain.

C. Install storage aggregate to the elevation specified in the contract documents.

3.06 FILTER AGGREGATE

A. Place filter aggregate directly over storage aggregate.

B. Install aggregate in a single lift with a thickness of 4 inches.

C. Compact filter aggregate until no visible movement can be seen in the aggregate layer with four passes from a vibratory plate compactor or vibratory roller. If a vibratory roller is utilized, perform the final two passes without vibration. Do not crush aggregate. If specified, proof roll according to Section 2010, 3.06, C.

3.07 BEDDING AGGREGATE

A. Place bedding aggregate directly over filter aggregate.

B. Install aggregate in a single lift with a thickness of 2 inches.

C. Use laser guided spreader or place screed rails on the completed filter aggregate layer. Use screed width no less than the full width of each cross-section component of the roadway and no less than 16 feet for parking areas. Set elevation to reflect compaction following paver placement. Surface variations must be within 3/8 inch when tested with a 10 foot straightedge.

D. Restrict pedestrians and equipment from screeded bedding prior to placement of pavers.

3.08 INSTALLING PCC EDGE RESTRAINT

Place PCC edge restraint according to Section 7010.

3.09 INSTALLING INTERLOCKING PERMEABLE PAVER SYSTEM

Place and install pavers according to the pattern specified, the paver manufacturer's published installation specifications, and the following:

A. Where pavers are placed against a curb and gutter or other pavement, installation of an edge course or soldier course is required if the pavement edge is not straight. Trim pavers as required to compensate for deviations in the adjacent pavement edge. Do not cut pavers to less than 1/3 their original size.

B. Install PCC edge restraint.

C. Place chalk lines on the bedding course to maintain straight joint lines.

D. After pavers have been installed on the bedding course, and all cut pavers have been inserted to provide a full and complete surface, inspect pavers for damaged units and irregular joint lines. Remove and replace pavers as required.

E. After inspection and replacement of damaged pavers, fill joint openings with bedding stone. Sweep the surface clean.

F. Compact pavement surface with a minimum of three passes of a vibratory plate compactor capable of at least 5,000 pounds centrifugal compaction force. Vary direction of each pass by 45 degrees to the previous pass. Do not operate plate compactor within 6 feet of an unrestrained pavement edge.

G. Re-inspect pavers, and remove and replace all damaged units. Refill joint openings completely. Sweep pavers clean. Complete compaction with two passes of the plate compactor.

H. Refill all paver joint openings with bedding aggregate 6 months after installation.

3.10 QUALITY CONTROL

A. Ensure horizontal alignment of the PCC edge restraint is within 1/2 inch of design alignment.

B. Ensure final surface is within 3/8 inch when tested with a 10 foot straightedge.

C. Ensure no greater than 1/8 inch difference in height between adjacent pavers.

D. Maintain surface elevation within 1/4 inch above adjacent drainage inlets, gutters, and other appurtenances.

3.11 PROTECTION OF PAVEMENT

A. Protect pavement from heavy construction traffic, including trucks, skid steers, loaders, and all tracked vehicles.

B. Provide barriers and protection as necessary.

3.11 PROTECTION OF PAVEMENT (Continued)

C. Do not place soil, mulch, sand, aggregate, or stockpile other materials on the pavement surface that may contaminate the pavement and plug the porous surface.

D. Remove by vacuuming any base and bedding materials contaminated with sediment and replace with clean materials at no cost to the contracting authority.

END OF SECTION

Refer to the contract documents for dimensions, grades, and additional requirements for permeable interlocking pavers and associated improvements.

(1) Permeable interlocking pavers as specified in the contract documents.

(2) 2 inch minimum permeable pavement bedding aggregate to accomodate imperfections in the permeable pavement filter aggregate layer.

(3) Permeable pavement storage aggregate thickness as specified in the contract documents.

(4) When underdrain collectors and/or laterals are specified, install to the line and grade specified in the contract documents. Place permeable pavement filter aggregate to springline of pipe.

(5) Place 4 inches of filter aggregate under curb and gutter section. Extend to 12 inches beyond the back of curb. Extend engineering fabric under aggregate.

(6) Install paver edge restraint system along unrestrained edges.

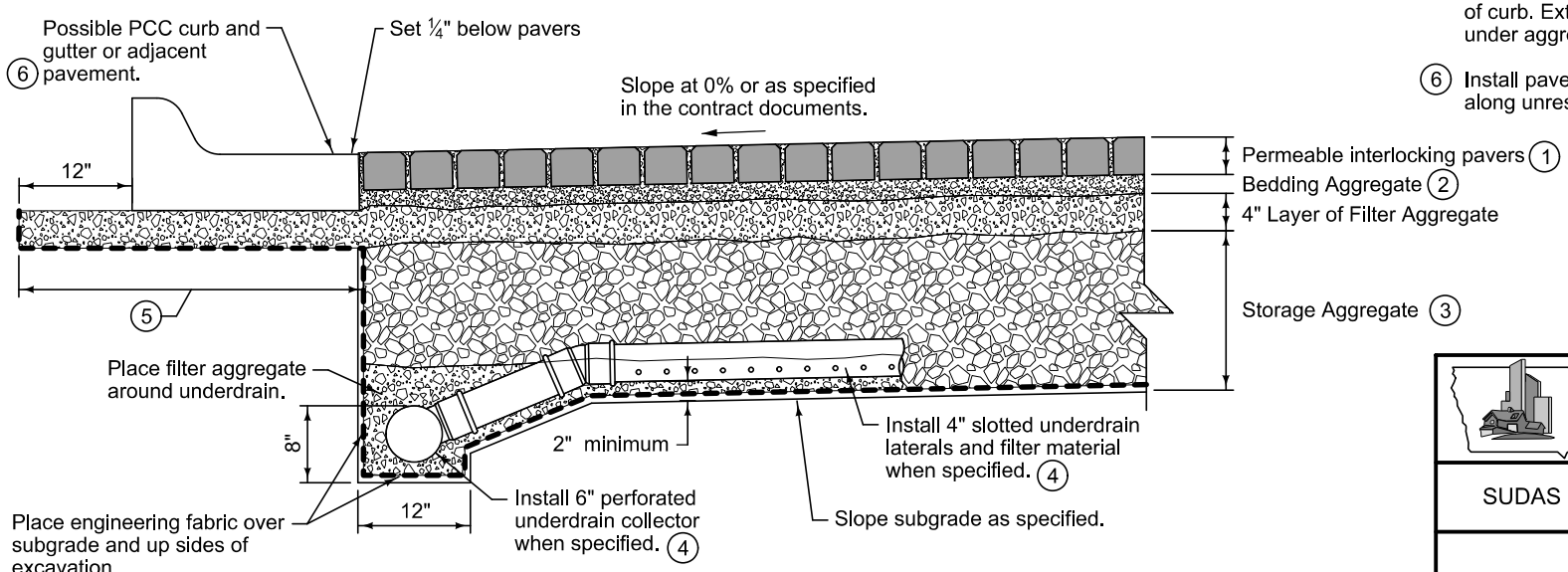


FIGURE 7080.101

SHEET 1 OF 1

SUDAS

REVISION	
New	10-20-15

7080.101

SHEET 1 of 1

SUDAS Standard Specifications

PERMEABLE INTERLOCKING PAVERS

Refer to the contract documents for dimensions, grades, and additional requirements for permeable interlocking pavers and associated improvements.

1. Permeable interlocking pavers as specified in the contract documents.
2. 2 inch minimum permeable pavement bedding aggregate to accomodate imperfections in the permeable pavement filter aggregate layer.
3. Permeable pavement storage aggregate thickness as specified in the contract documents.
4. Set PCC edge restraint 1/4 inch below pavers.

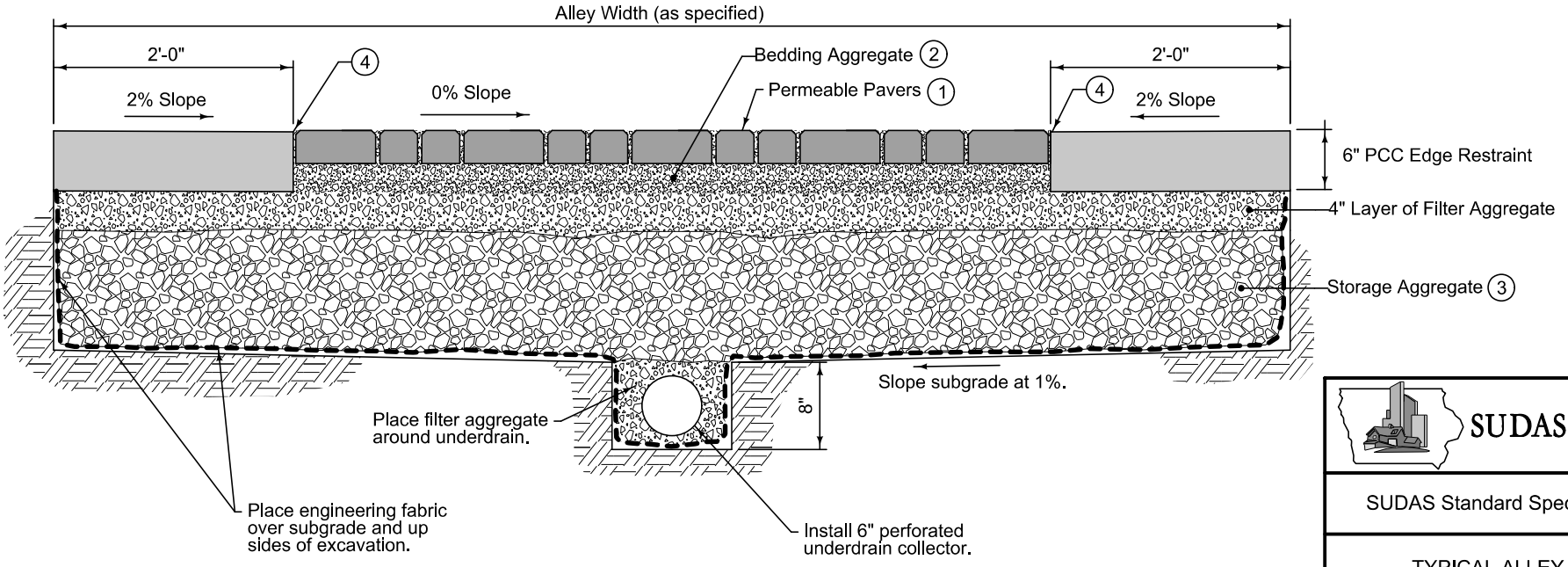


FIGURE 7080.102

SHEET 1 OF 1

SUDAS

REVISION: New 10-20-15

7080.102

SHEET 1 of 1

SUDAS Standard Specifications

TYPICAL ALLEY WITH PERMEABLE PAVERS

COLD-IN-PLACE PAVEMENT RECYCLING

PART 1 - GENERAL

1.01 SECTION INCLUDES

Cold-in-place recycling (CIR) of asphalt roadways

1.02 DESCRIPTION OF WORK

Includes milling and mixing of existing asphalt materials, addition of recycling agents and additives if required, compaction of the reclaimed materials, and curing of the compacted street.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants as well as the following:

A. Prepare and submit the job mix formula to the Engineer for approval prior to initiating full recycling operations.

B. Provide quality control test results.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Cold-in-place Recycling:

1. Measurement: Measurement will be in square yards for the area of roadway recycled.

2. Payment: Payment will be at the unit price per square yard of roadway recycled.

3. Includes: Unit price includes, but is not limited to, milling and sizing of existing asphalt layers; protecting street fixtures; development of a job mix formula; adding and mixing recycling agents and additives, if required; supplying and incorporating water; compacting the reclaimed mix; shaping of the mix; completing secondary compaction, if required; removing any loose or excess material; and final clean up.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Bituminous Recycling Agents:

1. **Measurement:** Measurement will be in gallons of asphalt emulsion or foamed asphalt furnished and incorporated.

2. **Payment:** Payment will be at the unit price per gallon of asphalt emulsion or foamed asphalt furnished and incorporated.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the recycled mix.

C. Chemical Recycling Additives:

1. **Measurement:** Measurement will be in tons of chemical recycling additives.

2. **Payment:** Payment will be at the unit price per ton of chemical recycling additives.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the recycled mix.

D. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

E. Surface Course: Comply with Section 7011 or Section 7021 for overlay pavement.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bituminous Recycling Agent: Use asphalt emulsion (HFMS-2s or CSS-1) meeting the requirements of Iowa DOT Section 4140, or foamed asphalt using PG 52-34S asphalt binder meeting the requirements of Iowa DOT Sections 2318 and 4137.

B. Chemical Recycling Additives:

1. Cement complying with Iowa DOT Article 4101.01, A.

2. Hydrated lime complying with AASHTO M 216.

3. If approved by the Engineer, use other proprietary products according to the manufacturer's requirements.

C. Water: Comply with Iowa DOT Section 4102**.** Potable water obtained from an approved supply does not need to be tested**.**

2.02 JOB MIX FORMULA

Compile a job mix formula using an analysis of the existing asphalt pavement layers and the required strength of the recycled pavement section as specified in the contract documents. The job mix formula will identify the recycling agent and any additives; the rates for the recycling agent and additive, if needed; and the rate of water to reach the optimum moisture content. Tolerances should be included to allow the Contractor to adjust the mixture so that it is placed successfully.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. General:

1. Perform cold-in-place recycling between May 1 and October 1.

2. Perform recycling operations when weather conditions are such that proper mixing, shaping, and compacting the recycled mix can be accomplished. General criteria includes:
   a. Begin operations when air temperature is 55°F and rising.
   b. Cease operations when air temperature is 55°F or less and falling.
   c. Do not begin operations if the National Weather Service forecasts a temperature of 35°F or less in the next 24 hours or if the weather is rainy or foggy.

B. Equipment:

1. Furnish a self-propelled machine capable of milling the existing paving material to the width and depth specified in the contract documents. Ensure the equipment meets the following:
   a. Equipped with automatic depth control to maintain a constant depth and width.
   b. Capable of milling the existing roadway to the required gradation in one pass.
   c. Accurately controls the rate of flow and total delivery of the recycling agent and additives, if needed, into the recycled mixture in relation to the speed and quantity of the material being recycled.
   d. Capable of mixing the recycled material and any recycling agent and additive required by the job mix formula into a homogeneous mixture.

2. If specified in the contract documents, use an asphalt foaming system that accurately and uniformly adds the required percent of water to the hot asphalt binder. Use equipment fitted with a test nozzle to provide field samples of the foamed asphalt. Equip tankers supplying the hot asphalt binder with a thermometer to continuously monitor the temperature of the asphalt in the bottom third of the tank.

3. Use a bituminous paver complying with Iowa DOT Article 2001.19. Heating the screed will not be allowed.

4. Have the following rollers available for use:
   a. Double drum steel roller (static and vibratory)
   b. Pneumatic tire roller (25 ton or greater)

3.02 PREPARATION

Prior to initiating the recycling process, undertake the following tasks:

A. Identify and protect all affected utilities.

B. Remove excess dirt, vegetation, raised pavement markings, standing water, and any other objectionable materials.

3.03 UTILITIES

All utilities within the project limits should be protected prior to the milling. Locate and lower manholes, water valve boxes, and other fixtures a minimum of 2 inches below the bottom of the recycled section. Re-set manhole castings, water valves, and other fixtures to the proper elevations following completion of the compaction of the recycled mixture and placement of any surface course. Protect stormwater intakes by preventing recycled material from entering the drainage system.

3.04 CONTROL STRIP

Construct a control strip during the first day of production to verify that the equipment, construction methodology, and workmanship meet the specifications. Adequately size the control strip to verify that the optimal rates of water, recycling agent, and additives can be achieved. Establish a rolling pattern that will result in optimum compaction. The Engineer may waive the control strip provided the Contractor provides proof that the work will meet the specifications based on previous experience using the same equipment, personnel, and materials.

3.05 MILLING THE PAVEMENT

Mill the existing asphalt pavement and underlying areas to initiate the recycling process.

A. Mill the full depth of the asphalt layers in a single pass.

B. Verify the gradation of the pulverized material meets the specifications.

C. Provide a 3 inch overlap of the longitudinal joint and 24 inches between transverse joints

3.06 RECYCLING AGENT APPLICATION

For single unit recycling trains, add the bituminous agent in the cutting drum. For two-unit trains, add it in the mix paver and for multi-unit trains add the bituminous agent in the pugmill. Ensure residual asphalt content is ± 0.5% of the target established in the job mix formula. Maintain foamed asphalt binder ± 20°F of the optimum temperature established by the job mix formula.

3.07 RECYCLING ADDITIVES

Add chemical recycling agents as additives to applications that use bituminous recycling agents at the rates required by the job mix formula. Apply the chemical additive in dry or slurry form by adding it on the pavement ahead of the milling operation, adding it directly to the mixing chamber, or spraying it over the cutting teeth of the milling machine.

3.08 COMPACTION

Ensure recycled material is ± 2% of the optimum moisture content.

A. Timing: Compact the mixed recycled roadway materials based on the type of recycling agent used as follows.

1. Asphalt Emulsion: Complete compaction at or just after the emulsion breaks.

2. Foamed Asphalt: Initiate immediately after mixing and complete prior to the mixture drying out.

3.08 COMPACTION (Continued)

B. Process: Follow the rolling pattern established with construction of the control strip regarding type and size of roller. Perform initial rolling with the pneumatic tired roller and final rolling with the steel wheeled roller. Set the vibratory amplitude/frequency, tire pressure for pneumatic, and static weight of all rollers based on the depth of the recycled mixture to be compacted. Uniformly compact the mixture to a minimum of 94% of maximum dry density according to AASHTO T 134 on a moving average of five consecutive tests with no individual test below 92%.

C. Shaping: Complete rolling to achieve the required density. Ensure the crown of the compacted recycled roadway is within 6 inches of the established centerline, unless otherwise specified in the contract documents.

3.09 SECONDARY COMPACTION

If necessary, complete secondary compaction to eliminate wheel marks and minor consolidation caused by construction traffic prior to opening. Complete secondary compaction during daylight hours and when the minimum ambient temperature is 80°F. Suspend operations if cracking of the mat occurs.

3.10 SMOOTHNESS

Ensure surface of recycled base course is free of bumps, ruts, indentations, segregation of aggregates and conforms to the required elevations. Check surface with a 10 foot straightedge and correct any irregularity 3/8" or larger. Complete corrective measures at no cost to the contracting agency.

3.11 SURFACE COURSE

Protect the CIR surface from damage prior to adding the surface course. Any damage will be repaired at Contractor's expense. Restrict application of overlays and other surface treatments until one of the following has been met:

A. Average moisture content of the CIR layer is no more than 0.3% above the residual moisture content according to Iowa DOT Materials I.M. 504 or 3.5%, whichever is greater.

B. The moisture content of the CIR layer has reached a plateau of less than 5% and has remained constant (within ± 0.3%) for a minimum of 3 calendar days.

C. The CIR layer has been completed for 21 calendar days.

The Engineer may adjust this drying period depending on field conditions.

3.12 QUALITY CONTROL

The Contractor is responsible for the quality control of the materials and the CIR process.

A. Sample and test the asphalt recycling agent according to Iowa DOT Materials I.M. 204.

B. Apply the asphalt recycling agent at the target application rate ± 0.06 gallon per square yard per inch for standard emulsion and ± 0.33 gallon per square yard per inch for foamed asphalt.

END OF SECTION

FULL DEPTH RECLAMATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

Full depth reclamation of asphalt roadways

1.02 DESCRIPTION OF WORK

Includes pulverizing and mixing of existing asphalt and underlying materials; addition of stabilizing agents and additives if required; compaction of the reclaimed materials and curing of the compacted street.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants as well as the following:

A. Prepare and submit the job mix formula to the Engineer for approval prior to initiating full reclaiming operations.

B. Provide quality control test results.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Full Depth Reclamation:

1. Measurement: Measurement will be in square yards for the area of roadway reclaimed.

2. Payment: Payment will be at the unit price per square yard of roadway reclaimed.

3. Includes: Unit price includes, but is not limited to, pulverizing and sizing of existing asphalt layers; incorporating and mixing of existing underlying materials; protecting street fixtures; development of a job mix formula; adding and mixing stabilizing agents and additives, if required; compacting the reclaimed mix; shaping of the mix; removing any loose or excess material; curing; and final clean up.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Mechanical Stabilization Agents:

1. **Measurement:** Measurement will be in tons of aggregate.

2. **Payment:** Payment will be at the unit price per ton of aggregate.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of aggregate and blending of the aggregates.

C. Bituminous Stabilization Agents:

1. **Measurement:** Measurement will be in gallons of asphalt emulsion or foamed asphalt furnished and incorporated.

2. **Payment:** Payment will be at the unit price per gallon of asphalt emulsion or foamed asphalt furnished and incorporated.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the reclaimed mix.

D. Chemical Stabilization Agents:

1. **Measurement:** Measurement will be in tons of chemical stabilization agents.

2. **Payment:** Payment will be at the unit price per ton of chemical stabilization agents.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the reclaimed mix.

E. Microcracking

1. **Measurement:** Measurement will be in square yards for the area of roadway microcracked.

2. **Payment:** Payment will be at the unit price per square yard of roadway microcracked.

3. **Includes:** Unit price includes, but is not limited to, furnishing equipment, protecting street fixtures, completing microcracking, and curing.

F. Interlayer for Cement Stabilized Base

1. **Measurement:** Measurement will be in square yards for each type and thickness of interlayer.

2. **Payment:** Payment will be at the unit price per square yard for each type and thickness of interlayer.

3. **Includes:** Unit price includes, but is not limited to, surface cleaning, furnishing, and placing of the interlayer.

G. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Mechanical Stabilizing Agents: Use virgin crushed aggregates, RAP, or crushed PCC in the gradation called for in the job mix formula.

B. Bituminous Stabilizing Agent: Use asphalt emulsion (HFMS-2s) meeting the requirements of Iowa DOT Section 4140, or foamed asphalt using PG 52-34S asphalt binder meeting the requirements of Iowa DOT Section 4137.

C. Chemical Stabilizing Agent:

1. Cement complying with Iowa DOT Article 4101.01.
2. Class C or Class F Fly Ash complying with Iowa DOT Section 4108.
3. Hydrated Lime complying with AASHTO M 216.
4. Calcium Chloride complying with Iowa DOT Section 4194.
5. If approved by the Engineer, use proprietary products according to the manufacturer's requirements.

D. Fog Seal Cure: Comply with Iowa DOT Section 2306.

E. Water: Comply with Iowa DOT Section 4102**.** Potable water obtained from an approved supply does not need to be tested**.**

F. Interlayer

1. Class A crushed stone complying with Iowa DOT Article 4120.04.
2. HMA interlayer complying with Section 7021, 2.04, B.

2.02 JOB MIX FORMULA

Compile a job mix formula using an analysis of the existing asphalt pavement layers and the subbase/subgrade and the required strength of the reclaimed pavement section as specified in the contract documents. The job mix formula will identify the stabilizing agent and any additives; the rates for the stabilizing agent and additive, if needed; and the rate of water to reach the optimum moisture content. Allowable tolerances should be included to allow the Contractor to adjust the mixture so that it is placed successfully.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. General:

1. Perform full depth reclamation between April 1 and November 1.

2. Perform reclaiming operations when weather conditions are such that proper mixing, shaping, and compacting the reclaimed mix can be accomplished.

B. Equipment:

1. Furnish a self-propelled machine capable of reclaiming the existing paving material to the width and depth specified in the contract documents. Ensure the equipment meets the following:
   a. Equipped with automatic depth control to maintain a constant depth and width.
   b. Capable of pulverizing the existing roadway to the required gradation.
   c. Accurately controls the rate of flow and total delivery of the stabilizing agent and additives, if needed, into the reclaimed mixture in relation to the speed and quantity of the material being recycled.
   d. Capable of mixing the reclaimed material and any stabilizing agent and additive required by the job mix formula into a homogeneous mixture.

2. If specified in the contract documents, use an asphalt foaming system that accurately and uniformly adds the required percent of water to the hot asphalt binder. Use equipment fitted with a test nozzle to provide field samples of the foamed asphalt. Equip tankers supplying the hot asphalt binder with a thermometer to continuously monitor the temperature of the asphalt in the bottom third of the tank.

3. Have the following rollers available for use:
   a. Sheepsfoot roller
   b. Double drum steel roller (static and vibratory)
   c. Pneumatic tire roller (25 ton or greater)

4. Provide a motor grader with grade and cross-slope control.

3.02 PREPARATION

Prior to initiating the reclaiming process, undertake the following tasks:

A. Identify and protect all affected utilities.

B. Remove excess dirt, vegetation, raised pavement markings, standing water, and any other objectionable materials.

3.03 UTILITIES

All utilities within the project limits should be protected prior to the pulverization. Locate and lower manholes, water valve boxes, and other fixtures a minimum of 4 inches below the bottom of the reclaimed section. Re-set manhole castings, water valves, and other fixtures to the proper elevations following completion of the compaction of the reclaimed mixture. If lowering of fixtures is not practical, excavate material from around the fixture to a location where it can be pulverized by the reclaimer. Move the pulverized material back around the fixture after mixing and compact with smaller compaction equipment to the required densities. Protect stormwater intakes by preventing reclaimed material from entering the drainage system.

3.04 CONTROL STRIP

Construct a control strip during the first day of production to verify that the equipment, construction methodology, and workmanship meet the specifications. Adequately size the control strip to verify that the optimal rates of water, stabilizing agent, and additives can be achieved. Establish a rolling pattern that will result in optimum compaction. The Engineer may waive the control strip provided the Contractor provides proof that the work will meet the specifications based on previous experience using the same equipment, personnel, and materials.

3.05 PULVERIZING

Pulverize the existing asphalt pavement and underlying areas to initiate the reclaiming process.

A. Pulverize the full depth of the asphalt layers and the underlying materials in a single pass, unless multiple passes are specified in the contract documents.

B. If multiple passes are specified, leave a minimum of 1 inch of the underlying layer intact with the initial pulverizing pass.

C. Prior to the second pulverizing/mixing pass, complete light compaction and reshaping to establish a solid working base.

D. Verify the gradation of the pulverized material meets the job mix formula.

E. Provide a 6 inch overlap of the longitudinal joint and 24 inches between transverse joints when multiple passes are required.

3.06 REMOVAL OF EXCESS MATERIAL

Following the initial pulverization pass and prior to the mixing pass, if required, remove any excess reclaimed material from the project area to a site designated by the Engineer as a means to meet final design elevations.

3.07 STABILIZING AGENT APPLICATION

A. Mechanical: Spread aggregate in a uniform layer ahead of the pulverizer. Placement can be completed during the initial pulverizing pass or as a part of a mixing pass.

B. Chemical: Spread dry chemical stabilizers onto the reclaimed material between the pulverizing pass and the mixing pass. Take corrective measures if dust is a problem. Apply chemical stabilizers in slurry form through the reclaimer's on-board liquid additive system, if so equipped, or directly on the reclaimed material in advance of the mixing pass. Disburse slurry uniformly over the entire reclaimed roadway. Do not exceed 30 minutes from the time the slurry is applied until the mixing begins. Ensure chemical stabilizer application rate is ± 0.5% as required by the job mix formula.

C. Bituminous: Inject the asphalt emulsion or foamed asphalt at the required rate through the reclaimer's on-board liquid additive system. Ensure residual asphalt content is ± 0.5% of the target established in the job mix formula. Maintain foamed asphalt binder ± 20°F of the optimum temperature established by the job mix formula.

3.08 STABILIZING ADDITIVES

Add chemical stabilizing agents as additives to applications that use bituminous stabilizers at the rates required by the job mix formula. Apply the chemical additive in dry form, slurry form, or through the reclaimer's liquid injection system after the pulverizing pass.

3.09 COMPACTION

Ensure reclaimed material is within 2% of the optimum moisture content.

A. Timing: Compact the mixed reclaimed roadway materials based on the type of stabilizing agent used as follows:

1. **Mechanical:** Upon completion of all mixing passes.

2. **Chemical:**
   a. **Cement:** Do not exceed two hours between mixing and final compaction.
   b. **Hydrated Lime and Kiln Dust:** Initiate compaction 4 hours after mixing. Maintain moisture content above the optimum level during that time.

3. **Bituminous:**
   a. **Asphalt Emulsion:** Complete compaction at or just after the emulsion breaks.
   b. **Foamed Asphalt:** Initiate immediately after mixing and complete prior to the mixture drying out.

B. Process: Follow the rolling pattern established with construction of the control strip with respect to type and size of roller. Perform initial rolling with sheepsfoot roller until the roller pads walk out of the reclaimed mix. Set the vibratory amplitude/frequency, tire pressure for pneumatic, and static weight of all rollers based on the depth of the reclaimed mixture to be compacted. Uniformly compact the mixture to a minimum of 98% of maximum dry density according to AASHTO T 134 on a moving average of five consecutive tests with no individual test below 96%.

C. Shaping: Following sheepsfoot roller walk out, cut the reclaimed road bed and shape to required grade and cross-section to remove roller marks. Complete rolling to achieve the required density. Ensure the crown of the compacted reclaimed roadway is within 6 inches of the established centerline, unless otherwise specified in the contract documents. If grade control is required, stake according to Section 11,010, 3.03, A.

3.10 CURING

A. Moisture: Following final finishing, maintain the surface moisture by completing regular applications of a light spray of water. Continue moisture cure for a minimum of 7 days. Apply water spray such that the surface is not eroded.

B. Bituminous: Apply bituminous fog seal within 24 hours of finishing operations. Maintain moisture cure until bituminous cure is placed. Prior to application of fog seal, clean all loose and extraneous materials from the surface. Complete fog seal cure according to Iowa DOT Section 2306. If traffic is allowed on the roadway prior to the fog seal drying so that material is picked up on tires, add a sand blotter to the entire roadway width.

3.11 MICROCRACKING

If specified in the contract documents, complete microcracking of the cement stabilized reclaimed roadway starting within 24 to 48 hours after moisture curing was initiated. Use a 10 to 12 ton vibratory steel drum roller with vibration set at maximum amplitude and speed limited to 2 mph. Use 3 to 4 passes over the entire roadway except the outside 1 foot on uncurbed sections. Continue moisture curing or apply fog seal cure following completion of microcracking.

3.12 INTERLAYER

If specified in the contract documents, complete placement of the HMA interlayer according to Section 7021. Complete placement of the Class A crushed stone interlayer by complying with Iowa DOT Section 2312.

END OF SECTION

CRACK AND SEAT EXISTING PCC PAVEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

Crack and seat of existing PCC pavement prior to overlay.

1.02 DESCRIPTION OF WORK

Full-depth saw cut along curbs and in the area of fixtures; cracking of existing PCC pavement; seating of the cracked pavement. Associated work could include subdrain installation; removal and replacement of curb and gutter; removal of existing asphalt overlay or large partial depth patches; vibration monitoring; installing crack control fabric between the leveling course and surface lifts over all full-depth saw cuts; milling of notches along the curb and at the ends of the project.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Notify all nearby affected parties 24 hours in advance that vibration generating activities will begin when the pavement cracking operation is ongoing. Report any specific concerns raised by adjacent parties to the Engineer.

1.08 MEASUREMENT AND PAYMENT

A. Crack and Seat of PCC Pavement:

1. **Measurement:** Measurement will be in square yards for the area cracked and seated.

2. **Payment:** Payment will be at the unit price per square yard of roadway cracked and seated.

3. **Includes:** Unit price includes, but is not limited to, notifying adjacent properties, providing traffic control and no parking signs; vibration monitoring if specified; cracking and seating of the designated PCC pavement to the specified pattern; watering to verify crack pattern; protecting existing fixtures; cleaning of slab prior to overlay; and final project site cleanup.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Remove and Replace Curb and Gutter:

1. **Measurement:** Measurement will be in linear feet along the face of the curb for each type and size of curb and gutter removed and replaced.

2. **Payment:** Payment will be at the unit price per linear foot for each type and size of curb and gutter removed and replaced.

3. **Includes:** Unit price include, but is not limited to, full depth sawing; removing and disposing removed materials; furnishing and compacting subgrade material to bring to the proper elevation; all form work required; concrete; placing new curb and gutter; and final cleanup and backfill placement behind the new curb.

C. Full Depth Saw Cut:

1. **Measurement:** Measurement will be in linear feet for the length of full depth saw cut.

2. **Payment:** Payment will be made at the unit price per linear foot of full depth saw cut.

3. **Includes:** Unit price includes, but is not limited to, providing a concrete saw or other cutting device that will result in a full depth vertical edge and severing all tie or reinforcing steel.

D. Milling: Comply with Section 7040.

E. Subdrains: Comply with Section 4040.

F. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes (major and minor) and intakes (minor) and Section 5020 for adjustment of water valves.

G. Intake Adjustment, Major:

1. **Measurement:** Each existing intake adjusted to grade by removal of the boxout including any grate assembly and re-setting the grate or adjusting the open throat elevation of the intake will be counted.

2. **Payment:** Payment will be made at the unit price for each major intake adjustment.

3. **Includes:** Unit price includes, but is not limited to, sawing all three sides of the boxout; removing and replacing the boxout; furnishing and installing a new grate assembly or, if specified, removing and re-setting the existing grate assembly; removing existing open-throat intake grate; adjusting intake walls; furnishing and installing new intake grate or, if specified, re-setting existing intake grate; and furnishing, placing, and compacting backfill.

H. Joint Control Fabric:

1. **Measurement**: Measurement will be in linear feet of 12 inch wide joint control fabric placed.

2. **Payment:** Payment will be made at the unit price per linear foot of joint control fabric placed.

3. **Includes:** Unit price includes, but is not limited to, cleaning and preparing the surface, furnishing, placing, and adhering joint control fabric prior to placing surface lift.

1.08 MEASUREMENT AND PAYMENT (Continued)

I. Partial Depth Patch Removal:

1. Measurement: Measurement will be in square feet of partial depth patch removed.

2. Payment: Payment will be at the unit price per square feet of partial depth patches removed.

3. Includes: Unit price includes, but is not limited to, provide equipment and removing all designated partial depth patches down to the base PCC, cleaning of the former patch area; and disposal of the patch material.

J. Rock Interlayer:

1. Measurement: Measurement will be in tons of rock interlayer.

2. Payment: Payment will be at the unit price per ton of rock interlayer.

3. Includes: Unit price includes, but is not limited to, furnishing and placing the rock interlayer to the thickness specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Joint Control Fabric: Supply a polypropylene, needle punched, non-woven fabric coated with asphalt adhesive on one side and asphalt tack coat on the other meeting the following average roll values.

Property	Test Method	Unit	Minimum Value
Strip Tensile Strength	ASTM D882[1]	lbs/inch	45
Puncture Resistance	ASTM E154	lbs	175
Pliability	ASTM D146[2]	----	No cracks

[1] Use 12 in/min test speed and a 1 inch initial distance between grips

[2] Use 180° bend on 1/4 inch mandrel at -25°F

B. Rock Interlayer: Meet the requirements of Iowa DOT Section 4120 for Class A crushed stone.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Equipment:

1. **Cracking Equipment:** Provide a segmental type breaker capable of controlled forward and transverse movement and of fracturing the pavement to the full depth of the slab while maintaining the fractured face interlock of the aggregate. Do not use equipment that punches holes in the pavement or results in excessive spalling.

2. **Seating Equipment:** Use a pneumatic rubber tire roller with a minimum weight of 30 tons.

3.02 PREPARATION

Prior to initiating the crack and seat process, undertake the following tasks:

A. Identify and protect all affected utilities.

B. Set up all traffic control including parking restrictions.

C. Install subdrains if specified in the contract documents.

D. Remove all asphalt overlays.

E. Notify adjacent property owners.

3.03 FULL DEPTH SAW CUTS

Prior to initiating the crack and seat operation:

A. Complete full depth saw cuts along the curb line as shown the contract documents.

B. Complete full depth saw cuts at the edges of all manhole and intake boxouts. If manhole boxouts are not present, saw a 5 feet by 5 feet diamond shape around the manhole casting.

C. At water valves and other fixtures, complete a full depth saw cut in a square shape a minimum of 6 inches from the edge of the fixture.

3.04 PARTIAL DEPTH PATCHES

Remove partial depth patches that are not solid or sound and larger than 4 square feet according to Section 7040.

3.05 INTAKE ADJUSTMENT, MAJOR

A. Grate Type: Saw and remove existing boxout and intake grate assembly. If minor adjustments using adjustment rings is not possible, rebuild intake walls according to Section 6010 to the proper elevation and set new grate assembly. Existing intake grate assembly may be used when specified in the contract documents. Replace boxout to meet new elevations.

B. Open-throat Type: Saw and remove existing boxout and intake top. Adjust intake walls according to Section 6010 to meet new elevations and install new intake grate. Existing intake grate may be reused when specified in the contract documents. Replace boxout to meet new elevations.

3.06 TEST SECTION

At the start of cracking operations, the Engineer will designate a 100 foot test section. Utilize varying energy and crack spacing until a satisfactory spacing is established. Furnish and apply water to the test section to allow visual verification of the cracking pattern. Apply water to the cracked sections at least once per day or when pavement depth changes to verify crack pattern is being maintained. If conditions change, the Engineer may order the development of a new test section.

3.07 CRACKING

A. Crack the existing pavement to produce full depth transverse hairline cracks with a spacing of 18 to 36 inches.

B. Do not induce cracking within 2 feet of an existing transverse joint or crack.

C. Prevent the formation of continuous longitudinal cracks.

D. Do not destabilize the subgrade.

E. Do not damage utility fixtures.

3.08 SEATING

A. Seat the cracked pavement with a minimum of two passes of the 30 ton pneumatic roller. If two passes are not sufficient, continue rolling until the Engineer determines seating is adequate.

B. Complete seating of all areas cracked each work day.

3.09 MILLING

If specified in the contract documents, complete notch and runout milling according to Figure 7021.101.

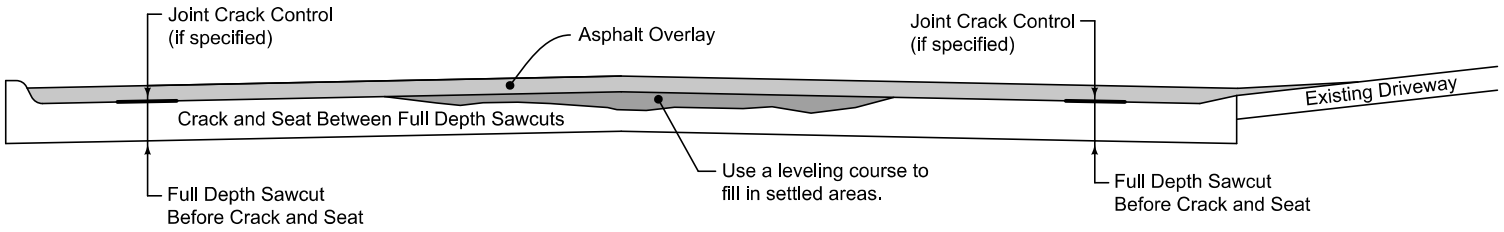
3.10 REMOVAL OF MATERIAL

Following the crack and seat process remove dirt, debris, and loose materials prior to opening the roadway to local traffic and again prior to placing the leveling course and surface lift.

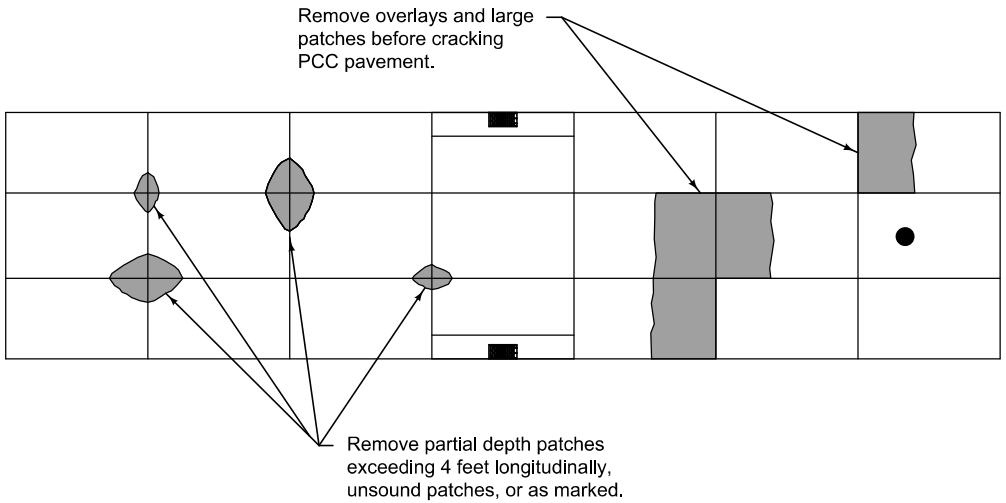
3.11 JOINT CONTROL FABRIC

Install joint control fabric over full depth saw cuts prior to final overlay lift according to the manufacturer's recommendations**.**

END OF SECTION



OVERLAY DETAIL



REMOVAL OF EXISTING ASPHALT

FIGURE 7092.101

SHEET 1 OF 1

SUDAS

REVISION
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7092.101

SHEET 1 of 1

SUDAS Standard Specifications

OVERLAY WITH CRACK AND SEAT

Insert tab here called

DIVISION 8
Traffic Control

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TRAFFIC SIGNALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Underground

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D. Cabinet and Controller

E. Poles, Heads, and Signs

1.02 DESCRIPTION OF WORK

This part of the specifications includes the furnishing of all material and equipment necessary to complete, in place and operational, traffic control signal(s) as described in the project plans.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the additional requirements listed below. All of the following must be submitted within 30 days after awarding of the contract for the project. Verify the method of submittal with the Jurisdiction.

A. Schedule of Unit Prices: Submit a completed schedule of unit prices. Estimates of the work performed on the project will be made by the Jurisdiction and the unit costs will be used to prepare progress payments to the Contractor.

B. Material and Equipment List: Submit a completed list of materials and equipment to the Jurisdiction for written approval before any equipment or materials are ordered.

C. Contractor Certification: Submit the name(s) and contact information of the International Municipal Signal Association (IMSA) Level II Certified Traffic Signal Technician(s) working on the project and a copy of their IMSA certificate.

D. Shop Drawings/Catalog Cuts: Submit PDF shop drawings file for traffic signal poles and structures to be furnished on the project. Submit single PDF of catalog cuts files and list manufacturer's specifications for all items in the project documents.

E. Fiber Optic Cable: Submit a splicing schematic.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. Comply with the current edition of the MUTCD as adopted by the Iowa DOT.

B. Electrical equipment complying with current NEMA requirements.

C. Ensure materials and work conform to current NEC and IMSA requirements.

1.08 MEASUREMENT AND PAYMENT

A. Traffic Signal:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for traffic signal installation. Partial payment will be made according to the approved schedule of unit prices for those materials installed.

3. **Includes:** Lump sum price includes, but is not limited to, furnishing and installing all pole foundations, poles, wiring, conduit, heads, signs, detection equipment, traffic signal control equipment (including pedestrian equipment), traffic signal controller and cabinet, and associated appurtenances for a complete, fully operation installation.

B. Temporary Traffic Signal:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for temporary traffic signal. 80% of the lump sum bid amount will be paid upon completion of the installation and successful initial operation of the signal; the final 20% will be paid upon removal of the temporary traffic signal and cleanup of the site.

3. **Includes:** Lump sum price includes, but is not limited to, furnishing, installing, maintaining, and removing poles; wiring; traffic signal control equipment including pedestrian equipment if specified; implement all modifications of signal timing, signal placement and display due to Contractor initiated changes in the construction staging plan established by the Contracting Authority; relocation of trailer mounted temporary traffic signal systems; placement in another physical location to address changes in construction staging; and all appurtenances.

C. Traffic Signal Removal:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for traffic signal removal.

3. **Includes:** Lump sum price includes, but is not limited to, removal of poles, concrete pads, foundations, wiring, traffic signal cabinet and equipment, pedestrian signal equipment, and handholes; delivery of removed materials to the location specified in the contract documents; furnishing, placing, and compacting backfill in all excavations; and restoring disturbed surfaces.

PART 2 - PRODUCTS

2.01 UNDERGROUND

A. Handhole:

1. General:

a. Cable Hooks: Unless otherwise specified, provide four galvanized steel cable hooks with a minimum diameter of 3/8 inch and a minimum length of 5 inches.

b. Granular Base: Comply with the following gradations; however, the Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

Sieve	Percent Passing
2”	100
1 1/2”	80 to 90
1”	15 to 20
3/4”	0 to 0.5

c. Cover: Include “TRAFFIC SIGNAL” as a message on the cover. Alternate messages may be required as specified in the contract documents.

2. Precast Concrete Handhole:

a. Pipe: Comply with ASTM C 76. Minimum Class III, Wall B (Iowa DOT Class 2000D). Four, 8 inch knockouts (conduit entrance points) equally spaced around the handhole.

b. Casting: Gray cast iron and certified according to requirements of AASHTO M 306 for a 16,000 pound proof-load (HS-20).

3. Composite Handhole and Cover: Composed of mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass. Ensure the handhole and cover has a minimum ANSI/SCTE 77 2017 Tier 15 rating. Provide a skid resistant surface on the cover. Provide two 3/8-16 UNC stainless steel hex head bolts with washers.

4. HDPE Handhole and Cover:

a. Size: Provide handhole and cover with a minimum inside diameter of 24 inches and a minimum of 24 inches in depth. Handhole to be conical in shape with the taper from bottom to top.

b. Loading: Ensure handhole, any extensions, and cover comply as a complete unit with ANSI 77 with a minimum Tier 15 rating.

c. Resin: HDPE resin to comply with ASTM D 790 for minimum flexural modulus of 142,000 psi and ASTM D 638 for minimum yield strength of 3,100 psi when using a Type IV specimen, 2 inch per minute test speed, and 0.075 inch thick molded sample.

d. Cover: Ensure cover has a skid resistant surface meeting PROWAG requirements with stainless steel bolts meeting manufacturer’s requirements. Ensure cover fits handhole to meet PROWAG vertical surface discontinuity requirements when placed in pedestrian walkways.

B. Conduit:

1. General:

a. Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings.

b. Use a manufactured conduit sealing compound that is readily workable material at temperatures as low as 30°F and will not melt or run at temperatures as high as 300°F.

2.01 UNDERGROUND (Continued)

c. Furnish flat polyester pull tape with a minimum pulling strength of 1,250 pounds and permanent sequential footage markings.

2. Steel Conduit and Fittings:
a. Comply with ANSI C80.1.
b. Use weatherproof expansion fittings with galvanized, malleable iron, fixed and expansion heads jointed by rigid steel conduit sleeves. As an option, the fixed head may be integral with the sleeve, forming a one piece body of galvanized malleable iron.
c. Provide steel bushings.

3. Plastic Conduit and Fittings:
a. PVC:
1) PVC Schedule 40 plastic conduit and fittings complying with NEMA TC-2 (pipe), NEMA TC-3 (fittings), and UL 651 for Schedule 80.
2) Solvent welded, socket type fittings, except where otherwise specified in the contract documents.
3) Threaded adaptors for jointing plastic conduit to rigid metal ducts.
4) Provide bell end fittings or bushings.
b. HDPE:
1) Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), SDR 13.5.
2) Use the color specified in the latest NEC or approved by the owner.
3) Continuous reel or straight pieces to minimize splicing.
4) For dissimilar conduit connections, provide an adhesive compatible with both materials.

C. Wiring and Cable: Provide wire that is plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable.

1. Power Cable: Comply with Iowa DOT Article 4185.11.

2. Signal Cable: Comply with IMSA Specifications 19-1 (PVC jacket) or 20-1 (polyethylene jacket) for polyethylene insulated, 600 volt, solid, multi-conductor copper wire, #14 American Wire Gauge (AWG).

3. Tracer Wire: Comply with #10 AWG, single conductor, stranded copper, type thermoplastic heat and water resistant, nylon-coated (THWN), with UL approval, and an orange colored jacket.

4. Ethernet Cable: Provide outdoor use rated cable. Provide either Category 5E (CAT5e) or Category 6 (CAT6) cable.

5. Fiber Optic Cable and Accessories:
a. Furnish fiber optic cable of the mode type, size, and number of fibers specified in the contract documents, and all associated accessories.
b. Meet the latest applicable standard specifications by ANSI, Electronics Industries Association (EIA), International Telecommunication Unit (ITU), and Telecommunications Industries Association (TIA).
c. Multimode Fiber:
Core Diameter: 62.5 µm ± 1.0 µm
Cladding Diameter: 125.0 µm ± 2.0 µm
Core Concentricity: ± 1%
Max. Attenuation: 3.50 dB/km @ 850 µm

2.01 UNDERGROUND (Continued)

d. Single-Mode Fiber: Meet attributes of ITU-T G.652.D Table 2 and/or ITU-T G.657.A1 for low loss bend as specified in the contract documents.
e. Glass reinforced plastic rod central member designed to prevent the buckling of the cable. Cable core interstices filled with water blocking tape to prevent water infiltration. Dielectric fillers may be included in the cable core where needed to lend symmetry to the cable cross-section.
f. Buffer tubes of dual layer construction with a polycarbonate inner layer and polyester outer layer. Each buffer tube filled with a water-swellable yarn or tape. Buffer tubes stranded around the central member using reverse oscillation or “SZ” stranding process. Gel-free cable and buffer tubes.
g. Buffer tubes and fibers meeting TIA/EIA-598A, “Color coding of fiber optic cables,” with 12 fibers per buffer tube.
h. Cable tensile strength provided by a high tensile strength aramid yarn and/or fiber glass.
i. Dielectric cables, without armoring, or armored cables with corrugated steel tape armor as specified in the contract documents. Outer jacket of medium density polyethylene applied directly over the tensile strength members and flooding compound. Jacket or sheath marked in a contrasting color with the manufacturer's name and the words “Optical Cable,” the year of manufacture, and sequential meter or feet marks. Additionally, provide a durable weather proof label on the cable jacket showing the actual attenuation of each fiber expressed in dB/km.
j. Cable fabricated to withstand a maximum pulling tension of 600 pounds during installation (short term) and 135 pounds upon installation (long term).
k. Shipping, storing, and operating temperature range of the cable: -40° C to + 70° C. Installation temperature range of cable: -30° C to + 70° C.
l. Each fiber of all fiber optic cable tested by manufacturer at the 100% level for the following tests:
    - Proof tested at a minimum load of 50 kpsi (350 Mpa)
    - Attenuation
m. Meet the appropriate standard Fiber Optic Test Procedure for the following measurements:
    - Fluid Penetration
    - Compound Drip
    - Compressive Loading Resistance
    - Cyclic Flexing
    - Cyclic Impact
    - Tensile Loading and Bending
n. Make cable ends available for testing. Seal cable ends to prevent moisture impregnation.
o. Fiber Distribution Panel: Provide a fiber distribution panel capable of terminating the number of fibers as specified in the contract documents.
p. Fiber Optic Connectors:
    1) ST type connectors of ceramic ferrule and physical contact end finish to terminate multi-mode fibers to equipment.
    2) SC type connectors of ceramic ferrule and physical contact end finish to terminate single-mode fibers to equipment.
    3) ST or mechanical connectors not allowed for cable splices.
    4) Maximum attenuation per connector: 0.75 dB.
q. Fiber Optic Jumpers/Patch Cords: For connections in the cabinet, provide factory-assembled duplex pigtail jumpers with dielectric strength member, durable outer jacket and ST or SC compatible connectors. Provide adequate length for connections and 2 feet minimum slack.
r. Fiber Optic Breakout Kits: Provide breakout kits for separation and protection of individual fibers, with buffering tube and jacketing materials suitable for termination of the fiber and fiber optic connector.

2.01 UNDERGROUND (Continued)

s. Splices/ Splice Enclosures: Fusion splice continuous fiber runs or branch circuit connections in splice enclosures as allowed or specified in the contract documents. Provide environmentally protected outside plant splice enclosures with adequate number of trays to splice all fibers. Do not splice continuous fibers unless physical restraints require all fibers to be cut, unless approved by the Jurisdiction. Maximum attenuation per splice: 0.3 dB.

D. Footings and Foundations:

1. Use Class C structural concrete complying with Iowa DOT Section 2403.

2. Use uncoated reinforcing steel complying with Iowa DOT Section 4151.

E. Bonding and Grounding:

1. Ground Rods: Provide 5/8 inch by 8 foot copper clad, steel ground rod.

2. Bonding Jumper or Connecting Wire: Provide #6 AWG bare conductor, copper wire.

2.02 DETECTION

A. Inductive Loop Vehicle Detector: A detector consists of a conductor loop or series of loops installed in the roadway, lead-in (feeder) cable, and a sensor (amplifier) unit with power supply installed in a traffic signal controller cabinet.

1. Cables:
- **a. Tube Loop Detector Cable:** Comply with IMSA Specifications 51-5.
- **b. Preformed Loop Detector Cable:** As approved by the Engineer.
- **c. Loop Detector Lead-in Cable:** Comply with IMSA Specifications 50-2.

2. Detector Loop Sealant:
- a. Use a rapid cure, high viscosity, liquid epoxy sealant formulated for use in sealing inductive wire loops and leads embedded in pavement. Ensure the cured sealer is unaffected by oils, gasoline, grease, acids, and most alkalis.
- b. Use a sealant complying with Iowa DOT Materials I.M. 491.18.

3. Sensor (Amplifier) Unit:
- a. Use a sensor unit that is solid state, digital, providing detection channel(s) with an inductance range of 0 to 2,000 micro-henries. Output circuits of the sensor unit will be provided by relays. Vehicle presence will result in a continuous call indication.
- b. Provide a sensor unit with the following qualities:
  - 1) Sensitivity adjustment to allow as a minimum the selection of high, medium, or low sensitivity.
  - 2) Be capable of providing reliable detection of all licensed motor vehicles.
  - 3) Provide an indicator light for visual indication of each vehicle detection.
  - 4) Will not require external equipment for tuning or adjustment.
  - 5) Provide operation in the pulse mode or presence mode. Ensure mode switch is readily accessible.
  - 6) Provide a self tuning system that is activated automatically with each application of power. Provide automatic and continuous fine tuning to correct for environmental drift of loop impedance.
  - 7) Provide for fail-safe operation (continuous call) in the event of detector loop failure.
  - 8) Ensure each detector channel will respond to a frequency shift in an increasing or decreasing value as occurs with temperature shifts in the pavement without requiring a locked call.

2.02 DETECTION (Continued)

9) Use detector units with delay and extension timing. The delay feature is selected and adjusted externally on the sensor unit housing. Digitally derived timing is selectable in 1 second increments from 0 to 30 seconds. Ensure delay timing inhibits detector output until presence has been maintained for the time selected. Restart delay timer at each new detection.
10) Use a sensor unit capable of normal operation without interference and false calls between sensor units ("crosstalk") when installed in the physical environment of the controller cabinet and the electrical environment of the associated electronic equipment installed therein, including other detectors.

B. Pedestrian Push Button Detectors:

1. Assembly:
a. Ensure the entire assembly is weather tight, secure against electrical shock, withstands continuous hard usage.
b. Provide a removable contact assembly mounted in a die cast aluminum case.
c. Ensure contacts are normally open with no current flowing except at the moment of actuation.
d. Ensure the contacts are entirely insulated from the housing and operating button with terminals for making connections.
e. Provide housing with one outlet for 1/2 inch pipe.

2. Accessible Pedestrian Signals (APS) Push Button Stations:
a. Housing: Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
b. Audible and Vibrotactile Features: Audible walk indication tone, vibrotactile arrow, and locator tone complying with MUTCD.
c. Voice Messages: As specified in the contract documents and per MUTCD.
d. Speaker: Weatherproof with automatic volume adjustment to 5 dBA over ambient sound. Maximum volume 100 dB at 3 feet.
e. Push Button: Nonrusting metal alloy, ADA compliant, 2 inch diameter with tactile arrow and 3 pounds maximum operational force.
f. Switch: Solid state rated at 20 million operations minimum.
g. Program and Audio File Updates: USB or Ethernet.
h. Operating Temperature: -30 to + 165^0F.

3. Solid State Pedestrian Push Buttons (non-APS):
a. Housing: Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
b. Push Button: Nonrusting metal alloy, ADA compliant, 2 inch diameter with 3 pounds maximum operational force, with momentary LED visual confirmation and audible tone confirmation.
c. Switch: Solid state piezo-driven, rated at 20 million operations minimum.
d. Operating Temperature: -30 to + 165^0F.

4. Signs: Furnish signs complying with MUTCD.

C. Video Detection Camera System: Detects vehicles by processing video images and providing detection outputs to the traffic signal controller.

1. Video Detection System and Processors:
a. Processor to be card rack mounted, shelf mounted, or located within camera. Compatible with NEMA TS-1, TS-2, ITE ATC, and Type 170 and 2070 controllers and cabinets.

2.02 DETECTION (Continued)

b. Must be capable of the following:
   1) Shadow rejection without special hardware.
   2) Non-impaired operation under light intensity changes.
   3) Maintained operation during various weather conditions (e.g. rain, fog, snow).
   4) Anti-vibration, 5% rejection based on image change.
   5) Ability to select direction of flow parameters.
   6) Ability to properly detect directionally.
   7) Operate in presence mode with less than 4% error.
c. Provide user-defined detection zone programming via a graphical user interface (GUI) and any necessary equipment for future programming. Store detection zones in non-volatile memory.
d. Comply with NEMA TS-1 and TS-2 environmental and physical standards with an operating temperature of -34°C to +60°C, and 0% to 95% relative humidity.
e. Ensure a factory certified representative from the supplier provides on-site VDS programming and testing.

2. Video Cameras:
a. Meet NEMA-4 or NEMA-6P environmental standards.
b. Use camera cable(s) meeting the manufacturer's recommendations. Provide a continuous run, without splices, from the camera to the controller cabinet.
c. Camera per Approach or Advance Detection Camera:
   1) Provide a charge-coupled device (CCD) image sensor with variable focus color or black and white lens providing a minimum of 4 to at least a 40 degree horizontal field of view.
   2) Equipped with internal thermostatically controlled heater and external sunshield.
d. Single Stop Line Detection Camera:
   1) Provide a minimum 5 MP image sensor with power over ethernet and a fisheye lens capable of detecting multiple approaches from a single mounting location.
   2) Include the ability to count traffic.
   3) Provide necessary internal thermostatically controlled heater as needed.

D. Microwave/Radar Vehicle Detectors: Detects all vehicles moving within the field of detection at speeds from 2 to 80 mph.

1. Must be capable of the following:
   a. Minimum detection range from 3 to 200 feet for all vehicles.
   b. Pattern spread of the detection field no more than 16 degrees.
   c. Self-tuning and capable of continuous operation over a temperature range of -35°F to 165°F.
   d. Side-fire mount or overhead mount.
   e. Detecting directional traffic and the direction user selectable.

2. Microprocessor based using Doppler microwave at an operating frequency of 10.525 GHz.

3. FCC certification and tested to the applicable FCC specifications.

4. Enclosure constructed of aluminum or stainless steel and water resistant.

5. All user operated controls and adjustments must be clearly marked and easily accessible.

6. Relay detection output to the controller with a minimum 5 amp rating and designed to place a constant call to the controller in the event of any failure.

7. Easily accessible indicator showing activation of detection relay.

2.02 DETECTION (Continued)

8. Required wiring as recommended by the manufacturer.

9. Provide mounting hardware for the type of mounting specified in the contract documents and power supply equipment as recommended by the manufacturer.

E. Wireless Magnetic Sensors (Pod/Puck): Provide as specified in the contract documents in pavement sensors, access points, base stations, and repeaters, if necessary.

2.03 COMMUNICATIONS

A. Traffic Monitoring System: Provide as specified in the contract documents including, video camera in dome, dome mounting bracket and hardware, camera controller, cabling from camera to controller cabinet, and all accessories, software, and hardware necessary for a complete and operational system.

1. Pan/tilt/zoom (PTZ) color camera with automatic conversion to monochrome during low light levels, auto focus, auto-iris control, electronic image stabilization, privacy masking and progressive CMOS sensor. Minimum 1920 x 1080 maximum resolution. Minimum optical zoom: 25X. Minimum digital zoom: 12X.

2. Camera system provided in a NEMA 4X or IP66 certified rugged weather-resistant package.

3. Provide all required lightning protection for electronics control, power, and coax video outputs.

4. Operating temperature range: -40ºC to +50ºC.

5. Maximum cable length as specified by camera manufacturer.

6. Provide full 360 degree endless pan and 220 degree tilt under PTZ control.

7. Dome electronics capable of programming a minimum of 64 preset views and nine preprogrammed pattern sequences of preset views. All views selectable by the central office computer or a remote control device.

8. Provide encoder and decoder devices as needed to transmit video over existing or proposed communication systems at 30 frames per second (or more).

9. Provide all necessary rack support devices for video viewing and PTZ control.

10. Provide ability to control PTZ and view video remotely. Includes installing necessary software/programming needed for agency to operate system.

B. Fiber Optic Hub Cabinet: As specified in the contract documents.

C. Wireless Interconnect Network: Provides two-way data communication between the system control software and local traffic signal controllers.

1. Data Transceiver:
   a. Utilize a license-free spread spectrum radio frequency (902-928 MHZ) with frequency hopping technology.
   b. Completely programmable by software. Furnish software to the Jurisdiction.
   c. Built-in diagnostics capabilities.
   d. Configurable as master, slave, or repeater with store and forward capability.
   e. Maintains user selectable power output levels between 0.1 and 1 watt.

2.03 COMMUNICATIONS (Continued)

f. Operates with input voltages between 6 VDC and 30 VDC.
g. RS-232 interface with 115.2 kbps capability.
h. Operating temperature of -40°C to +75°C.
i. Receiver sensitivity of -108 to -110 dBm at 10^{-6} BER.
j. Protected from power surges.
k. Rack or shelf mounted in controller cabinet and connections for antenna, power, and controller.

2. Antenna:
a. Capable of transmitting and receiving data between intersections.
b. Mount near the top of the signal pole nearest the controller cabinet or as specified in the contract documents. Provide engineer-approved mounting hardware.
c. Connect to transceiver via appropriate cable from pole to signal cabinet in same conduit as traffic signal cable. Conceal cable within a watertight connection at antenna.

2.04 CABINET AND CONTROLLER

A. Controller, Cabinet, and Auxiliary Equipment: Comply with the latest edition of NEMA TS1 or TS2, CalTrans model 2070, or ITE advanced transportation controller (ATC) standards.

1. Controller:
a. Solid state modular design with digital timing and capable of accommodating at least eight phases.
b. Fully prompted, front panel keyboard with menu driven programmability.
c. Local time base scheduler including automatic accommodation for daylight savings time.
d. Local coordination control.
e. Local preemption control with at least four programmable internal preemption sequences.
f. Current software and documentation.
g. Data retained in a memory medium that does not require battery backup.

2. Cabinet:
a. Unpainted aluminum cabinet according to NEMA standards.
b. Aluminum cabinet riser with same dimensions as cabinet and 12 to 18 inch height, as specified in the contract documents.
c. ATC cabinet voltage category as specified in the contract documents.
d. Police door with auto/flash switch, manual/stop time switch, and on/off power switch for signal heads only. Controller to remain in full operation regardless of switch positions.
e. Maintenance panel on inside of the main door containing the following test switches.
   1) Controller power switch.
   2) Detector test switches.
   3) Stop time switch.
   4) Signal flash switch.
f. Heavy-duty clear plastic envelope attached to inside wall of cabinet or cabinet door, for cabinet wiring diagrams, 12 inches by 18 inches minimum.
g. GFI electrical outlet and lamp in accessible location near the front of the cabinet. GFI outlet fused separately from main AC circuit breaker. LED cabinet lamp connected and fused with GFI outlet.
h. Back panel positions to accommodate phasing and expansibility specified in the contract documents.

2.04 CABINET AND CONTROLLER (Continued)

i. Power protection devices including AC power circuit breakers, radio interference suppressors, and lightning and surge protectors.
   1) AC field service single pole, nonadjustable, magnetic breaker rated for 117 VAC operation, NEC approved.
   2) Radio interference suppressors (RIS) as required to minimize interference in all broadcast transmission and aircraft frequency bands.
   3) Lightning arrestor/surge protector capable of withstanding repeated (minimum of 25) 30,000 ampere surges.

j. Neatly train wiring throughout the cabinet and riser. Bundle and attach wiring to interior panels using nonconductive clamps or tie-wraps.

3. Auxiliary Equipment: Conflict monitor/malfunction management unit, flasher, load switches, terminals and facilities, and miscellaneous equipment and materials according to NEMA standards. For ATC cabinets, use serial interface unit, high density switch pack/flasher unit, cabinet monitor unit, cabinet power supply requirements, auxiliary display unit, sensor unit, and miscellaneous equipment materials meeting ITE standards.

B. Uninterruptible Power Supply Battery Backup System: Monitors 120VAC input from the electric utility source and automatically switches to/from a system consisting of batteries and electronics.

1. Include a maintenance bypass switch to allow operation of the traffic signal system while repairs are made to the battery backup system.

2. Designed to provide a minimum of 4 hours of normal operation.

3. Use cabinet equipment that is plug connected and shelf mounted.

4. Designed to cover a temperature range from -30°F to +165°F and include a surge suppressor.

C. Emergency Vehicle Preemption System: As specified in the contract documents.

2.05 POLES, HEADS, AND SIGNS

A. Vehicle Traffic Signal Head Assembly: Comply with current MUTCD and ITE standards.

1. Housing:
   a. Individual signal sections made of a durable polycarbonate. Use color specified in the contract documents. Color to be an integral part of the materials composition.
   b. Self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly and securely fastened together.
   c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
   d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.

2. Optical System: Designed to prevent any objectionable reflection of sun rays even at times of the day when the sun may shine directly into the lens.

3. Lenses: 12 inch diameter polycarbonate. Do not use glass lenses.

2.05 POLES, HEADS, AND SIGNS (Continued)

4. Visors:

a. Standard Installation:

1) Each signal lens is to have a visor with the bottom 25% open.
2) Minimum 0.1 inch in thickness and black in color.
3) Fits tightly against the housing door with no filtration of light between the visor and door.
4) Minimum length of 9 1/2 inches. Ensure the visor angle is slightly downward.

b. Optically Programmed Sections: Make sure the optical unit and visor are designed as a whole to eliminate the return of outside rays entering the unit from above the horizontal.

5. Terminal Block:

a. Three-section signal equipped with a six position terminal block.
b. Four- and five-section signal equipped with an eight position terminal block.

6. Backplate:

a. Manufactured one-piece, durable, black plastic or aluminum capable of withstanding 100 mph winds.
b. Provides 5 inches of black field around the assembly.
c. If specified, provide high visibility reflective tape with a minimum width of 1 inch.

7. Mounting Hardware:

a. Rigid: 1 1/2 inch aluminum pipe and fittings, natural aluminum finish or match the pole color if specified in the contract documents. Secure to pole with a minimum 5/8 inch wide stainless steel banding material.

b. Universally Adjustable: Rigid mounted, consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes. Provide galvanized steel cable material per manufacturer's recommendation.

8. LED Modules: Comply with current ITE standards and consistent with cabinet voltage requirements.

B. Pedestrian Traffic Signal Head Assembly: Comply with current MUTCD and ITE standards.

1. Housing:

a. Made of a durable polycarbonate. Use color specified in the contract documents. Color to be an integral part of the materials composition.
b. Self-contained unit capable of separate mounting or inclusion in a signal face containing one or more signal sections rigidly and securely fastened together.
c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.

2. Visor:

a. Egg crate or tunnel type visor, as specified in the contract documents, attached to the housing door by stainless steel screws or according to manufacturer's requirements.
b. Fit tightly against the housing door to prevent any filtration of light between the door and the visor.
c. Ensure the visor angle is slightly downward.

2.05 POLES, HEADS, AND SIGNS (Continued)

3. LED Module:

a. Provide a LED unit(s) for the filled upraised hand symbol, walking person symbol, and countdown timer.
b. Ensure immediate blank out of the countdown timer display upon recognizing a shortened “Walk” or a shortened "Flashing Don't Walk" interval.
c. Comply with current ITE standards and consistent with cabinet voltage requirements.

C. Traffic Signal Poles and Mast Arms:

1. General:

a. Use mast arm length and vertical pole height as specified in the contract documents.
b. Ensure the mast arms, poles, and supporting bases are galvanized on both interior and exterior surfaces according to ASTM A 123.
c. Use continuously tapered, round, steel poles of the transformer base type for poles with mast arms 60 feet or less. Fabricate poles from low carbon (maximum carbon 0.30%) steel of U.S. standard gauge.
d. For poles with mast arms greater than 60 feet or when a transformer base is not specified, provide a 6 inch by 16 inch handhole in the pole shaft for cable access. Provide a cover for the handhole. Secure the cover to the base with simple tools. Use corrosion resistant hardware.
e. Ensure minimum yield strength of 48,000 psi after manufacture. Supply base and flange plates of structural steel complying with ASTM A 36 and cast steel complying with ASTM A 27, Grade 65-35 or better.
f. Where a combination street lighting/signal pole is specified in the contract documents, ensure the luminaire arm is mounted in the same vertical plane as the signal arm unless otherwise specified. Use a luminaire arm of the single member tapered type. Fabricate the pole with a minimum 4 inch by 6 inch handhole and cover located opposite the signal mast arm.
g. If allowed by the Engineer, poles and mast arms may be fabricated by shop welding two sections together, resulting in a smooth joint as follows:
    1) Ensure a minimum of 60% penetration for longitudinal butt welds in plates 3/8 inch and less in thickness, except within 1 foot of a transverse butt-welded joint. Ensure a minimum of 80% penetration for longitudinal butt welds in plates over 3/8 inch in thickness.
    2) Ensure 100% penetration for longitudinal butt welds in poles and arms within 1 foot of a transverse butt-welded joint.
    3) Ensure 100% penetration for transverse butt welds by using a back-up ring or bar to connect the sections.
    4) Examine the full length of all transverse butt welds and 100% penetration longitudinal butt welds by ultrasonic inspection according to the requirements of ANSI/AWS D1.1.
    5) Comply with ANSI/AWS D1.1 except as modified by Iowa DOT Article 2408.03, B.
h. For mast arms over 50 feet length, two-piece mast arms with a slip-fit and bolt connection are allowed.
i. Provide non-shrink grout (complying with Iowa DOT Materials I.M. 491.13) or a rodent guard (complying with Iowa DOT Materials I.M. 443.01) for placement between the pole base and the foundation per the manufacturer’s requirements.

2.05 POLES, HEADS, AND SIGNS (Continued)

2. Pole Design: Comply with AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Use a 90 mph basic wind speed with a 50 year mean recurrence interval for strength design. Use Category II for fatigue design. Apply only natural wind gust loads (i.e. do not apply galloping loads, vortex shedding loads, or truck-induced gust loads) for fatigue design. Install vibration mitigation devices that mechanically or statically minimize vibration on the mast arm caused by wind on all traffic signal pole mast arms over 60 feet in length as shown on Figure 8010.105.

3. Hardware:

a. General:

1) Equip poles and mast arms with all necessary hardware and anchor bolts to provide for a complete installation without additional parts.
2) Furnish each anchor bolt with one leveling nut, one anchoring nut, and one jam nut (if required) on the exposed end and one of the following on the embedded end: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor bolts, nuts, and washers that comply with Iowa DOT Materials I.M. 453.08.

b. Anchor Bolts:

1) Use straight full-length galvanized bolts.
2) Comply with ASTM F 1554, Grade 105, S4 (-20°F).
3) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
4) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
5) Do not bend or weld anchor bolts.

c. Nuts:

1) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
2) Use heavy hex.
3) Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.
4) Nuts may be over-tapped according to the allowance requirements of ASTM A 563.
5) Refer to Section 8010, 3.05, B, 2 for tightening procedure and requirements.

d. Washers: Comply with ASTM F 436 Type 1.

e. Galvanizing: Galvanize entire anchor bolt assembly consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

D. Traffic Signal Pedestal Poles:

1. Materials:

a. Pedestal: The height from the bottom of the base to the top of the shaft as specified in the contract documents.

b. Pedestal Shaft: Schedule 80 with satin brush or spun finish aluminum tubing. Top of the shaft outer diameter to be 4 1/2 inches and provided with a pole cap. Supply base collar for poles with shaft lengths greater than 10 feet. Provide brackets to mount pedestrian signal on side of pole.

c. Pedestal Base: Cast aluminum, square in shape, with a handhole.

1) Handhole: Minimum of 3 1/2 inches by 5 1/2 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools.

2) Base: A breakaway base with a four bolt pattern uniformly spaced on a minimum of 6 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.

2.05 POLES, HEADS, AND SIGNS (Continued)

2. Anchor Bolts: Four 5/8 inch by 7 1/2 inch steel (minimum), hot dip galvanized anchor bolts complying with ASTM F 1554, Grade 36, meeting pole manufacturer requirements for installation, complete with all hardware required for installation. For pedestal pole sidewalk mounting, provide anchor bolts and hardware per pole manufacturer requirements.

E. Traffic Signs:

1. Sheet aluminum and retroreflective sheeting complying with Iowa DOT Section 4186.

2. Use a universally adjustable mast arm mounted sign bracket.

3. Comply with MUTCD and the contract documents for the street name sign dimensions, letter height, and font.

PART 3 - EXECUTION

3.01 UNDERGROUND

A. Handhole:

1. Locations:
a. Do not construct in ditch bottoms, low areas where ponding of water may occur, or where they will be subject to normal vehicular traffic.
b. With Engineer approval, additional handholes may be placed, at no additional cost to the Contracting Authority, to facilitate the work.

2. Excavation: Excavate as necessary to accommodate the handhole and granular base.

3. Granular Base: Install 8 inch thick granular base extending a minimum of 6 inches beyond the outside walls of the handhole.

4. Placement:
a. In paved areas, install the handhole at an elevation so the casting is level and flush with the pavement. In unpaved areas, install the handhole approximately 1 inch above the final grade.
b. Verify ring placement. Invert rings when installed in paved areas.

5. Conduit:
a. Remove knockouts as necessary to facilitate conduit entrance.
b. Extend conduit into the handhole, through a knockout, approximately 2 inches beyond the inside wall. Conduit to slope down and away from the handhole.
c. Place non-shrink grout (complying with Iowa DOT Materials I.M. 491.13) in the opening of the knockout area after placement of conduit.

6. Cable Hooks:
a. Install cable hooks centered between the knockouts and the top of the handhole anchored within the handhole wall.
b. Place non-shrink grout (complying with Iowa DOT Materials I.M. 491.13) in the opening around the hook after placement of the hook.

7. Backfill: Place suitable backfill material according to Section 3010.

8. Casting: Place the casting on the handhole. Ensure the final elevation meets the handhole placement requirements.

B. Conduit:

1. General:
a. Place conduit to a minimum depth of 30 inches and a maximum depth of 60 inches below the gutterline, unless utility conflicts require deeper placement. When conduit is placed behind the curb, place to a minimum depth of 24 inches and a maximum depth of 48 inches below top of curb.
b. Change direction at handholes or by bending, such that the conduit will not be damaged or its internal diameter changed. Ensure bends are uniform in curvature and the inside radius of curvature of any bend is no less than six times the internal diameter of the conduit.
c. On the exposed ends of conduit, place bell-end fittings on PVC or HDPE conduit and bushings on steel conduit prior to installing cable. Extend all conduits a minimum of 2 inches and a maximum of 4 inches above the finished surface of any foundation, footing, or structural base.

3.01 UNDERGROUND (Continued)

d. When it is necessary to cut and thread steel conduit, do not allow exposed threads. Ensure conduits and fittings are free from burrs and rough places. Clean, swab, and ream conduit runs before cables are installed. Use nipples to eliminate cutting and threading where short lengths of conduit are required. Coat damaged galvanized finish on conduit with zinc rich paint. Use only galvanized steel fittings with steel conduit.
e. Install duct plugs in conduit ends or pack conduit ends with a conduit sealing compound.
f. Install pull tape in each conduit segment, including empty conduits, and secure to duct plugs at each end.

2. Trenched Installation:

a. Place backfill in layers not to exceed 12 inches in depth with each layer thoroughly compacted before the next layer is placed. Ensure backfill material is free of cinders, broken concrete, or other hard or abrasive materials.
b. Remove all surplus material from the public right-of-way as soon as possible.

3. Trenchless Installation:

a. When placing conduit under pavements, use the trenchless installation methods described in Section 3020.
b. If trenchless methods that compact soils in the bore path are used, provide sufficient cover to prevent heaving of overlying paved surfaces.
c. Do not allow pits for boring to be closer than 2 feet to the back of curb, unless otherwise specified in the contract documents.

C. Wiring and Cable:

1. Where practical, follow color codes so that the red insulated conductor connects to the red indication terminal, yellow to yellow, and green to green. Ensure cables are properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables. Label home runs for cables as follows: northwest corner is red, southeast corner is blue, northeast corner is green, and southwest corner is orange.

2. Install continuous runs of vehicle and pedestrian signal cables from the vehicle or pedestrian signal head to the handhole compartment of the signal pole base. Install continuous runs of vehicle and pedestrian signal cables from the handhole compartment of the signal pole base to the terminal compartment in the controller cabinet. Do not splice signal cables in underground handholes.

3. Install continuous runs for video detection and emergency vehicle preemption cables from the unit to the controller cabinet.

4. Install continuous runs of power lead-in cables from the service point to the meter socket and from the meter socket to the controller cabinet.

5. Install continuous detector cable from each detector loop to the first handhole adjacent to the loop. Ensure cables are properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables. Install continuous homerun cable from the splice made in the first handhole to the terminal compartment in the controller cabinet. Attach the drain wire of the shielded cable to the ground in the controller cabinet.

6. Provide a minimum of 4 feet of additional cable at each handhole and loosely coil the extra cable on the handhole cable hooks. Provide a minimum of 2 feet of additional cable at each signal pole (measured from the handhole compartment in the pole to the end of the cable). Provide a minimum of 10 feet of additional cable at each controller base. For fiber optic cable, coil the specified length in a wheel shape and hang vertically.

3.01 UNDERGROUND (Continued)

7. Pull cables through conduit using a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables, and minimize dragging on the ground or pavement.

8. Install a tracer wire in all conduits with the exception of conduits between detector loops and handholes. Use a silicon-filled wire nut to splice the tracer wire in each handhole and at the controller to form a continuous run.

9. Fiber Optic Cable and Accessories:
   a. Use a suitable cable feeder guide between the cable reel and the face of the conduit to protect the cable and guide the cable directly into the conduit off the reel. During the installation, carefully inspect cable jacket for defects. If defects are found, notify the Engineer prior to any additional cable being installed. Take care when pulling the cable to ensure the cable does not become kinked, crushed, twisted, snapped, etc.
   b. Attach a pulling eye to the cable and use to pull the cable through the conduit. Use a pulling swivel to preclude twisting of the cable. Lubricate cable prior to entering the conduit with a lubricant recommended by the manufacturer. Use dynamometer or break away pulling swing to ensure the pulling tension does not exceed the specified force of 600 pounds or the cable manufacturer's recommendations, whichever is less. Do not allow the cable to twist, stretch, become crushed, or forced around sharp turns that exceed the bend radius or scar or damage the jacket. Manually assist the pulling of the cable at each pull point.
   c. Do not pull cable through any intermediate junction box, handhole, pull box, pole base, or any other opening in the conduit unless specified in the contract documents. Install cable by pulling from handhole or controller cabinet to the immediate next downstream handhole or cabinet. Carefully store the remaining length of cable to be installed in the next conduit run(s) in a manner that is not hazardous to pedestrian or vehicular traffic, yet ensures that no damage to the cable occurs. Storage methods are subject to Engineer approval.
   d. At each handhole, visibly mark or tag cable, “CITY (or COUNTY) FIBER OPTIC”
   e. Secure cables inside controller cabinet so that no load is applied to exposed fiber strands.
   f. Ensure the radius of the bend for static storage is no less than 10 times the outside diameter of the cable, or as recommended by the manufacturer. Ensure the radius of the bend during installation is no less than 15 times the outside diameter of the cable, or as recommended by the manufacturer.
   g. Provide cable slack in each handhole, junction box, and cabinet as specified in the contract documents. Where handholes or junction boxes lack sufficient area for cable storage or bend radius requirements, provide equivalent additional slack in adjacent facilities. Coil and bind slack cable at three points around the cable perimeter and support in its static storage position.
   h. Install fiber optic accessories according to the manufacturer’s recommendations and as specified in the contract documents.

10. Fiber Optic Cable Field Testing: Provide for each fiber strand both on-reel testing prior to installation and final testing after installation using a high-resolution optical time domain reflectometer (OTDR). Conduct measurements for single-mode fibers at 1310 nanometer and 1550 nanometer wavelengths. Conduct measurements for multimode fibers at 850 nanometer wavelength. Record the identification, location, length, and attenuation measurements of each fiber, and furnish test reports to the Engineer. Replace any cable that fails testing, at no additional cost to the Contracting Authority.
    a. On-reel Testing: Perform testing for attenuation and continuity using OTDR and a pigtail splice. Complete testing in one direction only. Acceptable test results will be within ± 3% of factory-supplied attenuation measurements. Except for access to and test preparation of one end of the newly furnished cable, preserve the cable in its originally-shipped condition. Furnish test reports to the Engineer prior to installation.

3.01 UNDERGROUND (Continued)

b. Post installation, test 100% of the new cables' fiber count bi-directionally with an optical time domain reflectometer (OTDR) at 1310 nm and 1550 nm; in addition, use an optical loss test set (OLTS) to test all fibers at both wavelengths. Also test existing fibers that are spliced to or re-spliced as part of this contract in both directions and at both wavelengths. Provide the Engineer with up to five copies of any software required for viewing electronic files of the OLTS and OTDR traces. Use test equipment equal to EXFO FTB-500 OTDR meter, and Fluke DTX-CLT OLTS meter.
c. Ensure all test equipment has been factory certified within the last year. Provide copies of the certification 10 days prior to testing.
d. Record test results through the meter manufacturer's software with data compiled in a PDF. Additional alteration using software beyond the meter manufacturer's software will not be allowed. Submit test results in a format approved by the Engineer. Provide completed test forms on each fiber to the Engineer. Also provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, ensure test results show the following:
   - Cable and fiber identification (as approved by the Engineer)
   - Operator name
   - Date and time
   - Setup and test parameters including wavelength, pulse width, range, scale, and ambient temperature.
   - Test results for OTDR test in both directions for total fiber trace, splice loss/gain (dB), connector loss (dB), all events greater than 0.05 dB, measured length from cable markings, and total length from OTDR.
   - Test results for attenuation test including measured cable length (cable marking), total length (from OTDR test), number of splices (from as-built) and total link end-to-end attenuation in each direction, and the bidirectional average.
e. Ensure OTDR testing uses launch and receiving cables minimum 3,300 feet or greater than the dead zone for the OTDR used for this test.
f. Ensure all fiber connectors are cleaned and checked for dirt, scratches, or chips before installed in adapters and testing. Install all dust covers after testing is complete.
   - Ensure the fiber optic cable has a maximum attenuation of 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm when measured with an OLTS.
   - Ensure each connector has an averaged loss value of 0.25 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm.
   - Ensure each splice has an averaged loss value of 0.08 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm.

D. Footings and Foundations:

1. Excavation: Excavate to the size, shape, and depth specified in the contract documents. Ensure the bottom of all foundations rest securely on firm undisturbed soil. Minimize over-excavation to ensure support and stability of the foundation. Notify the Jurisdiction and Engineer immediately if high water and/or poor soils are encountered during excavation. Provide circular forms if needed at no additional cost to the Contracting Authority.

2. Foundation: Provide a means for holding all of the following elements rigidly in place while the concrete is being placed.

a. Forms:

1) Set the forms level or sloped to meet the adjacent paved areas.
2) When adjacent to paved areas, shape the top 11 inches of the foundation to be square and flush with the surrounding paved area. Provide preformed expansion material between the foundation and paved areas.

3.01 UNDERGROUND (Continued)

3) When installed in an unpaved area, set the top of the foundation 2 inches above the surface of the ground.

b. Reinforcing Steel: Install reinforcing steel.

c. Conduit: Install conduit.

d. Anchor Bolts:

1) Set anchor bolts using a template constructed to accommodate the specified elevation, orientation, and spacing according to the pole and controller manufacturer's requirements.
2) Center the pole anchor bolts within the concrete foundation.
3) Protect the anchor bolts until poles are erected.
4) Orient controller footing with the back of the cabinet toward the intersection such that the signal heads can be viewed while facing the controller, unless otherwise directed by the Engineer.

e. Concrete:

1) Place concrete to form a monolithic foundation. Consolidate concrete by vibration methods.
2) Finish the top of the base level and round the top edges with an edging tool having a radius of 1/2 inch. Provide a rubbed surface finish on the exposed surface of the footing or foundation.
3) Allow the foundation to cure a minimum of 4 days prior to erecting the poles and 7 days prior to installing the mast arms. Times may be shortened if supported by strength test results.

3. Backfill: Place suitable backfill material according to Section 3010.

E. Bonding and Grounding:

1. Ensure the traffic signal installation is grounded as required by the National Electric Safety Code.

2. Install a ground rod at each signal pole foundation and controller footing.

3. Use PVC conduit within the foundation or footing to accommodate the connection between the top of the concrete and the ground rod.

4. Bond poles to ground rods with copper wire. Connect ground wires to ground rods with approved mechanical connectors.

5. Bond rigid steel conduit ends in handholes with copper wire and approved fittings.

3.02 DETECTION

A. Detector Loop Cable Installation:

1. Coordinate the location of the detector loop with the Engineer. Obtain the Engineer's approval prior to cutting the pavement.

2. Saw to ensure proper depth and alignment of the slot. Make a 2 inch deep clean, straight, well-defined 3/8 inch wide saw cut without damage to adjacent areas. Overlap the saw cuts where the detector loop changes direction to provide full depth at all corners. Do not use right angle or corners less than 90 degrees. Minimize crossing the number of pavement joints where possible. Route the sawcut from the loop to the edge of pavement perpendicular to the flow of traffic, maintaining at least 1 foot of clearance from parallel joints.

3.02 DETECTION (Continued)

3. Before installing the detector loop cable, check the saw cuts for the presence of jagged edges or protrusions and remove if present. Clean and dry the saw cuts to remove cutting dust, grit, oil, moisture, or other contaminants. Clean by flushing with a stream of water under pressure. Use oil-free compressed air to dry the saw cuts.

4. Install detector loop cable without damage. Place three turns of the detector loop cable into the saw cut. Seal the ends of the tubing at the time of placement to prevent entrance of moisture.

5. Ensure the detector loop cables are in the bottom of the saw cut. Place detector loop sealant within the saw cut area. Comply with the manufacturer's instructions for mixing and using the detector loop sealant.

6. Install preformed loop detector according to the manufacturer's recommendations.

7. Identify each detector loop cable in the handhole by phase and location. Wind loops that are physically adjacent in an individual lane or adjacent lanes with opposite rotation (i.e. #1 clockwise, #2 counter-clockwise, #3 clockwise, etc.). Rotation reversal can be accomplished by reversing leads at the handhole.

8. Twist, with at least five turns per foot, all lengths of loop wires and tubing that are not embedded in the pavement.

9. Identify all detector loop lead-in cables with appropriate detector numbers.

10. Use a detector loop cable splice kit for the electrical splice between the detector loop cable and the detector loop lead-in cable to the controller.
    a. Ensure splice kit provides a watertight protective covering for the spliced wire, the shielding on the detector loop lead-in cable, and the end of the tubing containing the detector loop cable.
    b. Use a manufactured electrical splice kit approved by the Engineer.

11. Test all loops and document by using the following procedures:
    a. Determine the insulation resistance of the loop wire using a "megger" with 500V applied to either loop wire to earth ground. The resistance is to be greater than 100 megohms.
    b. Determine the inductance of the loop using a loop inductance meter.

B. Pedestrian Push Button Detectors:

1. Install according to the manufacturer's recommendations.

2. Seal the wire entrance into the pedestrian push button assembly.

C. Video Detection Camera System: Install according to the manufacturer's recommendations and as specified in the contract documents.

D. Wireless Magnetic Sensors (Pod/Puck): Install according to the manufacturer's recommendations.

3.03 COMMUNICATIONS

A. Traffic Monitoring System: Install according to the manufacturer's recommendations and as specified in the contract documents, as well as the following:

1. Position camera dome on the pole as directed by the Engineer.

2. Test installed system under the supervision of the Engineer, and certify as fully-functional.

B. Fiber Optic Hub Cabinet: Install according to the manufacturer's recommendations and as specified in the contract documents.

3.04 CABINET AND CONTROLLER

A. Cabinet:

1. Install according to the manufacturer's recommendations and as specified in the contract documents.

2. Install on pre-placed caulking material on the concrete base. After the cabinet is installed in place, place caulking material around the base of the cabinet.

B. Controller and Auxiliary Equipment: Install according to the manufacturer's recommendations and as specified in the contract documents.

C. UPS Battery Backup System: Install according to the manufacturer's recommendations and as specified in the contract documents. Provide service outlet that is not connected to the battery backup system.

D. Emergency Vehicle Preemption System: Install according to the manufacturer's recommendations and as specified in the contract documents.

3.05 POLES, HEADS, AND SIGNS

A. Vehicle and Pedestrian Traffic Signal Heads:

1. Inspect each signal head assembly while still on the ground for the following:
   a. Physical defects
   b. Visor type
   c. LED wattage
   d. Lens orientation
   e. Wiring connections

2. Attach signal head mounting hardware according to the manufacturer's recommendations. Apply anti-seize compound to all mechanical fasteners.

3. Adjust each signal head both vertically and horizontally to approximate a uniform grade of all like signal heads.

4. During the course of construction and until the signals are placed in operation, cover signal faces or turn away from approaching traffic. Plumb and aim the heads. Confirm placement of signal heads with the Engineer.

3.05 POLES, HEADS, AND SIGNS (Continued)

B. Traffic Signal and Pedestal Poles:

1. Erect all poles vertically under normal load.

2. Securely bolt the bases to the cast-in-place concrete foundations using the following procedures. Perform this work only on days with winds less than 15 mph. Tighten all of the nuts. Once the tightening procedure is started, complete on all of the base plate nuts without pause or delay.
   a. Use properly sized wrenches or sockets, or both, designed for tightening nuts or bolts, or both, to avoid rounding or other damage to the nuts. Do not use adjustable end or pipe wrenches.
   b. Ensure base plates, anchor rods, and nuts are free of all dirt or debris.
   c. Apply stick wax or bees wax to the threads and bearing surfaces of the anchor bolt, nuts, and washers.
   d. Tighten top nuts so they fully contact the base plate. Tighten leveling nuts to snug tight condition. Snug tight is defined as the full effort of one person on a wrench with a length equal to 14 times the bolt diameter but not less than 18 inches. Apply full effort as close to the end of the wrench as possible. Perform tightening by leaning back and using entire body weight to pull firmly on the end of the wrench until the nut stops rotating. Perform a minimum of two separate passes of tightening. Sequence tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all of the nuts in that pass have been tightened.
   e. Tighten top nuts to snug tight as described for the leveling nuts.
   f. Match-mark the top nuts and base plate using paint, crayon, or other approved means to provide a reference for determining the relative rotation of the nut and base plate during tightening. Further tighten the top nuts tightened in two passes, as listed in Table 8010.01, using a striking or hydraulic wrench. Follow a sequence of tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all nuts in that pass have been turned. Do not allow the leveling nut to rotate during the top nut tightening.
   g. Lubricate the jam nuts, place, and tighten to snug tight.

Table 8010.01: Bolt Tightening

Anchor Bolt Size	First Pass	Second Pass	Total Rotation
Less than or equal to 1 1/2 inch diameter	1/6 turn	1/6 turn	1/3 turn
Greater than 1 1/2 inch diameter	1/12 turn	1/12 turn	1/6 turn

3. A torque wrench should be used to verify that a torque at least equal to the computed verification torque, T_v, according to paragraph 6.9 of FHWA *Guidelines for the Installation, Inspection, Maintenance, and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, is required to additionally tighten the top nuts. An inability to achieve this torque should be interpreted to indicate that the threads have stripped and should be reported to the Engineer.

4. After leveling the poles, use non-shrink grout or a rodent guard between the pole base and the foundation. When non-shrink grout is used, neatly finish exposed edges of grout to present a pleasing appearance, and place a weep hole in the grout.

5. Apply anti-seize compound to all mechanical fasteners on pole access doors.

6. Install pedestrian push button post caps with tamper-proof set screws per manufacturer's direction or by driving the cap a minimum of 1/2 inch onto the post.

C. Traffic Signs: Install signs using universally adjustable sign brackets banded to the pole. Apply anti-seize compound to all mechanical fasteners.

3.06 TEMPORARY TRAFFIC SIGNAL

Construct according to Figure 8010.107 and to the configuration specified in the contract documents. Remove the temporary traffic signal as directed by the Engineer.

3.07 SURFACE RESTORATION

A. Replace or reconstruct features removed as a part of the work, such as sidewalks, driveways, curbs, roadway pavement, unpaved areas, or any other items.

B. Complete restoration according the applicable sections of the SUDAS Standard Specifications or as directed by the Engineer.

3.08 SIGNAL TURN ON

Six days in advance of the scheduled signal turn on, place static signs or portable dynamic message signs (PDMS) on at least each of the major street approaches indicating day of week when the traffic signals will be active. If required, special Traffic Signal Ahead signs or PDMS with “Signal Active” message may be left in place for up to 7 days following activation.

3.09 TESTING

A. Notify the Engineer 2 working days in advance of the time and date the signal or signal system will be ready for turn on. Do not turn on the signal or signal system without authorization of the Engineer.

B. Ensure a representative from the manufacturer and/or supplier of signal controller or other authorized person is at the project site when the signal controllers are ready to be turned on to provide technical assistance including, as a minimum, programming of all necessary input data.

C. All required signal timing data will be provided by the Engineer.

D. A test period of 30 calendar days will start upon confirmation from the Engineer that the signal or signal system is operating consistent with the project requirements. Any failure or malfunction of the equipment furnished by the Contractor, occurring during the test period will be corrected by the Contractor at no additional cost to the Contracting Authority. Upon confirmation by the Engineer that any failure or malfunction has been corrected, a new test period of 30 calendar days will start, exclusive of minor malfunctions such as lamp burnouts. Repeat this procedure until the signal equipment has operated satisfactorily for 30 consecutive calendar days.

E. After signal turn on and prior to completion of the 30 calendar day test period, respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported.

3.10 DOCUMENTATION

A. Provide file documentation packages with each signal system, consisting of the following:

1. Complete cabinet wiring diagram.

2. Complete physical description of the equipment.

3. Controller printout or equal documentation of initial controller settings installed in the field or in the office.

3.10 DOCUMENTATION (Continued)

4. Product manuals for all cabinet equipment.

5. Standard industry warranties on equipment supplied.

6. Documentation of field cable labeling scheme.

7. Diagram of phasing and detector locations.

8. One set of as-built construction plans indicating changes from the original contract documents.

B. Supply two complete sets of documentation. One set to be placed in the controller cabinet and the other set (less construction plan) to be delivered to the Engineer. Electronic (PDF) submittal of the documentation is acceptable, if allowed by the Engineer.

3.11 TRAFFIC SIGNAL REMOVAL

A. Remove and salvage traffic signal and pedestrian poles and posts, including mast arms, signal heads, wiring, mounting hardware, and associated equipment.

B. Remove and salvage controller cabinet and controller, including associated equipment.

C. Remove and dispose of handholes and abandoned conduit as specified in the contract documents.

D. Remove concrete pads and foundations, including reinforcing steel to a depth of 4 feet below established grade. Furnish, place, and compact backfill according to Section 3010.

E. Restore disturbed surfaces to match adjacent areas.

F. Deliver salvaged materials to the location specified in the contract documents.

END OF SECTION

(1) Shape top 11 inches with forms.

(2) Bolt spacing and conduit locations as specified by the manufacturer.

(3) Provide apron on three sides of cabinet if cabinet has front and back doors.

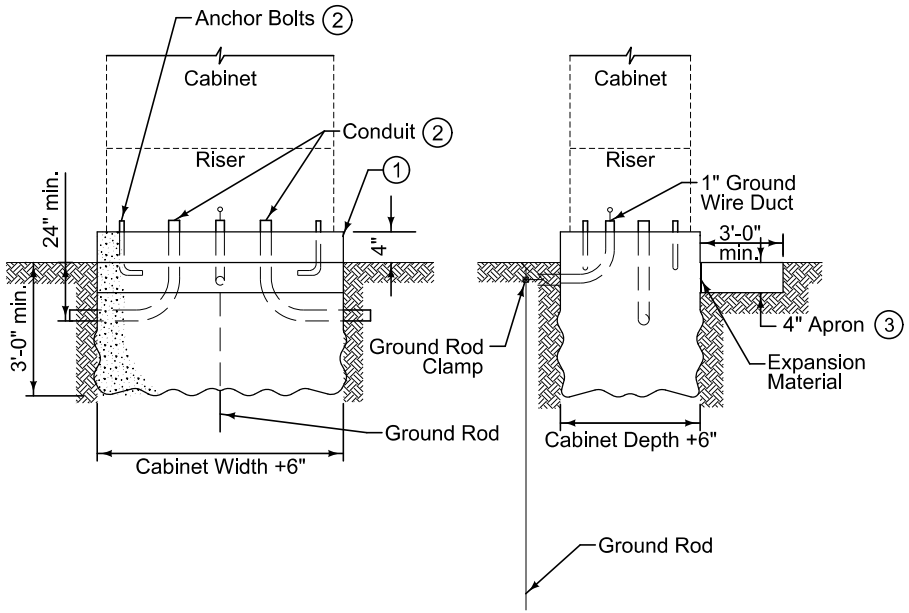


FIGURE 8010.101 | SHEET 1 OF 1

SUDAS

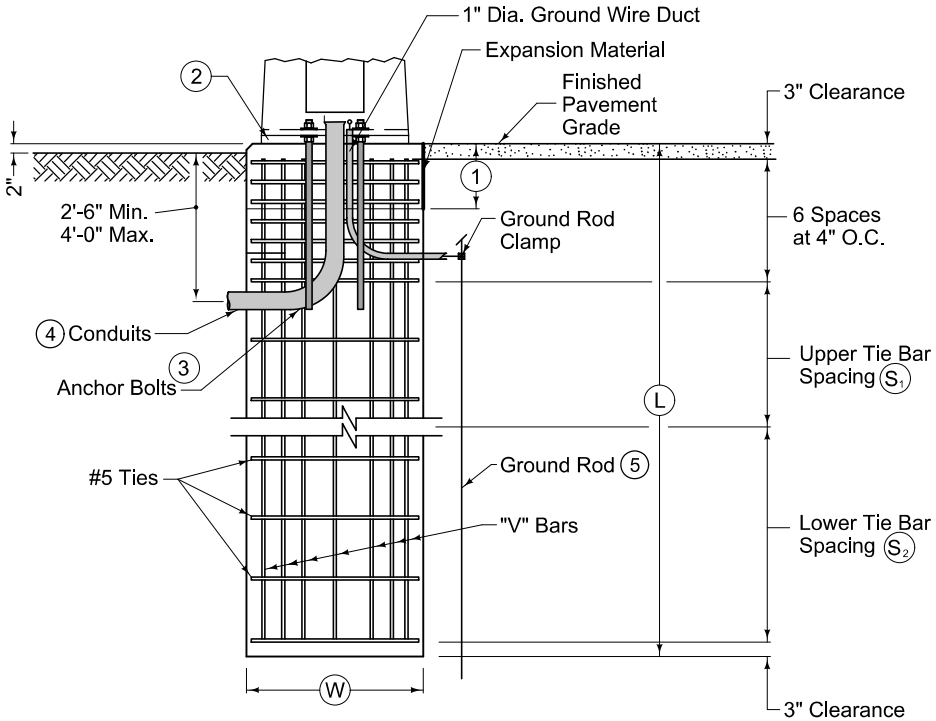
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SHEET 1 of 1

SUDAS Standard Specifications

CABINET FOOTING DETAILS

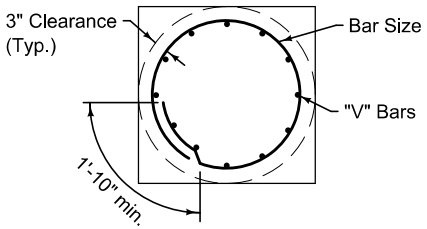


MAST ARM POLE FOUNDATION IN SOIL
TYPE A FOUNDATION

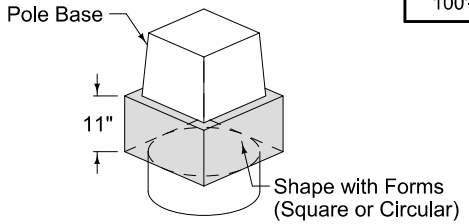
The Type A Foundation is the normally required foundation construction. Where rock is encountered, the Engineer may approve the use of the Type B or C Foundation. Prior to installing a foundation in rock, obtain a subsurface investigation certified by a geotechnical engineer licensed in the State of Iowa.

1. Shape top 11 inches with forms. See Detail 'A'.
2. Install rodent guard or non-shrink grout with weep hole.
3. Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.
4. Provide conduits as per plans.
5. Install ground rod adjacent to foundation or in adjacent handhole.

Max. Mast Arm Length	Foundation		"V" Bars			Tie Bars				
	W	L	Count	Size	Length	Count	Upper Spacing		Lower Spacing	
							# Spaces	S_1	# Spaces	S_2
35'-0"	3'-0"	12'-0"	12	#8	11'-6"	17	9	12"	N/A	N/A
45'-0"	3'-0"	14'-0"	12	#8	13'-6"	19	11	12"	N/A	N/A
55'-0"	3'-0"	16'-0"	12	#8	15'-6"	25	12	8"	5	12"
60'-0"	3'-0"	18'-0"	13	#8	17'-6"	28	15	8"	5	12"
70'-0"	3'-6"	18'-0"	12	#10	17'-6"	28	15	8"	5	12"
80'-0"	3'-6"	21'-0"	14	#10	20'-6"	40	28	6"	4	12"
90'-0"	4'-0"	22'-0"	16	#10	21'-6"	42	24	6"	10	8"
100'-0"	4'-0"	24'-0"	18	#10	23'-6"	47	32	6"	7	8"



PLAN VIEW



DETAIL 'A'

FIGURE 8010.102 | SHEET 1 OF 4

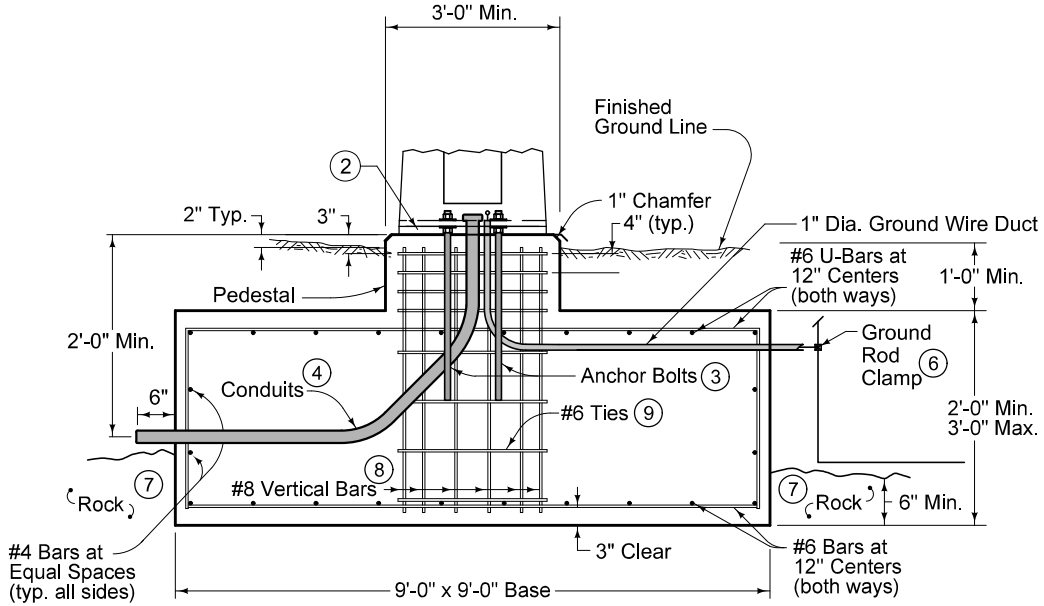
SUDAS | IOWA DOT | REVISION 5 04-19-22

FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 1 of 4

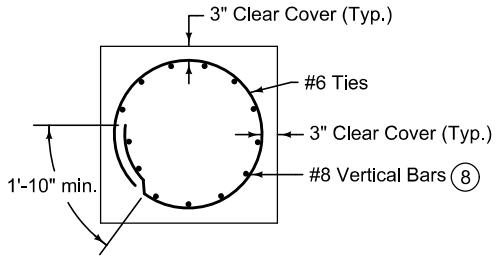
REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION



MAST ARM POLE FOUNDATION IN ROCK
TYPE B FOUNDATION



PLAN VIEW

Type B Foundation is applicable for traffic signal poles with mast arm lengths up to 60 feet.

If the excavation for a Type B Foundation is left open for more than 1 calendar day, install temporary barrier rail if any part of the excavatlon ls located wlthln the clear zone. Temporary barrler rall layout requires the Engineer's approval.

Competent rock has an average unconfined compressive strength (q_u) of at least 2.0 ksi and rock quality designation of at least 90%. Conditions not meeting minimum requirements will require either:
- A site specific design, or
- Using the parameters for Mast Arm Pole Foundation in Soil.

(2) Install rodent guard or non-shrink grout with weep hole.

(3) Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.

(4) Provide conduits as per plans.

(6) When in contact with rock, place ground rods as specified in National Electrical Code, current edition, adjacent to foundation or in adjacent handhole.

(7) Cast foundation concrete against competent rock. If foundation is formed, place backfill with concrete cast against rock.

(8) Place 13 equally spaced #8 vertical bars.

(9) #6 bars spaced at 8 inch maximum. Ties may be welded to vertical bars.

FIGURE 8010.102 | SHEET 2 OF 4

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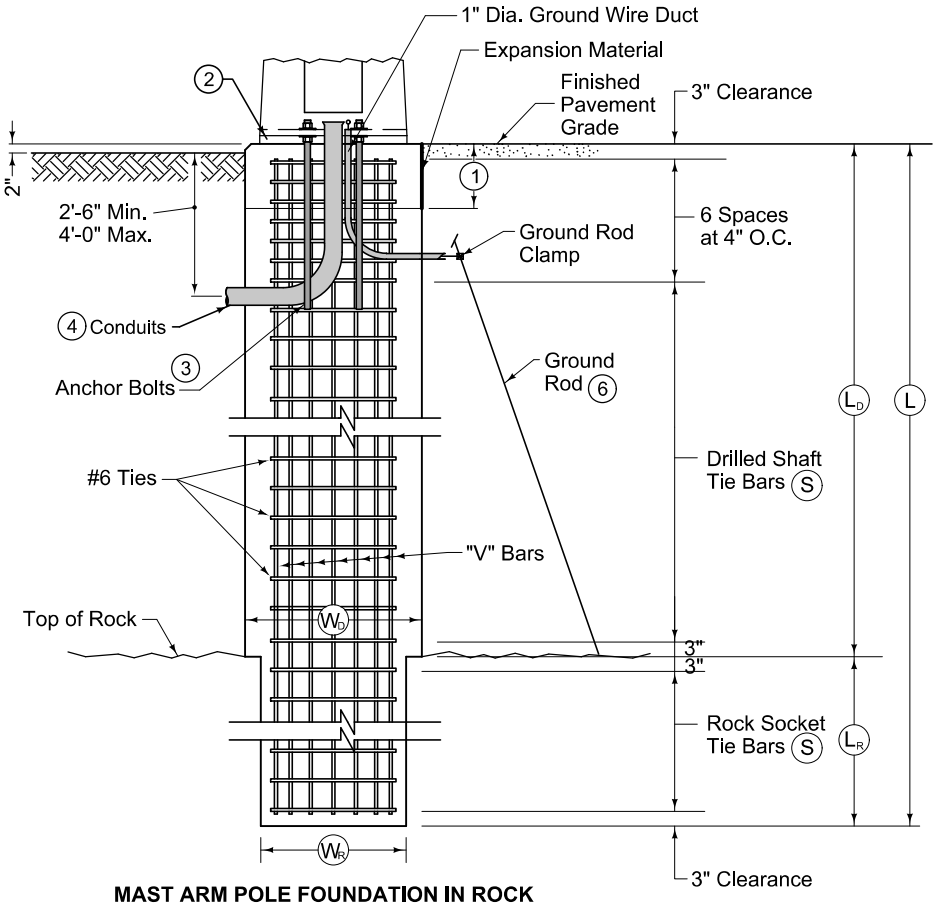
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 2 of 4

REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

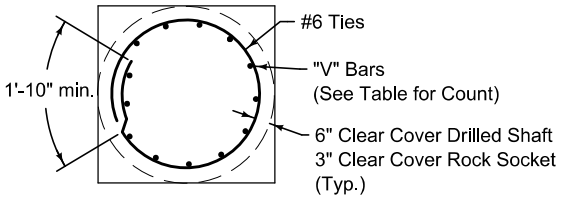
Paul D. Wigand
SUDAS DIRECTOR

Steven Nichols
DESIGN METHODS ENGINEER

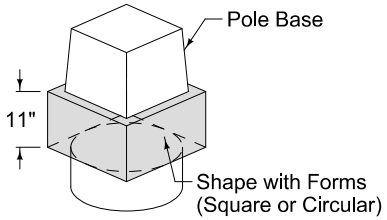
TRAFFIC SIGNAL POLE FOUNDATION



MAST ARM POLE FOUNDATION IN ROCK
TYPE C FOUNDATION



PLAN VIEW



DETAIL 'A'

1. Shape top 11 inches with forms. See Detail 'A'.
2. Install rodent guard or non-shrink grout with weep hole.
3. Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.
4. Provide conduits as per plans.
6. When in contact with rock, place ground rods as specified in National Electrical Code, current edition, adjacent to foundation or in adjacent handhole.

Max. Mast Arm Length	Foundation					"V" Bars			Tie Bars
	W_D Min.	W_R Min.	L*** Max.	L_D	L_R**** Broken Rock*	L_R**** Competent Rock**	Count	Size	Length	S Spacing
35'-0"	3'-0"	2'-6"	12'-0"	VARIES $L_D = (L - L_R)$	4'-6"	3'-0"	13	#8	L - 6"	6"
45'-0"	3'-0"	2'-6"	14'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
55'-0"	3'-0"	2'-6"	16'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
60'-0"	3'-0"	2'-6"	18'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
70'-0"	3'-6"	3'-0"	18'-0"		5'-6"	3'-6"	14	#9	L - 6"	5½"
80'-0"	3'-6"	3'-0"	21'-0"		5'-6"	3'-6"	14	#9	L - 6"	5½"
90'-0"	4'-0"	3'-6"	22'-0"		6'-0"	4'-0"	15	#10	L - 6"	5½"
100'-0"	4'-0"	3'-6"	24'-0"		6'-0"	4'-0"	15	#10	L - 6"	5½"

*Broken rock has an average unconfined compressive strength (q_u) of at least 1.0 ksi and rock quality designation of at least 20%.
**Competent rock has an average unconfined compressive strength (q_u) of at least 2.0 ksi and rock quality designation of at least 90%.
***Total foundation length L must be sufficient to provide a 3 inch clearance between the bottom of the traffic signal pole anchor bolts and the bottom of the rock socket.
****The Rock Socket Length L_R can be decreased if the total length of the shaft is L long as shown in the table.
Conditions not meeting minimum requirements will require site specific designs or shall use theType A Foundation Soil parameters.

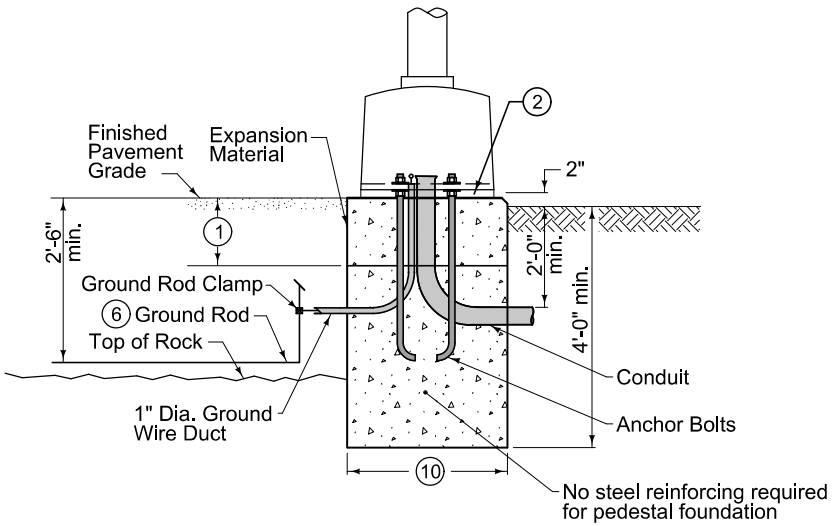
SUDAS | IOWA DOT | REVISION 5 04-19-22
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 3 of 4

REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

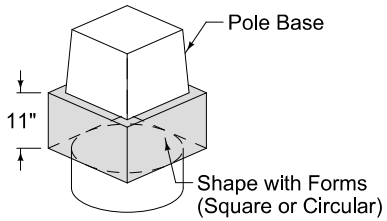
SUDAS DIRECTOR | DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION

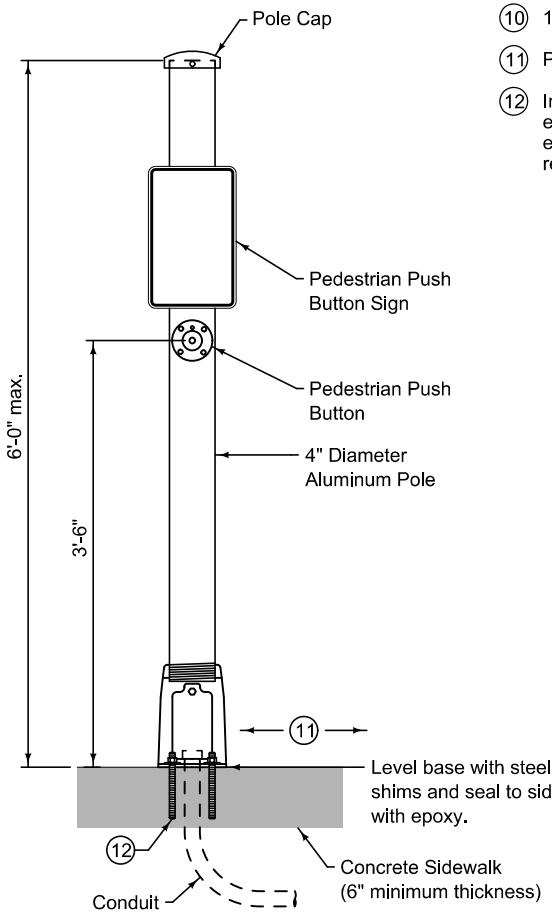
FIGURE 8010.102 SHEET 3 OF 4



PEDESTAL POLE FOUNDATION IN SOIL OR ROCK



DETAIL 'A'



ALTERNATE PUSH BUTTON POLE SIDEWALK MOUNTING

(1) Shape top 11 inches with forms. See Detail 'A'.

(2) Install rodent guard or non-shrink grout with weep hole.

(6) When in contact with rock, place ground rods as specified in National Electrical Code, current edition, adjacent to foundation or in adjacent handhole.

(10) 12 to 24 inch diameter as shown in contract documents.

(11) Provide 4 foot accessible path adjacent to push button pole.

(12) Install four anchor bolts, washers, and nuts in new or existing concrete sidewalk by drilling and anchoring with epoxy adhesive. Provide bolts according to manufacturer's recommendations.

SUDAS | IOWADOT | REVISION 5 04-19-22

FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 4 of 4

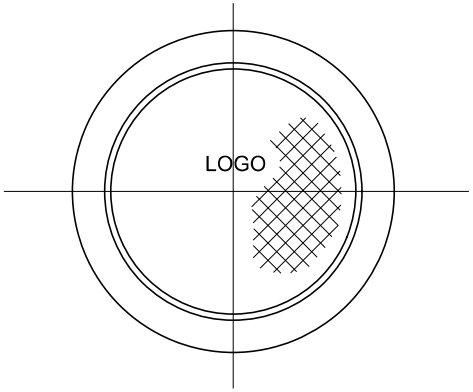
REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

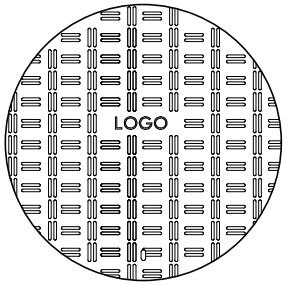
Paul D. Wigand, SUDAS DIRECTOR | Steven Nichols, DESIGN METHODS ENGINEER

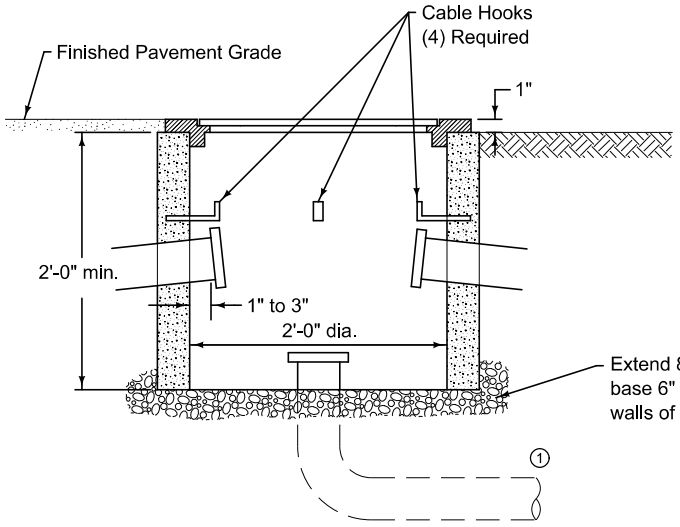
TRAFFIC SIGNAL POLE FOUNDATION

FIGURE 8010.102 | SHEET 4 OF 4

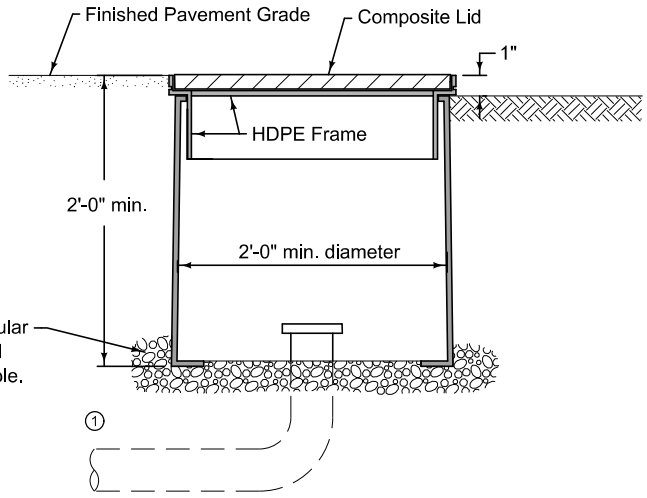
① Potential conduit entry through bottom of handhole.







PRECAST CONCRETE HANDHOLE (TYPE I)



HDPE HANDHOLE (TYPE V)

FIGURE 8010.103 | SHEET 1 OF 2

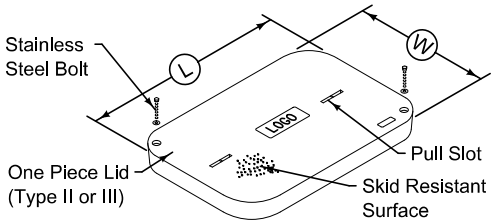
SUDAS	IOWA DOT	REVISION 2	04-19-22
FIGURE 8010.103	STANDARD ROAD PLAN	LI-103	SHEET 1 of 2

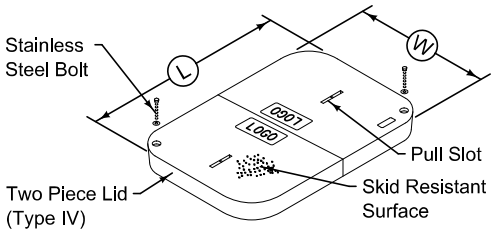
REVISIONS: Added option for conduit to enter through the bottom of handhole.

Paul D. Wigand
SUDAS DIRECTOR

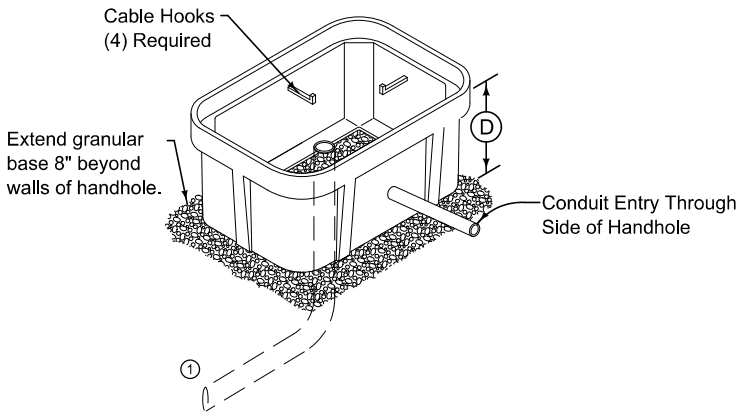
DESIGN METHODS ENGINEER

CONDUIT AND PRECAST HANDHOLES





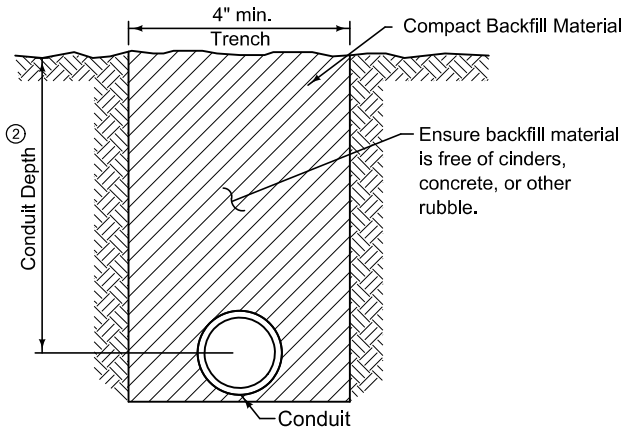
HANDHOLE DIMENSIONS TABLE (NOMINAL)			
TYPE	(L)	(W)	(D)
II	30"	17"	24"
III	36"	24"	30"
IV	48"	30"	36"



PRECAST CONCRETE COMPOSITE HANDHOLE

1 Potential conduit entry through bottom of handhole.

2 For conduit behind curb, place 24 to 48 inches below top of curb. For conduit under roadway, place 30 to 60 inches below the gutterline.



CONDUIT IN TRENCH

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FIGURE 8010.103 | STANDARD ROAD PLAN | LI-103

SHEET 2 of 2

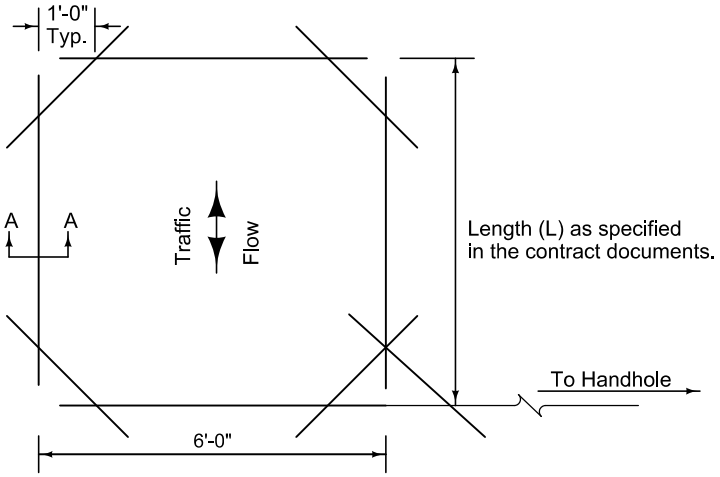
REVISIONS: Added option for conduit to enter through the bottom of handhole.

Paul D. Wigand
SUDAS DIRECTOR

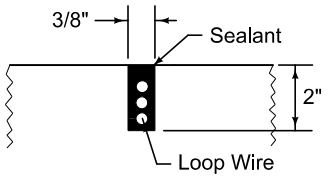
Steven Nichols
DESIGN METHODS ENGINEER

CONDUIT AND PRECAST HANDHOLES

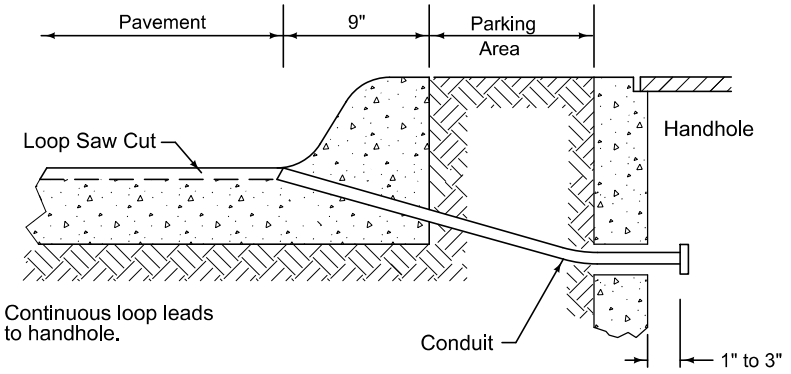
FIGURE 8010.103 | SHEET 2 OF 2



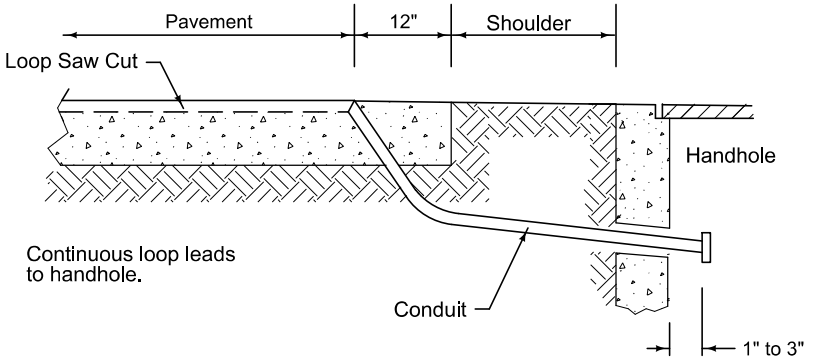
RECTANGULAR DETECTOR LOOP



SECTION A-A



CURB



NO CURB

DETECTOR CONDUIT ENTRY

FIGURE 8010.104

SHEET 1 OF 2

SUDAS

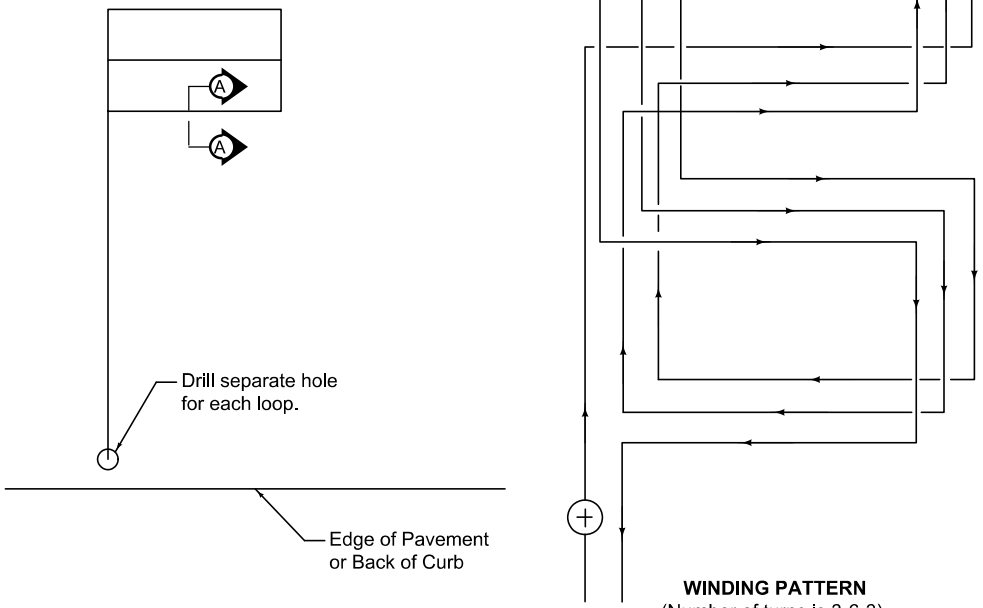
REVISION	
1	2022 Edition

8010.104

SHEET 1 of 2

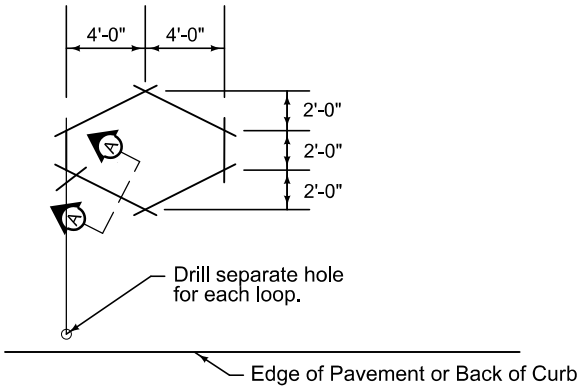
SUDAS Standard Specifications

INDUCTIVE LOOP VEHICLE DETECTORS

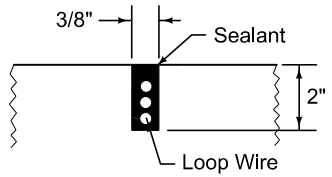


WINDING PATTERN
(Number of turns is 3-6-3)

BICYCLE QUADRUPOLE LOOP DETECTOR



MODIFIED DIAMOND DETECTOR LOOP



SECTION A-A

FIGURE 8010.104 SHEET 2 OF 2

SUDAS

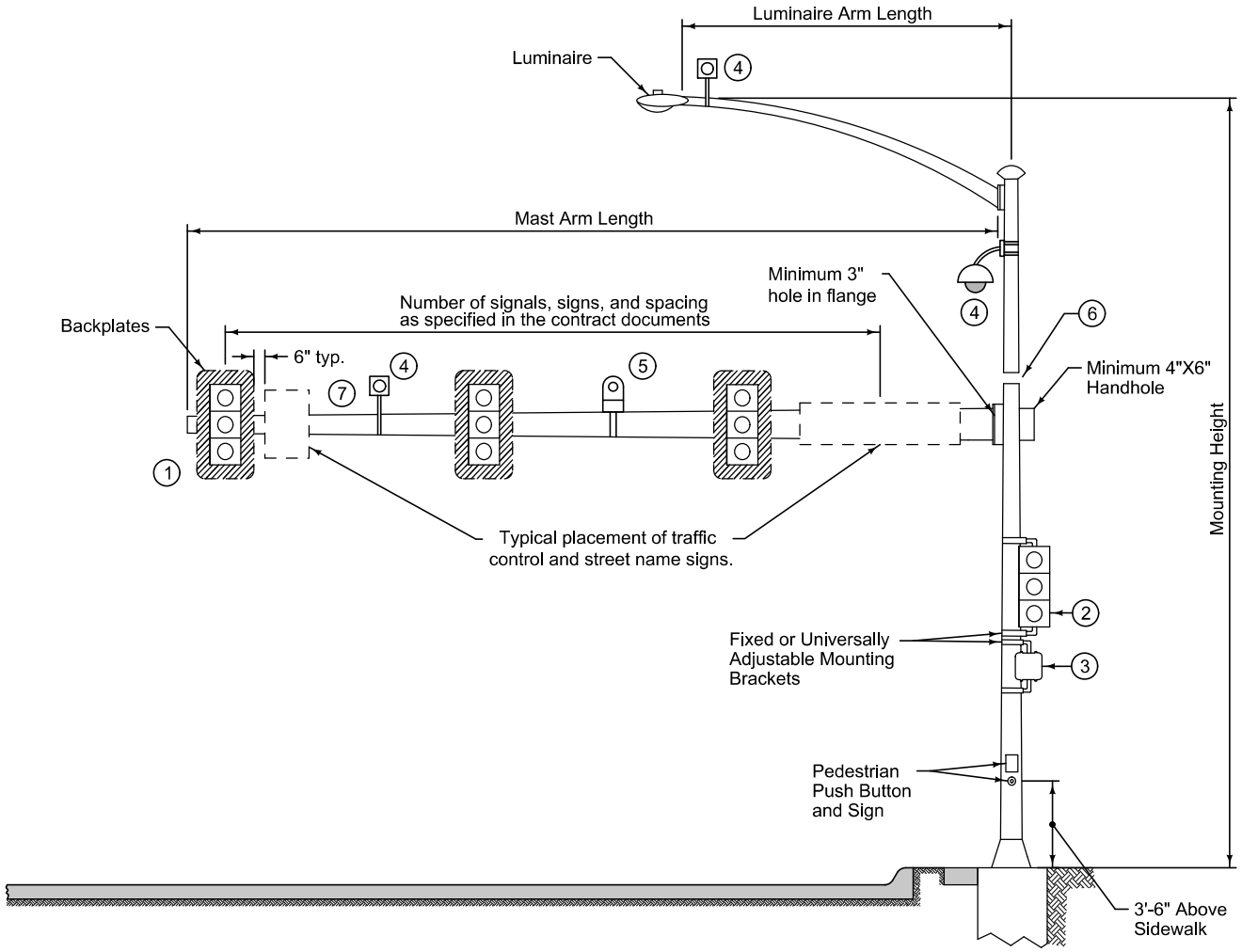
REVISION
1 2022 Edition

8010.104

SHEET 2 of 2

SUDAS Standard Specifications

INDUCTIVE LOOP VEHICLE DETECTORS



STEEL MAST ARM POLE

1. Ensure the top of the signal housing is no more than 25.6 feet above the pavement. Ensure the bottom of the signal housing and related attachments are at least 15 feet above the pavement.
2. Ensure the bottom of the signal housing (including brackets) that is not located over a roadway is a minimum of 10 feet and a maximum of 19 feet above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
3. Mount pedestrian signal heads with the bottom of the signal housing (including brackets) no less than 7 feet or more than 10 feet above the sidewalk level. Position and adjust heads to provide maximum visibility at the beginning of the controlled crosswalk.
4. Possible video camera location.
5. Possible EVP detector.
6. Pole cap if no luminaire extension.
7. Install wind vibration dampening device on mast arms greater than 60 feet in length. Locaton and mounting method as specified by manufacturer.

FIGURE 8010.105 | SHEET 1 OF 1

SUDAS

REVISION
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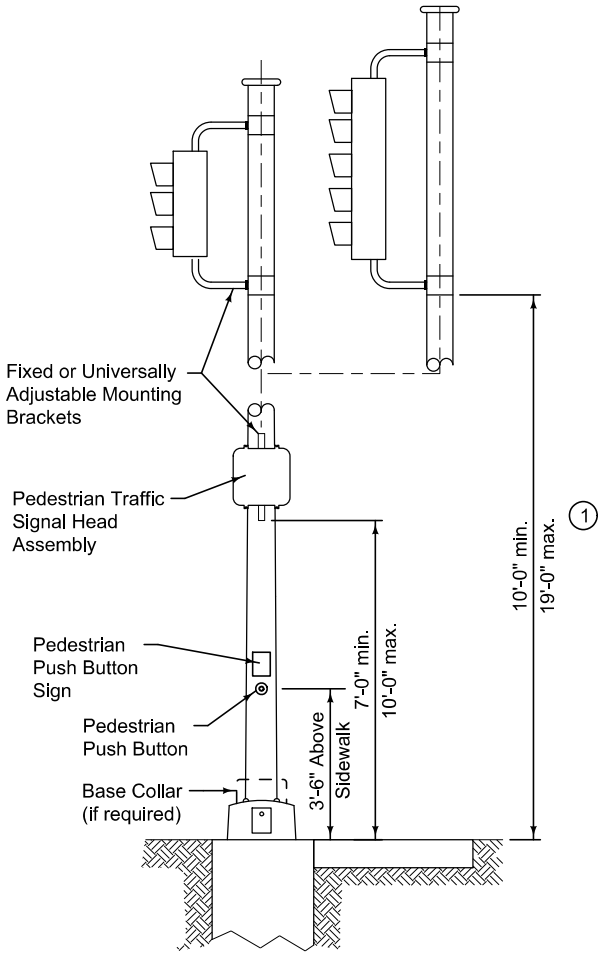
8010.105

SHEET 1 of 1

SUDAS Standard Specifications

MAST ARM POLE DETAILS

(1) For signal head visibility and possible pedestrian head installation.



PEDESTAL POLE

FIGURE 8010.106 | SHEET 1 OF 1

SUDAS

REVISION
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8010.106

SHEET 1 of 1

SUDAS Standard Specifications

PEDESTAL POLE DETAILS

(1) Possible video camera location.

(2) Possible EVP detector location.

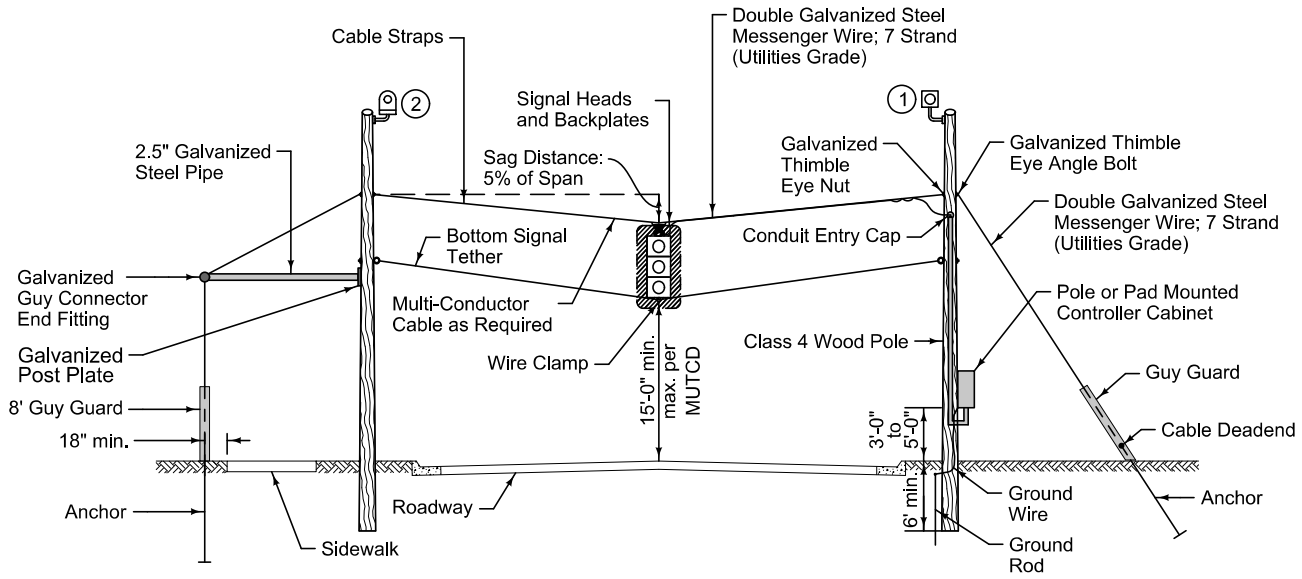


FIGURE 8010.107 | SHEET 1 OF 1

SUDAS

REVISION 1 | 2022 Edition

8010.107

SHEET 1 of 1

SUDAS Standard Specifications

WOOD POST SPAN ASSEMBLY

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Permanent Pavement Markings, Symbols, and Legends

B. Removable Pavement Markings, Symbols, and Legends

C. Temporary Delineators

D. Raised Pavement Markers

E. Removal of Pavement Markings, Symbols, and Legends

F. Grooves Cut for Pavement Markings, Symbols, and Legends

1.02 DESCRIPTION OF WORK

A. Furnish, install, maintain, and remove permanent or temporary pavement markings, temporary delineators, and raised pavement markers, such as for:

1. Diversions and on-site detours where the need for this work is anticipated as part of the traffic control plan to accommodate traffic during construction.

2. Replacing markings obliterated during construction activities on roads open to public traffic.

3. Changing markings on roads open to public traffic where the necessary changes result from staged construction.

4. Replacing markings that are obsolete.

5. Marking newly completed pavement surfaces.

6. Replacing existing markings that have faded or worn away on roads open to public traffic.

B. Permanent pavement markings are intended to remain in place after the project is completed. Temporary markings are designated for removal, will be obliterated during construction, or require changes during construction.

C. Diversions are installations or modifications for the transfer of traffic on four lane or wider roadways to lanes that would normally carry traffic in the opposite direction. Diversions provide for continuous but restricted traffic flow from both directions for divided highways. Diversions usually include crossovers.

D. On site detours are temporary roadways specifically constructed to accommodate traffic during construction.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants as well as the following:

A. Submit a list of pavement marking materials proposed for use on the project.

B. Provide the Engineer with a copy of the manufacturer’s recommendations for applying the pavement marking.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. General:

1. Painted, taped, or removed lines will be measured in stations based upon a single 4 inch width.

2. The length of each type of marking will be as specified in the contract documents and will consider measured field adjustments.

3. The measurement for dashed and dotted lines will be adjusted to exclude the skips.

4. Measured lengths of lines wider than 4 inches will be multiplied by a width factor as follows:
   Width Factor = Actual Width / 4 inches

B. Painted Pavement Markings, Solvent/Waterborne:

1. Measurement: Each type of painted pavement marking will be measured in stations.

2. Payment: Payment will be made at the unit price for each type of painted pavement marking.

3. Includes: Unit price includes, but is not limited to, reflectorizing spheres, layout, surface preparation, and application of marking paint.

C. Painted Pavement Markings, Durable:

1. Measurement: Each type of painted pavement markings will be measured in stations.

2. Payment: Payment will be made at the unit price for each type of painted pavement marking.

3. Includes: Unit price includes, but is not limited to, layout, surface preparation, and application of marking paint.

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Painted Pavement Markings, High-Build:

1. **Measurement:** Each type of painted pavement markings will be measured in stations.

2. **Payment:** Payment will be made at the unit price for each type of painted pavement marking.

3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of marking paint.

E. Permanent Tape Markings:

1. **Measurement:** Each type of marking tape will be measured in stations.

2. **Payment:** Payment will be made at the unit price for each type of tape marking.

3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of marking tape.

F. Wet, Retroreflective Removable Tape Markings:

1. **Measurement:** Wet, retroreflective removable tape markings will be measured in stations.

2. **Payment:** Payment will be made at the unit price per station for wet, retroreflective removable tape markings.

3. **Includes:** Unit price includes, but is not limited to layout, surface preparation, application, and removal.

G. Painted Symbols and Legends:

1. **Measurement:** Each type of painted symbol and legend will be counted.

2. **Payment:** Payment will be made at the unit price for each painted symbol and legend.

3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of each symbol and legend.

H. Precut Symbols and Legends:

1. **Measurement:** Each type of precut symbol and legend will be counted.

2. **Payment:** Payment will be made at the unit price for each precut symbol and legend.

3. **Includes:** Unit price includes, but is not limited to, layout, surface preparation, and application of each symbol and legend.

I. Temporary Delineators:

1. **Measurement:** Each temporary delineator installed and removed will be counted.

2. **Payment:** Payment will be made at the unit price for each delineator.

3. **Includes:** Unit price includes, but is not limited to, installation and removal of delineators.

1.08 MEASUREMENT AND PAYMENT (Continued)

J. Raised Pavement Markers:

1. **Measurement:** Each raised pavement marker installed and removed will be counted.

2. **Payment:** Payment will be made at the unit price for each marker.

3. **Includes:** Unit price includes, but is not limited to, installation and removal of pavement markers.

K. Pavement Markings Removed:

1. **Measurement:** Pavement markings removed will be measured in stations. Removable marking tape or markings obliterated during construction will not be measured.

2. **Payment:** Payment will be made at the unit price for pavement markings removed.

3. **Includes:** Unit price includes, but is not limited to, pavement marking removal and waste material collection, removal, and disposal.

L. Symbols and Legends Removed:

1. **Measurement:** Each symbols or legends removed will be counted.

2. **Payment:** Payment will be made at the unit price for each symbol or legend removed.

3. **Includes:** Unit price includes, but is not limited to, symbol and legend marking removal and waste material collection, removal, and disposal.

M. Grooves Cut for Pavement Markings:

1. **Measurement:** Measurement will be in stations and will be equivalent to the quantity of pavement markings associated with the grooving.

2. **Payment:** Payment will be made at the unit price per station.

3. **Includes:** Unit price includes, but is not limited to, layout, cutting grooves, collection and disposal of removed material, and additional groove width and transition length beyond the pavement marking dimensions.

N. Grooves Cut for Symbols and Legends:

1. **Measurement:** Each symbol or legend groove will be counted.

2. **Payment:** Payment will be made at the unit price for each symbol or legend groove.

3. **Includes:** Unit price includes, but is not limited to, layout, cutting grooves, and collection and disposal of removed material.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide pavement marking materials complying with Iowa DOT Sections 2527 and 4183.

B. Pavement marking materials include:

1. Wet, retroreflective removable tape markings

2. Painted Pavement Markings:
   a. Waterborne and solvent based paint pavement markings
   b. Durable paint pavement markings
   c. High-build waterborne paint pavement markings
   d. Methyl methacrylate (MMA), two component paint

3. Regular marking tape

4. Temporary delineators

5. Raised pavement markers

6. Channelizer markers

7. Preformed polymer tape

8. Removable, nonreflective preformed tape

9. Profiled pavement marking tape

10. Intersection marking tape

PART 3 - EXECUTION

3.01 EQUIPMENT

A. General: Utilize equipment complying with Iowa DOT Section 2527.

B. Pavement Marking Equipment:

1. Capable of placing two lines simultaneously with either line in a solid or intermittent pattern in yellow or white.
2. Capable of applying reflectorizing spheres at the required rate with a pressurized system.
3. All guns in full view of the operator at all times.
4. Equipped with a metering device to register the accumulated length of each gun, each day.
5. Designed so the pressure gages of each proportioning pump are visible to the operator at all times during operation to monitor fluctuations in pressure.
6. Capable of applying paint without dilution.

C. Pavement Marking Removal:

1. Operates without the release of dust.
2. Recovers all removed material.
3. Includes a waste collection and transfer system and for dry wastes, ensure the system incorporates high-efficiency particulate absorption (HEPA) methods and equipment.

D. Pavement Grooving:

1. Utilize grooving equipment with stacked diamond cutting heads mounted on a floating head with controls capable of providing uniform depth and alignment.
2. If pavement is grooved by dry cutting, provide equipment that is self vacuuming.
3. When requested, make available to the Engineer a caliper, depth gage, or depth plate, for use in measuring groove depth.

3.02 CONSTRUCTION

A. General:

1. Comply with the requirements of the MUTCD for traffic control during all pavement marking operations.
2. Install all pavement markings according to the product manufacturer’s published recommendations.

3.02 CONSTRUCTION (Continued)

3. Ensure the following for all painted and taped pavement markings:
   a. Uniform thickness
   b. Uniform distribution of reflectorizing spheres throughout the line width
   c. Line widths as specified, with a tolerance of ± 1/4 inch for 4 inch lines and ± 1/2 inch for wider lines
   d. Symbols and Legends are visually proportional to contract documents with an out-to-out tolerance of ± 6 inches
   e. Markings have sharp edges and cutoffs at the ends

4. For all painted markings:
   a. Apply the paint without dilution
   b. Apply reflectorizing spheres immediately to the wet-paint with a pressurized system

5. For all tape products, follow the manufacturer's recommendations for surface dryness, primers, adhesives, and other surface preparation requirements. Unless otherwise specified by the tape manufacturer, meet the following test for determining surface dryness before applying the tape:
   a. In an area of direct sunlight where the tape will be applied, place an 18 inch by 18 inch piece of polyethylene (a green or black garbage bag may be used). There should not be any holes or tears in the polyethylene.
   b. Tape down all the edges of the polyethylene sheet to seal all the edges and not allow any air movement to get under the polyethylene.
   c. Firmly tamp the tape using the tamper cart or by foot tamping.
   d. Allow 20 to 25 minutes for the polyethylene to be exposed to the direct sunlight.
   e. Remove the polyethylene from the road surface. If no moisture is present on the underside of the polyethylene or on the road surface, the tape can be applied.
   f. If any moisture is present, allow another hour to pass and repeat the test until no moisture is found.

B. Surface Preparation: For all pavement markings, ensure the pavement surface is dry and free from dirt, dust, oil, curing compound, and other contaminates that may interfere with markings properly bonding to the surface.

1. Clean surface to at least 1 inch wider than the anticipated marking.

2. Unless otherwise specified, sweep the pavement surface with a rotary broom or street sweeper.

3. Shoot an air blast on the pavement surface immediately prior to placing the new marking. The air blast is not intended to remove large amounts of dust, but only the residue that might be left from the removal and cleaning operation.

4. When pavement markings are placed on newly constructed PCC pavements, remove the existing curing compound film from horizontal surfaces in these locations. Curing compound film need not be removed from curbs or other vertical surfaces. Remove the curing compound in a manner that does not damage the underlying pavement.

3.02 CONSTRUCTION (Continued)

C. Painted Pavement Markings:

1. Waterborne and Solvent Based Paint: Apply paint and reflectorizing spheres at the nominal rates shown in the following tables.

Table 8020.01: Waterborne Paint Application Rates

Line Width	Wet-Film Thickness	Paint	Reflectorizing Spheres
4”	14 mils	343 ft of solid line per gallon of paint	9.0 lb/gal

Table 8020.02: Solvent-based Paint Application Rates

Line Width	Wet-Film Thickness	Paint	Reflectorizing Spheres
4”	16 mils	300 ft of solid line per gallon of paint	9.0 lb/gal

2. Durable Paint Pavement Markings:

a. Use the same binder thickness as applied on the National Transportation Product Evaluation Program (NTPEP) deck with a tolerance of 10%.
b. Bead application rate is at the discretion of the Contractor.
c. Construct durable pavement markings to comply with the following retroreflectivity requirements when tested according to Iowa DOT Materials I.M. 483.04.

Table 8020.03: Minimum Coefficient of Retroreflected Luminance

White line, symbols, and legends	300 mcd/ft^2/ft-cdl.
Yellow line	200 mcd/ft^2/ft-cdl.

3. High-Build Waterborne Paint Pavement Markings:

a. Provide binder thickness of 0.022 inches $\pm$ 0.0025 inches.
b. Bead application rate is at the discretion of the Contractor.
c. Construct high-build waterborne paint pavement markings to comply with the following retroreflectivity requirements when tested according to Iowa DOT Materials I.M. 483.04.

Table 8020.04: Minimum Coefficient of Retroreflected Luminance

White line, symbols, and legends	300 mcd/ft^2/ft-cdl.
Yellow line	225 mcd/ft^2/ft-cdl.

D. Marking Tape:

If grooving is specified, do not inlay the tape into hot HMA.

1. Inlaid: When the installation of preformed polymer pavement marking material or profiled pavement marking tape is in conjunction with placement of HMA, inlay the tape by positioning it on the HMA prior to the final rolling. Perform the installation of the tape according to the manufacturer's recommendations.

2. Grooved: When grooving is specified, install marking tape in recessed groove according to the manufacturer’s recommendations.

E. Temporary Delineators:

Mount temporary delineators 4 feet above the pavement on delineator posts. Install posts 2 feet from the outside edge of the shoulder at locations specified in the contract documents.

3.02 CONSTRUCTION (Continued)

F. Raised Pavement Markers: Ensure markers continually exposed to traffic do not extend more than 3/4 inch above the pavement surface.

G. Pavement Marking Layout and Location:

1. **Permanent Markings:** Place all lines within 2 inches of reference location. The location of edge lines may be referenced to the pavement edge. The locations of other longitudinal lines may be referenced to accurately locate longitudinal joints. Where reference locations do not exist or are not reliable, locate the lines as follows:
   a. For straight or nearly straight lines, reference the locations to a string line set between marking line points.
   b. For curves, reference the locations to closely spaced marking line points. For sharp curves, a spacing of 10 feet may be required.
   c. Other equally effective systems the Engineer approves.

2. **Temporary Markings:** The location of temporary pavement marking will be specified in the contract documents or as directed by the Engineer to maximize the effectiveness of the traffic control plan.

H. Removal of Pavement Markings:

1. **Staging:**
   a. At the start of construction and at each change in staging, remove all existing pavement markings that conflict with the pavement marking plan.
   b. Prior to final pavement marking, remove all temporary pavement markings.
   c. The Engineer may designate other pavement markings for removal to maximize the effectiveness of the traffic control plan.

2. **Process:**
   a. Remove existing painted pavement markings so that 90% or more of the pavement is visible. Tightly adhering markings may remain in the bottom of the tining and other depressions on the pavement surface, but ensure they are not visible to the motorist during daytime or nighttime. Remove tape markings according to the manufacturer's recommendations. Ensure removal processes do not cause functional damage to the transverse or longitudinal joint sealant materials.
   b. Conduct pavement marking removal operations in a manner so that the finished pavement surface is not damaged or left in a pattern that may mislead or misdirect the motorist. When the operations are completed, power broom the pavement surface. Remove all marking removal debris from the pavement surface before the pavement is open to public traffic.
   c. Perform pavement marking removal to a width no less than the width of the existing or new pavement markings plus 1 inch. Remove the entire area of the existing symbol, legend, or marking in a rectangular shape so no directionality may be observed from the removed symbol, legend, or marking.
   d. Removal of pavement markings may be performed by vacuum blasting, vacuum dry grinding, wet grinding, shot blasting, or high pressure water blasting. Open abrasive blasting or dry grinding without containment is not allowed.

I. Markings Obliterated During Construction:

1. On sections of pavement open to traffic, place pavement markings where construction or traffic operations have obliterated existing markings.

3.02 CONSTRUCTION (Continued)

2. Replace markings obliterated during construction within 3 calendar days after the operation that obliterated the markings has been completed. At intersections with Iowa DOT highways, replace all obliterated edge lines, lane lines, no passing zones, and centerlines prior to opening to traffic.

3. Place symbols and legends within 3 calendar days from the day the road is open to traffic.

J. Grooving for Pavement Markings: When specified in the contract documents, place pavement markings in a groove cut into the pavement surface. Dry or wet cut the groove in a single pass.

1. Groove Depth: Construct groove according to pavement marking material manufacturer's recommendations with the following minimums.
- **a. Paint:** Minimum groove depth of 60 mils.
- **b. Tape:** Minimum groove depth of 100 mils.

2. Groove Width: Marking width plus 1 inch with a tolerance of minus 0.0 inches and plus 0.2 inches.

3. Groove Length: Full length of tape plus 3 inches minimum grooving transition on either end. Do not use a continuous groove for dash markings. When replacing existing dash markings, start cycle so most of the existing marking is removed with the groove. No additional removal of existing markings is required.

4. Groove Position: Locate grooves a minimum of 2 inches from edge of longitudinal joints.

5. Finished Surface: Ensure the bottom of the groove has a fine corduroy-like texture. The maximum allowable rise between the high and low points across the width of the groove is 10 mils.

6. Groove Cleaning: Ensure the surface to receive the marking is free from dust, dirt, or other contaminates that may interfere with the marking properly bonding.
- **a. Dry Cutting:** Vacuum and broom grooves using a high pressure air blast for the final cleaning.
- **b. Wet Cutting:**
  1) Immediately flush the groove with high pressure water and recover the removed material.
  2) Allow the surface to dry a minimum of 24 hours to a visibly dry condition.

K. Limitations:

1. General:
- a. Coordinate pavement marking application with other construction work and associated traffic control changes.
- b. Complete the placement of pavement markings before the lane, road, on-site detour, or diversion is open to traffic.
- c. If unavoidable circumstances result in not being able to complete the pavement marking placement or removal specified for that day, provide traffic control until the pavement marking placement or removal work is completed.
- d. Follow the manufacturer's written recommendations for all details of application.

3.02 CONSTRUCTION (Continued)

2. Temperature Restrictions:

a. Waterborne and Solvent Based Paint Pavement Markings: Comply with Table 8020.05.

Table 8020.05: Pavement Marking Temperature Restrictions

Type of Marking	Oct. 23 to April 7	April 8 to April 22	April 23 to Oct. 7	Oct. 8 to Oct. 22
Waterborne Paint	not allowed	45° F	45° F	45° F
Low Temperature Waterborne Paint per Iowa DOT Materials I.M. 483.03	35° F	35° F	35° F	35° F
Solvent Based Paint	No restrictions	No restrictions	(a)	No restrictions

(a) Only use solvent-based paint if temperature requirements for waterborne paint cannot be met.

b. Durable Paint Pavement Markings:

1) Air and pavement surface temperature are 40°F and rising.
2) The Engineer may allow placement of durable paint at temperatures below these values based on the durable paint manufacturer's written recommendations.

c. High-Build Waterborne Paint Pavement Markings:

1) Air and pavement surface temperature are 50°F and rising.
2) When temperatures are below 50°F, the Engineer may approve the use of marking products denoted by the manufacturer as "low-temperature." When approved, low-temperature paints may be applied when temperatures are between 32°F and 50°F.

d. Marking Tape Pavement Markings:

1) Air and pavement surface temperature are 50°F and rising.
2) Minimum overnight temperature of 40°F the night before application
3) The Engineer may allow placement of marking tape at temperatures below these values based on the marking manufacturer's written recommendations.

END OF SECTION

TEMPORARY TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary Traffic Control Devices

B. Installation

C. Maintenance

D. Quality Control

1.02 DESCRIPTION OF WORK

This part of the specifications includes materials, equipment, and procedures for traffic control during construction. Furnish, erect, operate, maintain, move, and remove all traffic control devices required. Comply with the current edition of the MUTCD as adopted by the Iowa DOT.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Submit a traffic control plan for review and approval prior to installation.

B. Submit proposed modifications to the traffic control plan for review and approval prior to making changes.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. When a bid item for Temporary Traffic Control is included on the proposal form, comply with this section for measurement and payment

B. When the proposal form does not include a bid item for temporary traffic control, all costs incurred by the contractor for temporary traffic control are incidental to other work and will not be paid for separately.

1.08 MEASUREMENT AND PAYMENT

A. Temporary Traffic Control:

1. Measurement: Lump sum item; no measurement will be made.

2. Payment: Payment will be at the lump sum price for temporary traffic control. Proportional payments will be made equal to the percentage of the dollar amount paid on the original contract amount.

3. Includes: Lump sum price includes, but is not limited to, installation, maintenance, and removal of temporary traffic control; total roadway closures with installation and removal of detour signing as shown in the contract documents; removal and reinstallation or covering of permanent traffic control devices that conflict with the temporary traffic control plan; monitoring and documenting traffic control conditions; and flaggers or automated flagger assistance devices (AFAD). When required in the contract documents, the following are also included in traffic control unless a separate bid item is provided: portable dynamic message signs, temporary barrier rail, temporary flood lighting, and pilot cars.

PART 2 - PRODUCTS

2.01 GENERAL

Use products and materials complying with Part 6 of the MUTCD.

2.02 SIGNS

A. Material: Sheet aluminum, galvanized steel, plywood, or flexible roll-up material complying with Iowa DOT Article 4186.02.

B. Size and Type:

1. **Regulatory Signs:** As indicated in the contract documents or recommended in the MUTCD.
2. **Sidewalk Signs:** Minimum size 12 inch by 24 inch.
3. **Warning Signs:** Comply with Table 8030.01.

Table 8030.01: Warning Signs

Speed Limit (mph)	Minimum Sign Size	Minimum Uppercase Letter Size	Minimum Plaque Size
< 25	30” x 30”	4”	18” x 18”
25 - 35	36” x 36”	5”	18” x 24”
>35	48” x 48”	7”	24” x 30”

C. Retroreflective Sheeting: Comply with Iowa DOT Article 4186.03.

D. Posts:

1. **Wood Posts:** Comply with Iowa DOT Section 4164.
2. **U-Shaped Rail Steel Posts:** 3.0 pounds per foot.
3. **Perforated Square Steel Tube Posts:** 2 1/4 or 2 1/2 inch square 12 gage perforated steel tubing.

E. Portable Sign Stands: Crashworthy per the test and evaluation criteria of National Cooperative Highway Research Program (NCHRP) Report 350 or Manual on Assessing Safety Hardware (MASH). Must be stable in windy conditions.

2.03 CHANNELIZING DEVICES

Channelizing devices include cones, channelizers, tubular markers, vertical panels, drums, and barricades. Crashworthy per the test and evaluation criteria of NCHRP 350 or MASH-16.

A. Retroreflective Sheeting: Comply with Iowa DOT Article 4186.03.

B. Cones: Minimum height of 18 inches for daytime and speed less than or equal to 35 mph. Minimum height of 28 inches with retroreflective bands for nighttime or speed greater than 35 mph.

C. Channelizers: 42 inch height with retroreflective bands and 16 pound base.

D. Tubular Markers: Minimum diameter 2 inches with retroreflective bands. Minimum height 18 inches for daytime and speed less than or equal to 35 mph. Minimum height 28 inches for nighttime or speed greater than 35 mph.

2.03 CHANNELIZING DEVICES (Continued)

E. Vertical Panels: Minimum height 36 inches with 8 to 12 inch panel width and 24 inch minimum panel height.

F. Drums: Minimum width 18 inches. Minimum height 36 inches.

G. Barricades: Minimum rail length 2 feet for Type I or Type II barricades. Minimum rail length 4 feet for Type III barricades. Minimum height of top rail for Type I and Type II equals 3 feet and minimum height to top rail of a Type III is 5 feet.

2.04 MISCELLANEOUS PRODUCTS

A. Orange Mesh Safety Fence: Comply with Iowa DOT Article 4188.03.

B. Temporary Barrier Rail: Unless otherwise specified, use precast concrete units. Comply with Iowa DOT Standard Road Plan BA-401.

2.05 EQUIPMENT

A. Warning Lights:

1. For nighttime installation, provide Type A warning lights visible to both directions of traffic.

2. For 24 hour installations, provide Type B warning lights.

B. Arrow Boards: When required, provide Type A, B, or C arrow boards operating in sequential chevron mode.

C. Portable Dynamic Message Signs: Comply with Iowa DOT Article 4188.07.

D. Pilot Cars: Pickup trucks or automobiles with G20-4 signs reading: PILOT CAR - FOLLOW ME. Mount two signs on each vehicle, visible from both directions of traffic. Mount signs with bottom of signs at least 1 foot above the top of the vehicle's roof.

E. Vehicle Warning Lights: Supply amber, high-intensity rotating, flashing, oscillating, or strobe light.

2.06 FLAGGERS

A. General: Comply with the current Iowa DOT Flagger's Handbook for flagger operations, equipment, and apparel.

B. Lighting: Provide auxiliary lighting at flagger stations when nighttime flagging is required.

C. Training: For other than short time, emergency, or relief assignment of flaggers, provide flagger training to include the following:

1. Issuing a copy of the current Iowa DOT Flagger's Handbook to and review by each flagger.

2. Presentation of the current Iowa Professional Flagging Video to each flagger.

3. Issuing a flagger training card to each flagger, to be carried at all times and shown upon request. Include the following information on training card:
   a. Employee name
   b. Date of training
   c. Name of instructor
   d. Expiration date of December 31 of the year following the training date

2.06 FLAGGERS (Continued)

D. Automated Flagger Assistance Device (AFAD):

1. AFADs may be used for flagging operations.

2. Ensure all AFADs meet the current requirements of the MUTCD Section 6E.04 and 6E.06.
   a. Use RED/YELLOW lens type AFADs as per MUTCD Section 6E.06
   b. Comply with crashworthiness requirements of Iowa DOT Article 4188.01, B.
   c. If using AFADs on primary roadways, comply with Iowa DOT Article 4188.11 for remote communication capabilities.

3. Ensure AFAD is operated by trained flaggers who have been instructed how to use the project-specific AFAD. Ensure trained flaggers are available to step in as manual flaggers in case of an AFAD malfunction.

4. Place AFADs where flagger stations are shown on the project plans. Ensure AFADs are clearly visible to approaching traffic, and if used at night, illuminated as flagger stations.

5. Ensure flagger operating an AFAD has direct line of sight to the AFAD location and an unobstructed view of approaching traffic. The use of a camera to monitor the AFAD and/or the approaching traffic is not allowed in lieu of a manual flagger.

6. Ensure flaggers do not perform other duties while operating AFADs and do not leave AFADs unattended at any time while they are in use. Ensure pilot car drivers do not operate AFADs.

7. A single flagger is allowed to operate two AFADs if the following requirements are met:
   a. The flagger has unobstructed view of both AFADs,
   b. The flagger has unobstructed view of both directions of approaching traffic, and/or
   c. The distance between AFAD locations is not greater than 1,000 feet.

8. Immediately replace AFADs with manual flaggers in the event of malfunction.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install temporary traffic control devices according to the Section 8030 figures and Part 6 of the MUTCD.

B. Sign Posts: For durations more than 3 consecutive calendar days, mount the signs on fixed posts. For durations 3 consecutive calendar days or less, mount the signs on fixed posts or movable skids.

C. Temporary Barrier Rail: Place at locations specified in the contract documents. Tie and anchor units as shown on Iowa DOT Standard Road Plan BA-401.

D. Sandbags: Use sandbags to anchor all traffic control devices subject to movement by wind. Do not place sandbags on tops of barricades, drums, or vertical panels.

E. Conflicting Signs: Cover or remove signs with messages conflicting with temporary traffic control as approved or directed by the Engineer.

F. Modifications: Submit proposed traffic control plan modifications to the Engineer for review and approval prior to making changes.

3.02 MAINTENANCE

A. General: Promptly repair, replace, reposition, or clean traffic control devices, as needed, or as directed by the Engineer.

B. Non-working Hours: At the end of working hours, remove, cover, or turn down traffic control devices intended for working hours only.

3.03 QUALITY CONTROL

A. Traffic Control Technician: Maintain a traffic control technician on staff, responsible for the Contractor's traffic control quality control program, that has attended and passed the exam in one of the following classes:

1. ATSSA Traffic Control Technician
2. IMSA Work Zone Traffic Control
3. Minnesota DOT Traffic Control Supervisor
4. Texas Engineering Extension Service Work Zone Traffic Control

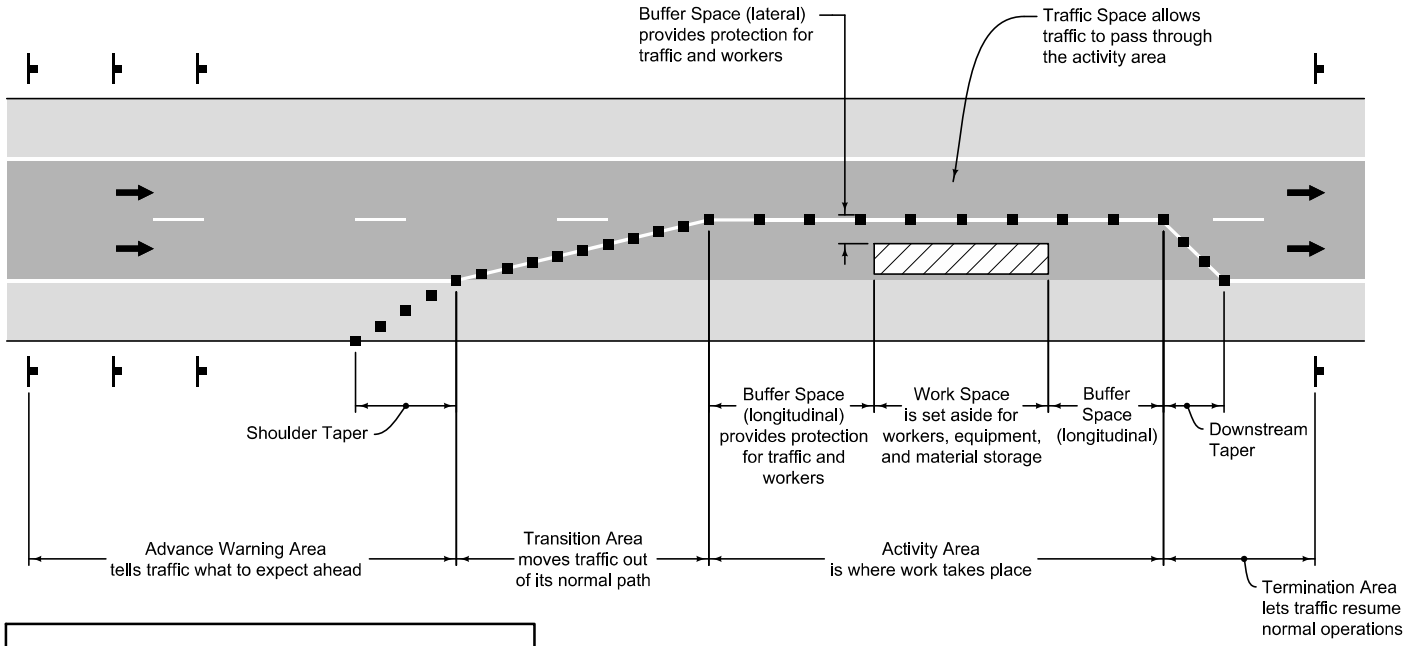
B. Monitoring and Documentation: Provide 24 hour mobile phone number for the traffic control technician. On a daily basis, perform the following quality control work associated with monitoring and documenting traffic control conditions.

1. Review all traffic control operations for compliance with the contract documents.
2. Monitor traffic operations and submit proposed traffic control plan changes to the Engineer for approval.
3. Coordinate all changes to the traffic control plan.
4. Coordinate all traffic control operations, including those of subcontractors and suppliers.

3.03 QUALITY CONTROL (Continued)

5. Maintain a traffic control diary to be submitted at the end of the project or as requested by the Engineer, with the following information:
   a. Listing and locating traffic control used each day, referenced to appropriate plan sheet or standard.
   b. All reviews of traffic control devices and operations, whether satisfactory or unsatisfactory, and corrections made.
   c. Approved changes to traffic control specified in the contract documents.
   d. Incidentals affecting the efficiency and safety of traffic.
   e. A list of trained flaggers used.

END OF SECTION



It may be necessary to combine two or more examples to adequately address the traffic control needed.

Utilize vehicle warning lights (amber, high-intensity rotating, flashing, oscillating, or strobe light) on all shadow and work vehicles.

Vehicle hazard lights may be used to supplement warning lights. Do not use hazard lights alone.

Flags may be used to call attention to the advanced warning signs.

If a closure extends overnight, utilize channelizing devices with retroreflective sheeting.

Speed limit refers to the legally established and signed speed limit.

If an arrow board is used on 2-lane roads, operate only in the caution mode.

Adjust the position of warning signs and channelizing devices for available sight distance.

Do not install temporary traffic control devices until work is ready to begin, and remove or cover all signs and devices promptly when they are not needed.

The END WORK (G20-2) signs shown on all figures are optional.

Key*

- Arrow Board
- Arrow Board Support or Trailer
- Channelizing Device
- Direction of Traffic
- Drum
- Flagger
- Pedestrian Channelizing Device
- Safety Fence
- Shadow Vehicle
- Sign (shown facing left)
- Type III Barricade
- Work Space
- Work Vehicle
- Vehicle Warning Light (amber, high-intensity rotating, flashing, oscillating, or strobe light)

*Applies to all Section 8030 figures

Distance Between Signs	
Speed Limit (mph)	A
20-25	100
30-40	250
45-50	350
55	500

Channelizing Device Spacing			
Speed Limit (mph)	Taper (ft)	Buffer (ft)	Work Space (ft)
20	20	40	40
25	25	50	50
30	30	60	60
35	35	70	70
40	40	80	80
45	45	90	90
50	50	100	100
55	55	110	110

Merging Taper Lengths for Lane Closure*		
Speed Limit (mph)	Taper Length (L) (ft)	Number of Devices
20	80	5
25	125	6
30	180	7
35	245	8
40	320	9
45	540	13
50	600	13
55	660	13

*Values shown are for a 12 foot shift. Table does not apply to one-lane, two-way (flagger) tapers

SUDAS

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8030.101

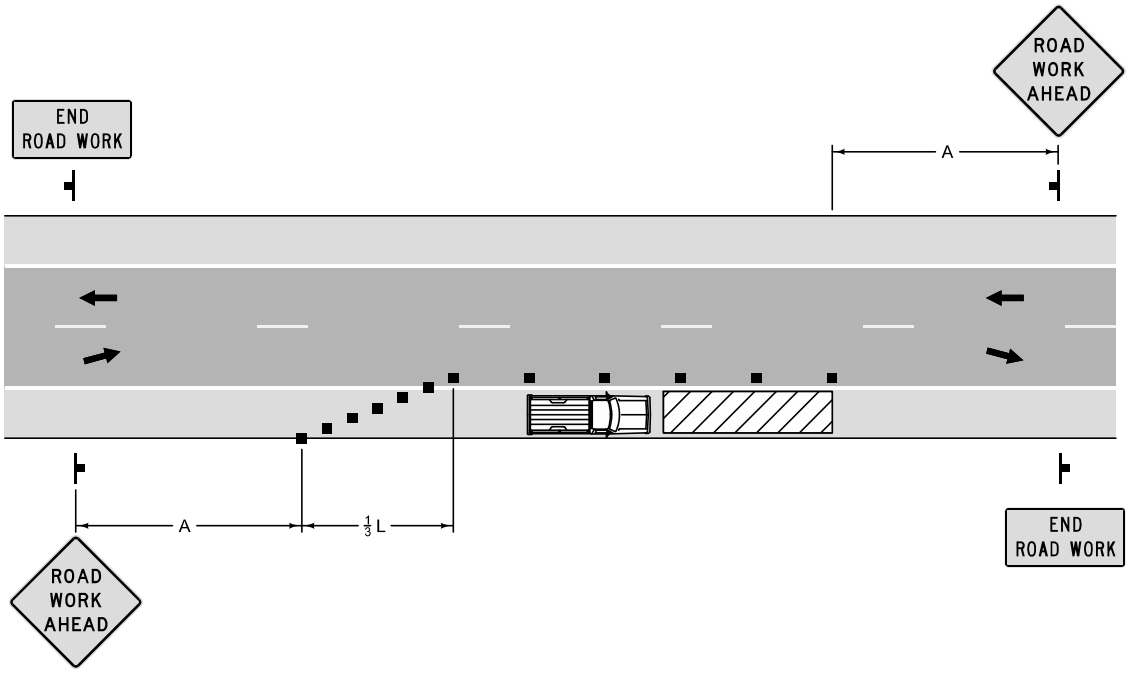
SHEET 1 of 1

SUDAS Standard Specifications

TEMPORARY TRAFFIC CONTROL GENERAL INFORMATION

FIGURE 8030.101

SHEET 1 OF 1



Use only on minor, low speed (≤ 40 mph) streets. Provide a lane closure for higher speed traffic conditions.

Maintain a minimum lane width of 10 feet as measured to the near face of channelizing devices. For short-term use on low speed, low volume roads without wider heavy commercial vehicles, a minimum lane width of 9 feet may be used.

Where the opposite shoulder is suitable for carrying vehicular traffic, lanes may be shifted by using closely spaced channelizing devices provided the resulting lane widths are at least 10 feet wide.

Additional advanced warning may be appropriate, such as a ROAD NARROWS sign.

For short-term work, the taper and channelizing devices may be omitted if a shadow vehicle with activated vehicle warning lights is used.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.102

SHEET 1 OF 1

SUDAS

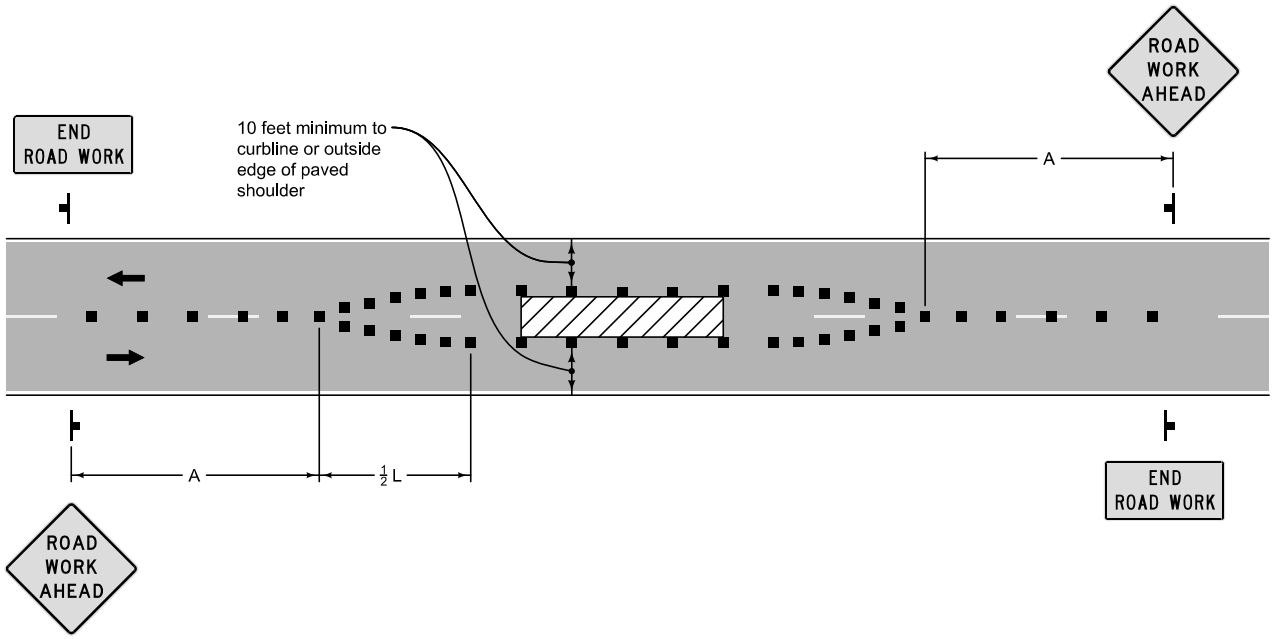
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SHEET 1 of 1

SUDAS Standard Specifications

WORK OFF OF PAVEMENT
WITH MINOR ENCROACHMENT
ONTO TRAVELED WAY



Maintain a minimum lane width on either side of the center work space of 10 feet as measured from the near edge of channelizing devices to the edge of pavement, paved shoulder, or face of curb.

A lane width of 9 feet may be used for short-term stationary work on low speed (≤ 40 mph), low volume roads when motor vehicle traffic does not include longer and wider heavy commercial vehicles.

A work vehicle displaying vehicle warning lights may be used instead of the channelizing devices forming the tapers.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.103

SHEET 1 OF 1

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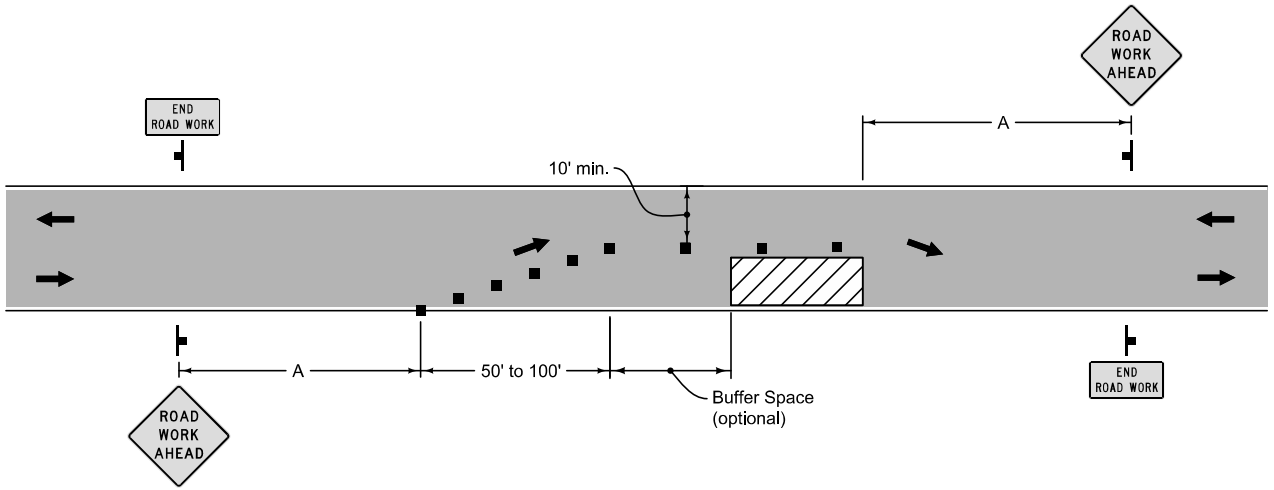
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SHEET 1 of 1

SUDAS Standard Specifications

WORK IN CENTER OF LOW VOLUME STREET



Alternate 1

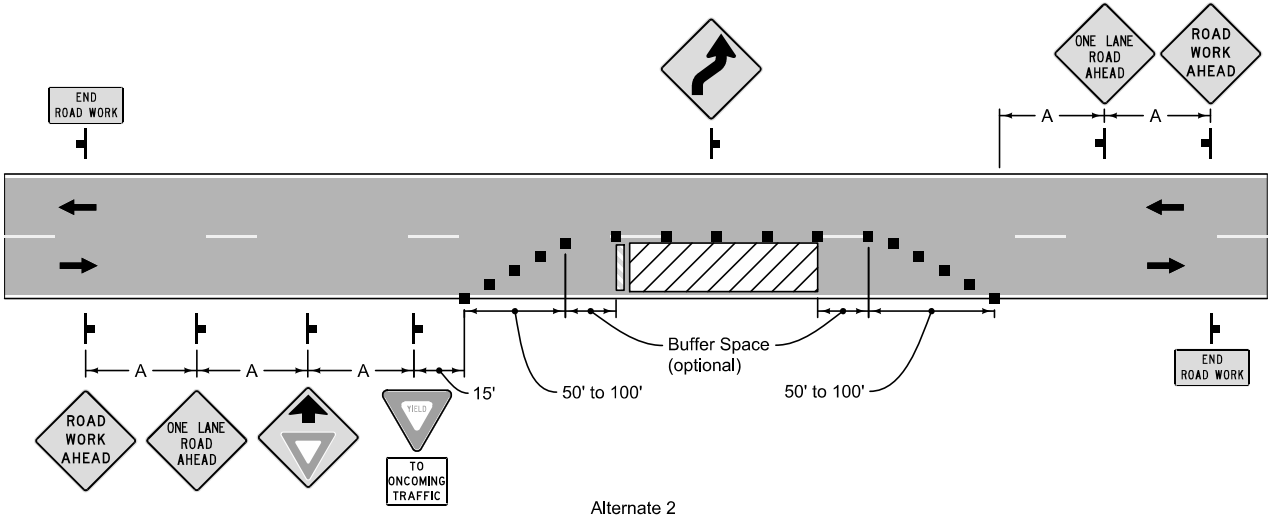
Refer to Figure 8030.101 for symbol key and sign spacing.

Alternate 1

Use of Alternate 1 is restricted to low-speed roadways with good sight distance (paved or unpaved) during daylight hours.

Traffic may be self-regulating when the work space is short and drivers can see the roadway beyond.

Use one or two flaggers when motor vehicle traffic cannot effectively self-regulate.



Alternate 2

Alternate 2

Use of Alternate 2 is restricted to roadways where average daily traffic is fewer than 400 vehicles and good sight distance exists.

Do not use within 2,500 feet of a similar work site.

May be used for overnight closures. During non-working hours remove materials, equipment, or stockpiled waste and fill or cover excavations.

FIGURE 8030.104

SHEET 1 OF 1

SUDAS

REVISION

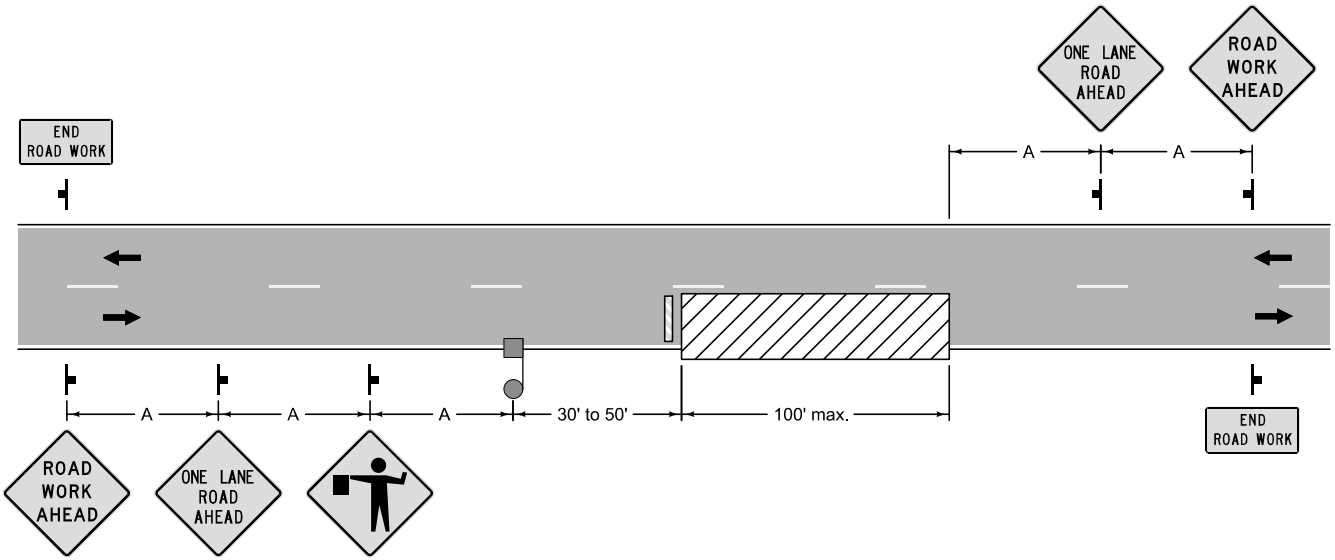
New 10-17-17

8030.104

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SUDAS Standard Specifications

LANE CLOSURE ON LOW VOLUME STREET (SELF-REGULATING)



Use is restricted to roadways where average daily traffic is fewer than 2,000 vehicles per day and good sight distance exists. Use during daylight hours only.

Do not park vehicles or equipment on opposite side of work area.

A work vehicle displaying vehicle warning lights may be substituted for the Type III barricade.

Refer to Figure 8030.101 for symbol key and sign spacing.

Flagger Notes:

Allow traffic in the open lane to flow freely.

Stop the first vehilcle in the closed lane from the flagger position shown, then move toward the centerline to stop other vehicles.

A second flagger may be required when the flagger's view of approaching traffic in the open lane is less than ¼ mile or the work site is in an area of restricted sight distance (such as a No Passing Zone); and excessive traffic delays and conflicts are encountered.

If second flagger is required, refer to Figure 8030.106.

FIGURE 8030.105

SHEET 1 OF 1

SUDAS

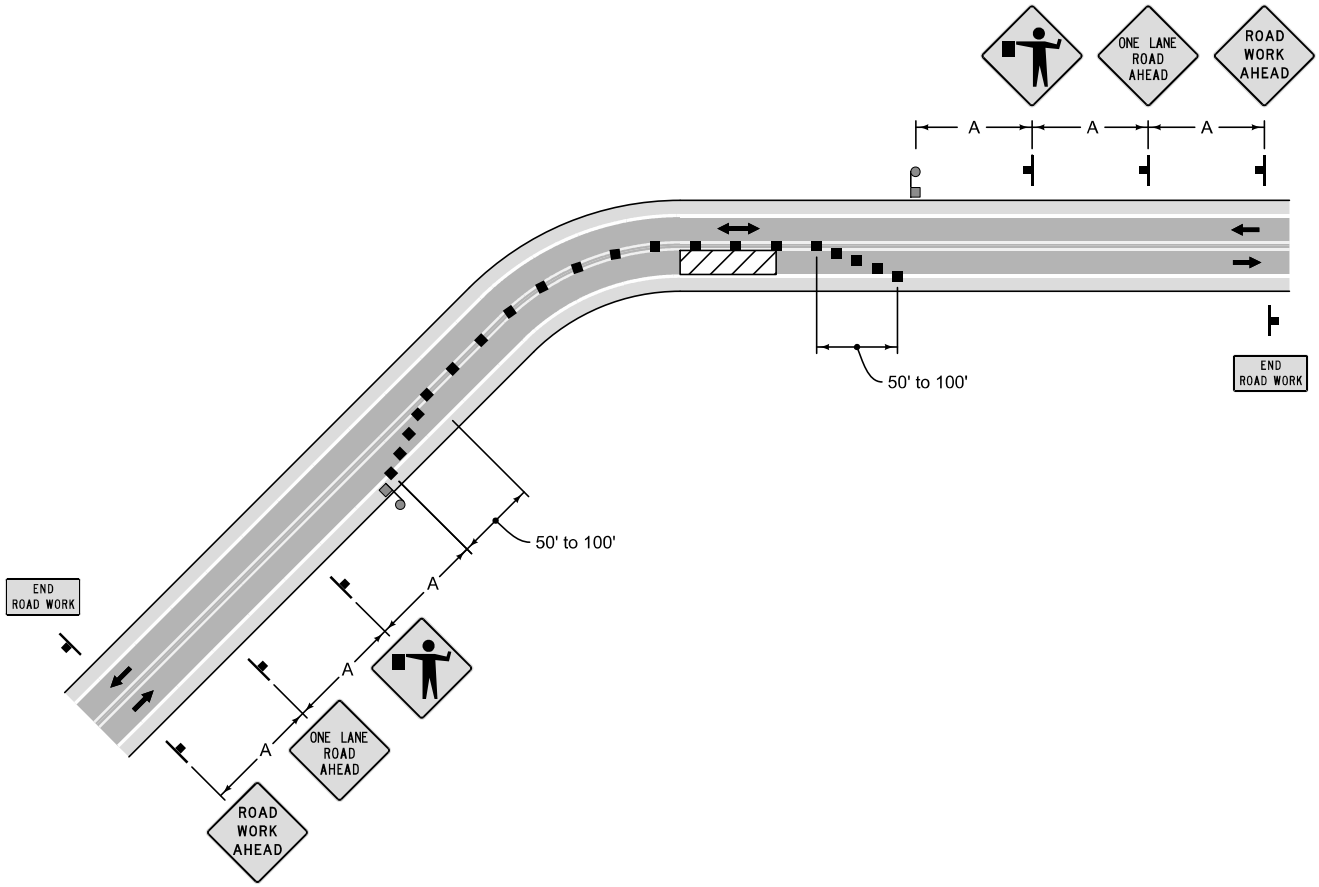
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SUDAS Standard Specifications

LANE CLOSURE FOR SHORT-TERM OR MOVING OPERATIONS USING A SINGLE FLAGGER



An optional BE PREPARED TO STOP sign may be added between the Flagger sign and the ONE LANE ROAD AHEAD sign.

Extend the buffer space as required so the two-way traffic taper is placed before a horizontal curve (or crest vertical curve) to provide adequate sight distance for the flagger and a queue of stopped vehicles.

Refer to Figure 8030.101 for symbol key and sign spacing.

Flagger Notes:

Stop the first vehicle in the closed lane from the flagger position shown, then move toward the centerline to stop other vehicles.

Provide lighting to mark flagger stations at night.

A single flagger may be used for low volume situations with short work zones on straight roadways where the flagger is visible to road users approaching from both directions. Refer to Figure 8030.105.

Refer to Figure 8030.107 for work in vicinity of a street-rail crossing.

FIGURE 8030.106

SHEET 1 OF 1

SUDAS

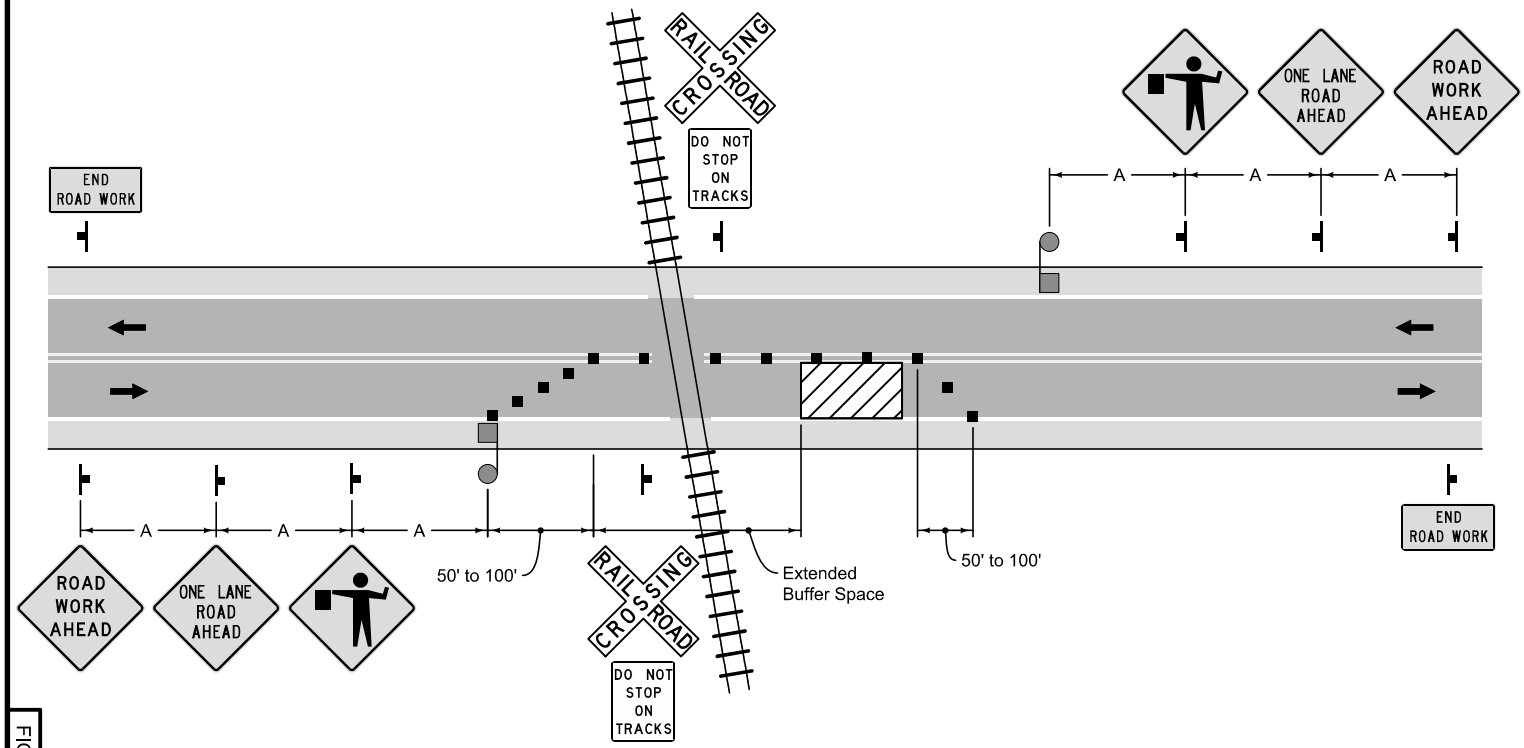
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SUDAS Standard Specifications

LANE CLOSURE ON TWO-LANE ROAD USING TWO FLAGGERS



Coordinate with railroad company early, before work starts.

When roadway work activities come within or near railroad grade crossing, take extra care to eliminate the possibility of lane restrictions, flagging, or other operations where vehicles might be stopped within the grade crossing, which is defined as 15 feet from the closest rail.

Extend the buffer space of the activity area upstream of the grade crossing (as depicted in the figure) so a vehicle backup by the flagging operation will not extend across the grade crossing.

Refer to Figure 8030.101 for symbol key and sign spacing.

Flagger Notes:

The railroad company may require railroad-supplied flaggers.

FIGURE 8030.107

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SUDAS Standard Specifications

WORK IN VICINITY OF ROADWAY-RAIL GRADE CROSSING

May be used for short-term daylight operations in urban areas on 3-lane street. Nighttime operations require additional traffic control and retroreflective sheeting.

Cones may be used as channelizing devices during daylight hours.

Flaggers and additional traffic control devices may be required for higher traffic volumes or commercial areas.

Refer to Figure 8030.101 for symbol key and sign spacing.

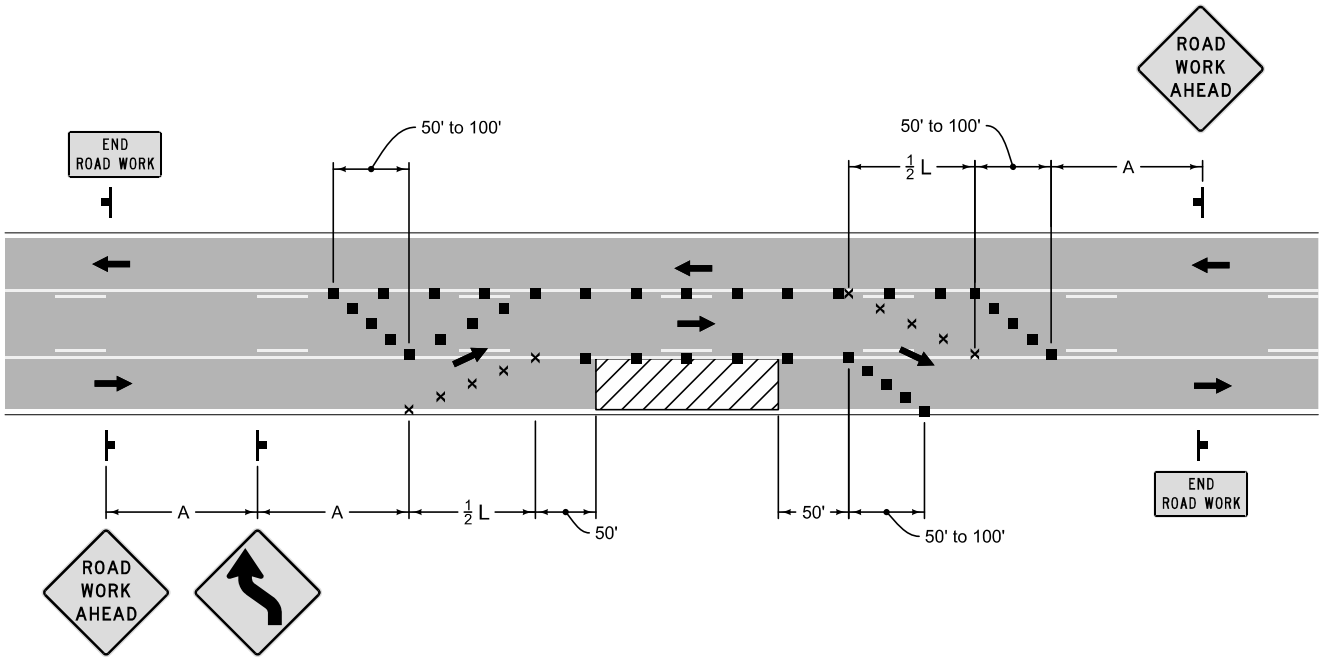


FIGURE 8030.108

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SUDAS Standard Specifications

TRAFFIC CONTROL FOR OUTSIDE LANE CLOSURE OF STREET WITH CONTINUOUS LEFT TURN LANE

May be used for short-term daylight operations in urban areas on 3-lane or 5-lane streets. Nighttime operations require additional traffic control and retroreflective sheeting.

Cones may be used as channelizing devices during daylight hours.

Flaggers and additional traffic control devices may be required for higher traffic volumes or commercial areas.

Refer to Figure 8030.101 for symbol key and sign spacing.

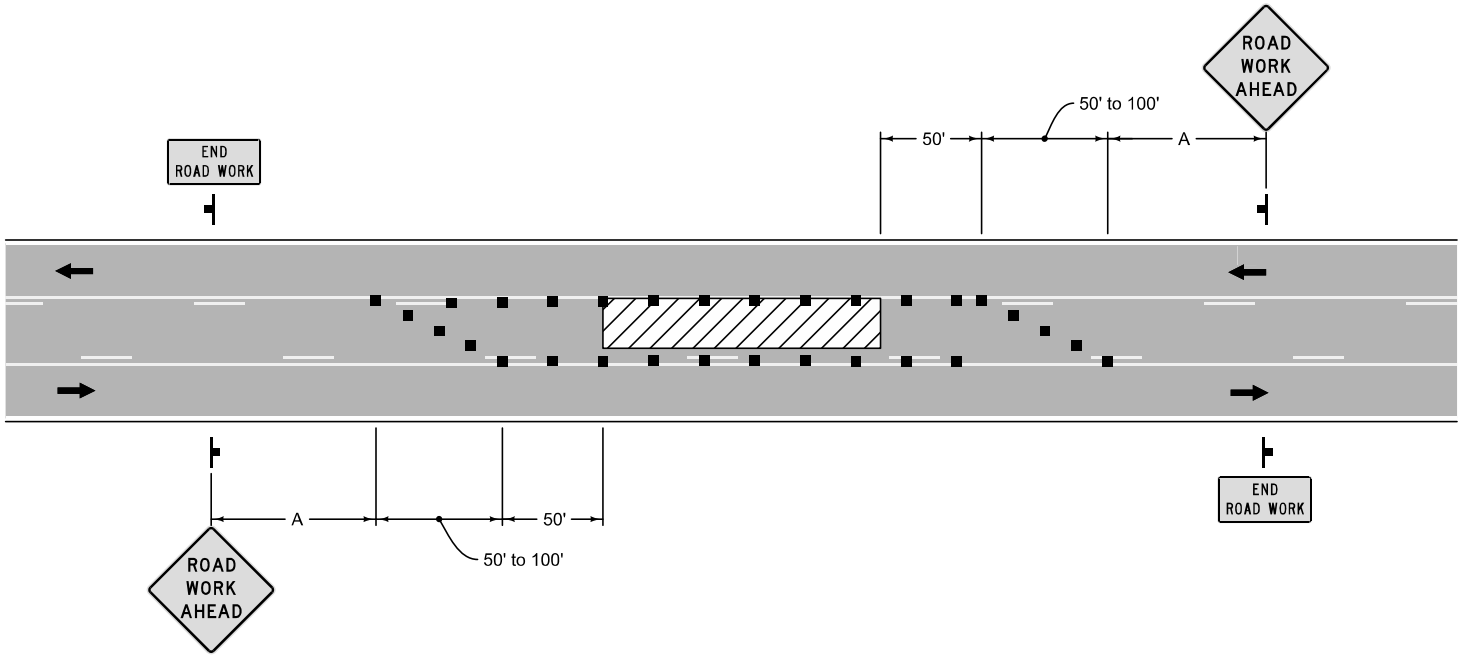


FIGURE 8030.109

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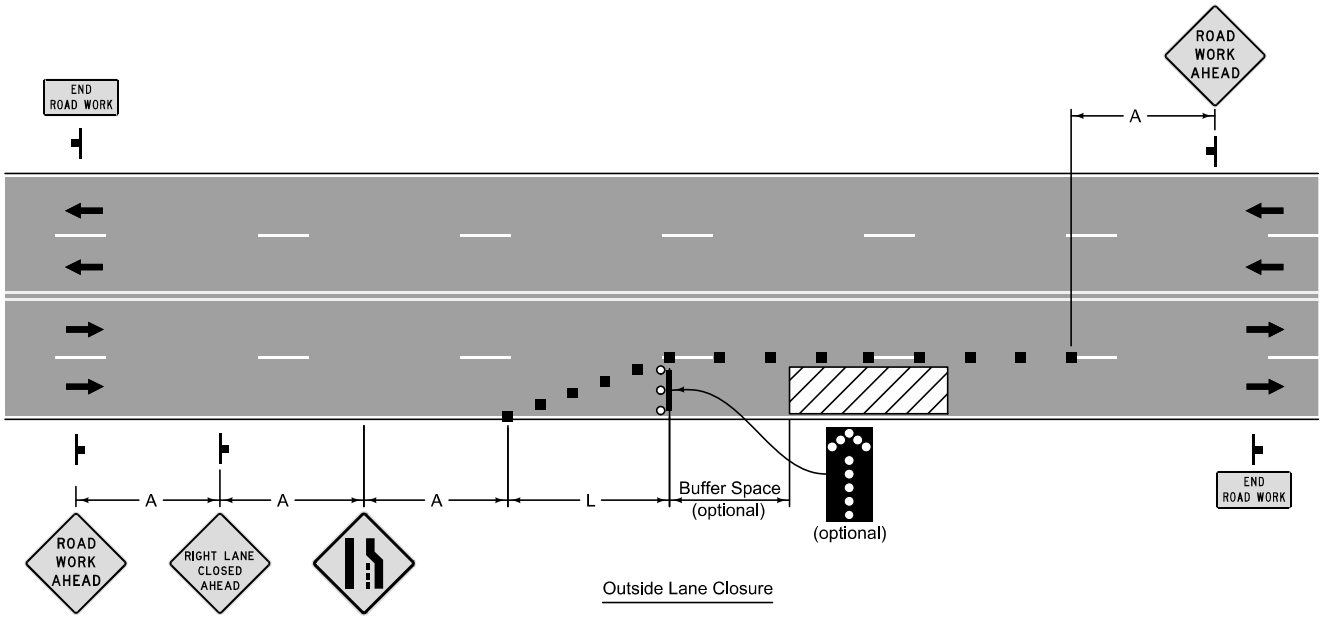
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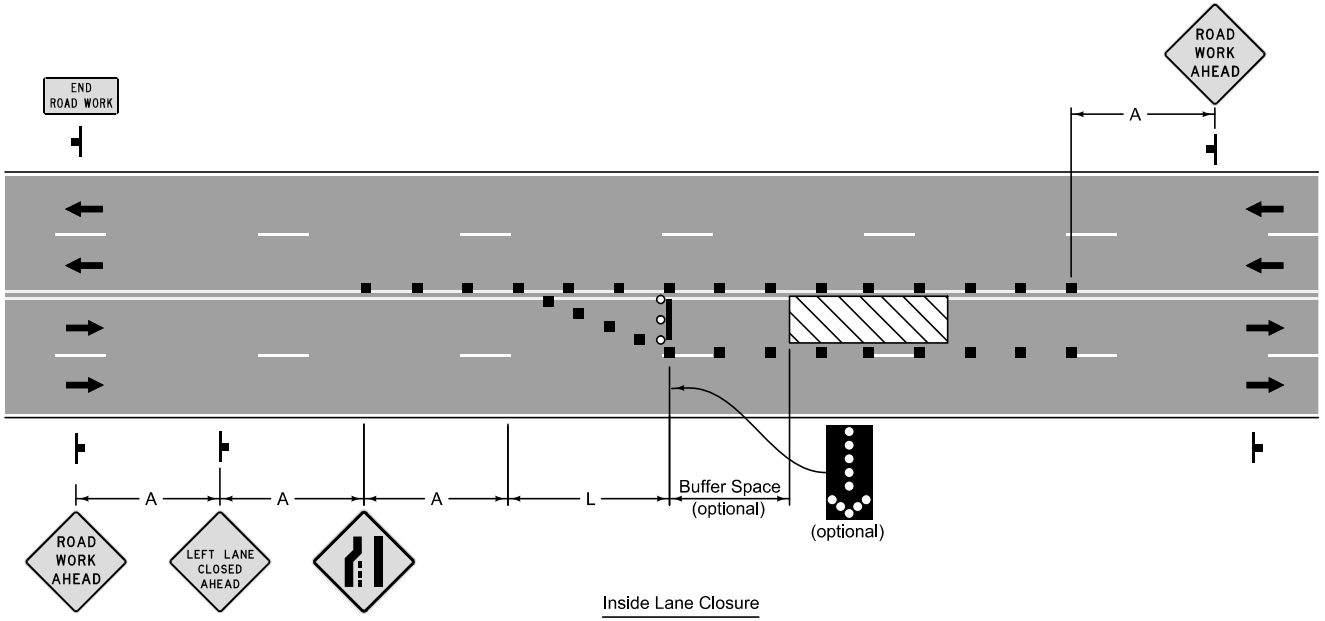
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SUDAS Standard Specifications

TRAFFIC CONTROL FOR CLOSURE OF CONTINUOUS LEFT TURN LANE



Outside Lane Closure



Inside Lane Closure

For low speed, low volume, urban streets the LEFT/RIGHT LANE CLOSED AHEAD sign may be omitted.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.110

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SUDAS

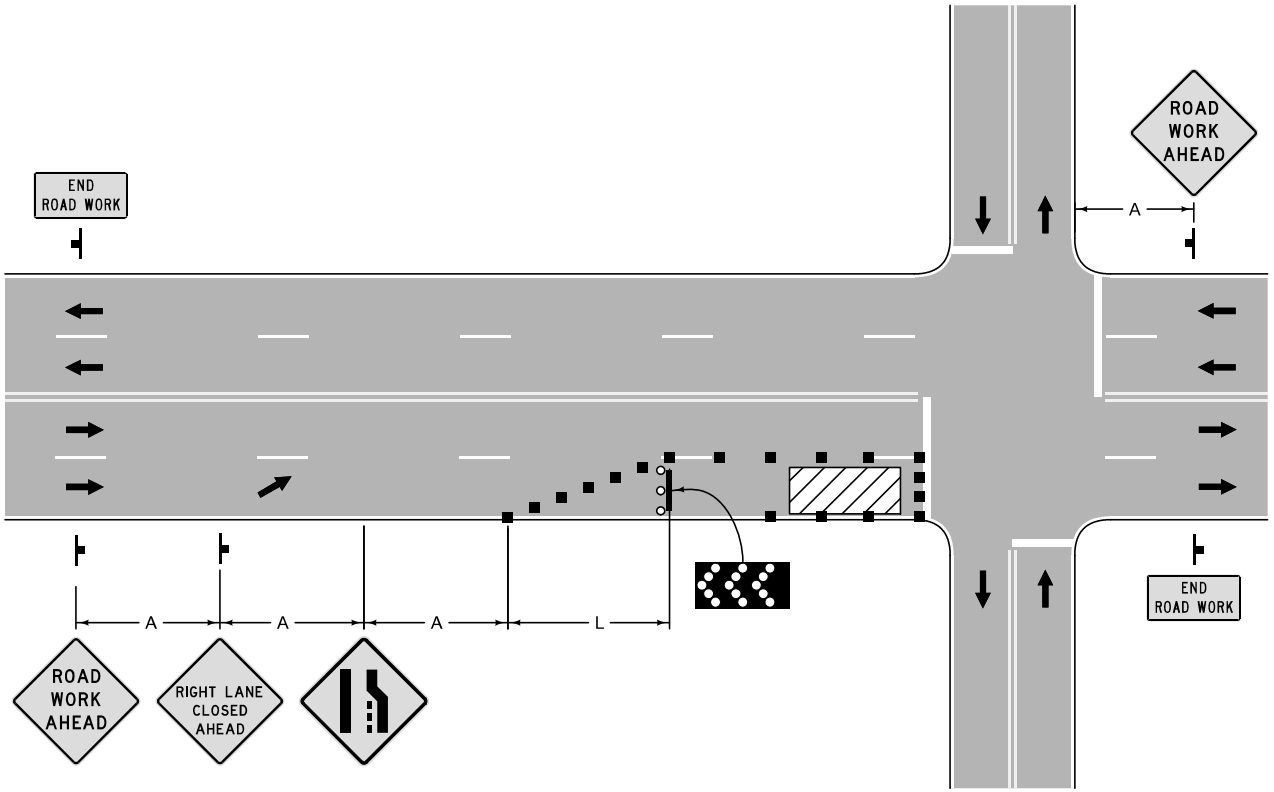
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SUDAS Standard Specifications

LANE CLOSURE ON MULTI-LANE STREET



Place arrow board within the closed lane behind the channelizing devices and as close to the beginning of the taper as practical, while keeping it on the paved surface.

If the work area extends across the crosswalk, the crosswalk should be closed using appropriate information and devices.

For traffic signal maintenance, consider using law enforcement and/or a shadow vehicle.

For intersection approaches reduced to a single lane, left-turning movements may be prohibited to maintain capacity for through motor vehicle traffic.

Right lane closure shown; for left lane closure, modify sign messages and arrow board.

Refer to Figure 8030.101 for symbol key and sign spacing.

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8030.111

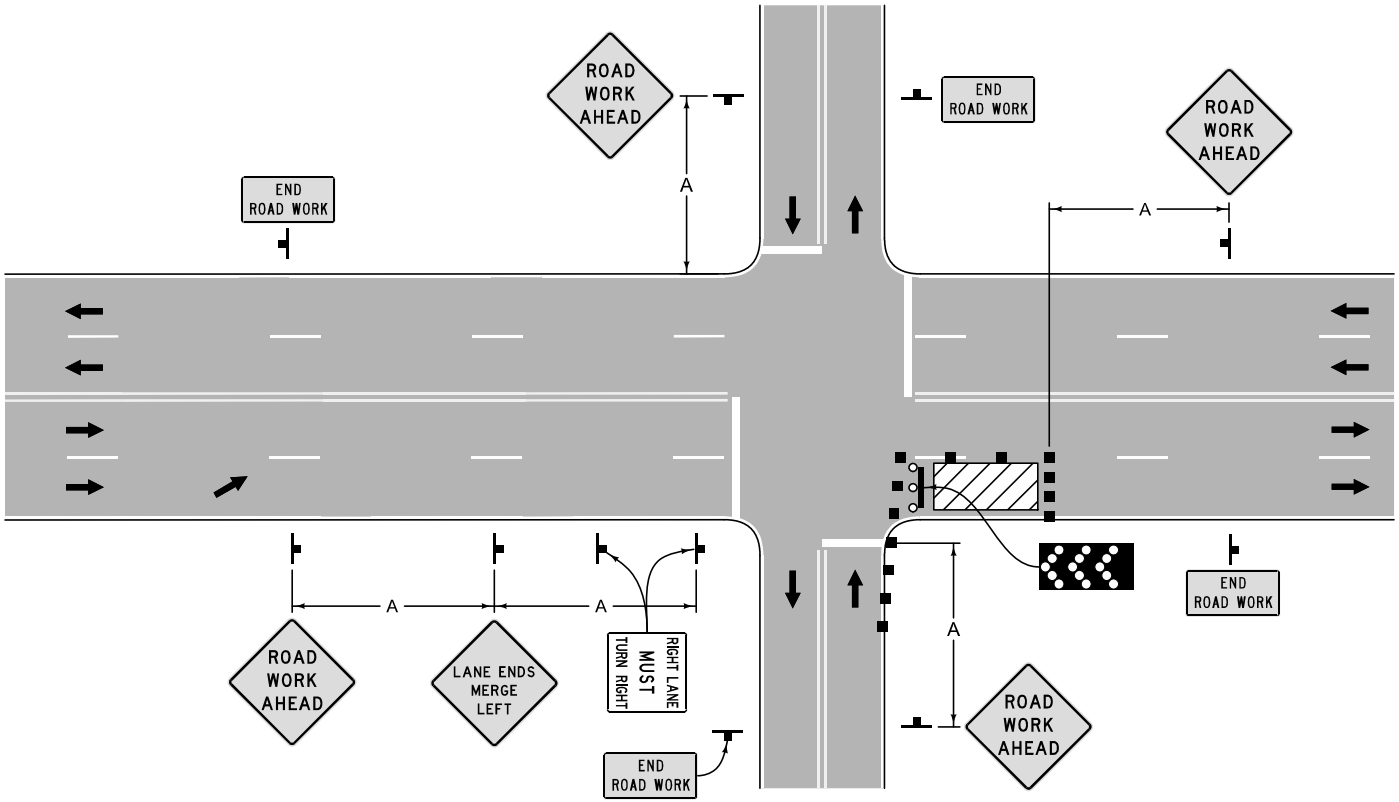
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SUDAS Standard Specifications

LANE CLOSURE AT
AN INTERSECTION

FIGURE 8030.111

SHEET 1 OF 1



If the work area extends across the crosswalk, the crosswalk should be closed using appropriate information and devices.

For traffic signal maintenance, consider using law enforcement and/or a shadow vehicle.

Right lane closure shown; for left lane closure, modify sign messages and arrow board.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.112

SHEET 1 OF 1

SUDAS

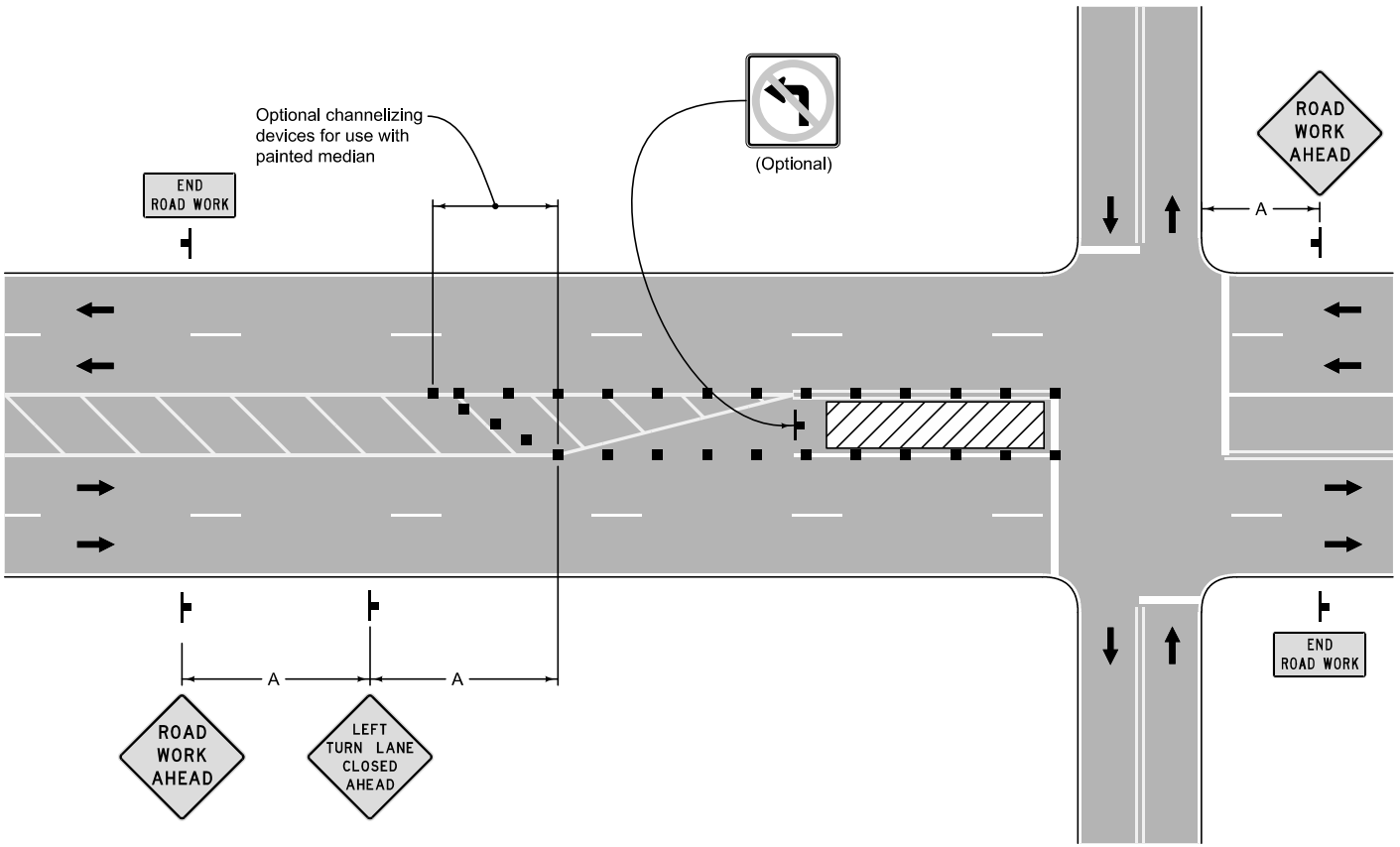
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SUDAS Standard Specifications

LANE CLOSURE ON THE FAR SIDE OF AN INTERSECTION



Left lane closure shown; for right lane closure, modify sign messages and channelizing devices.

For intersection approaches reduced to a single lane, left turn movements may be prohibited to maintain capacity for through motor vehicle traffic.

Prohibit left turn movements if sight distance from the through lane is restricted for left turning vehicles.

If work area extends across the crosswalk, the crosswalk should be closed using appropriate information and devices.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.113

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SUDAS

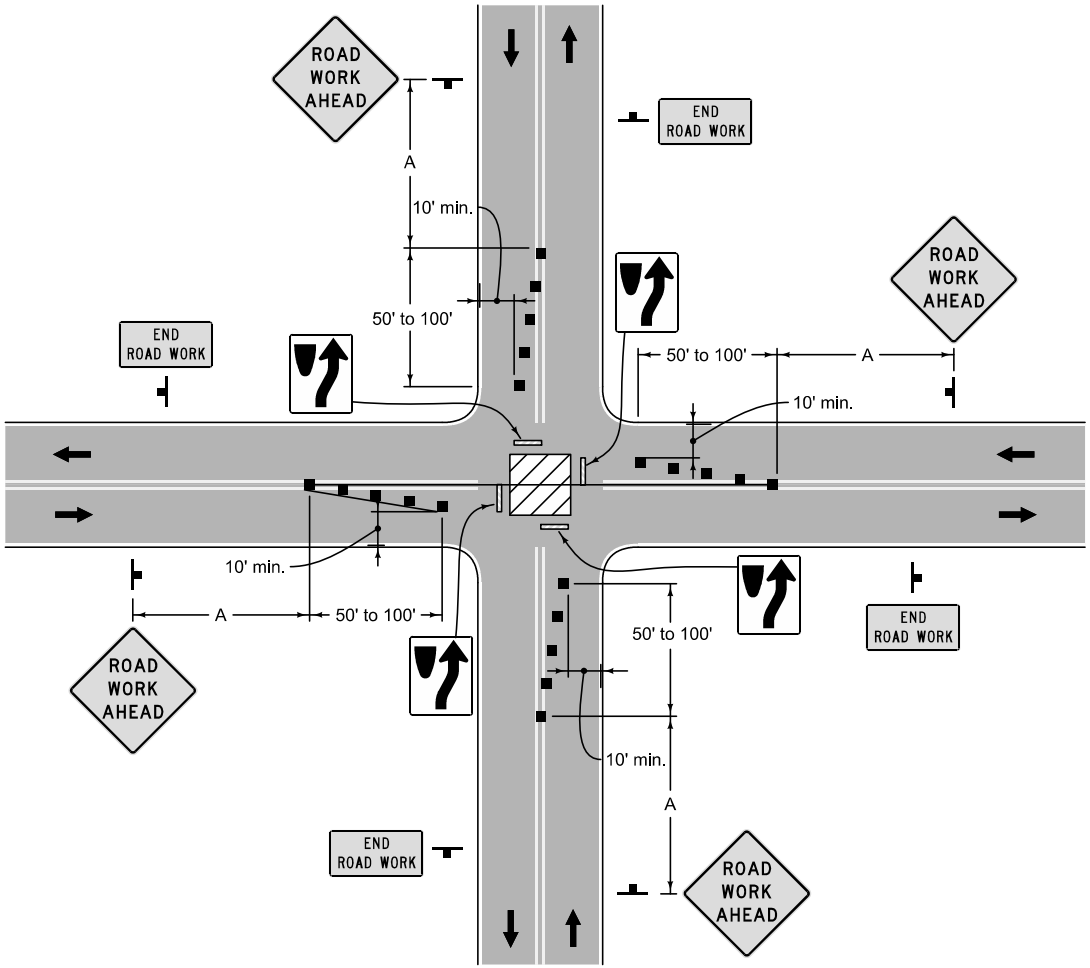
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SUDAS Standard Specifications

CLOSURE OF TURN LANE



Maintain a minimum lane width of 10 feet as measured to the near face of channelizing devices. For short-term use on low speed, low volume roads without wider heavy-commercial vehicles, a minimum lane width of 9 feet may be used.

Left turns may be prohibited as required by geometric and traffic conditions.

For short-duration work, the channelizing devices may be eliminated if a vehicle displaying vehicle warning lights is positioned in the work space. Arrow signs (W1-6) may be used to replace the KEEP RIGHT signs.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.114 | SHEET 1 OF 1

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SUDAS Standard Specifications

CLOSURE IN CENTER OF INTERSECTION

Use for pavement marking and surface maintenance operations in daylight hours only.

Place vehicle-mounted signs at an elevation so they are not obscured by equipment or materials and are fully visible to approaching traffic.

Cover or turn sign legends from view when work is not in progress.

Refer to Figure 8030.101 for symbol key and sign spacing.

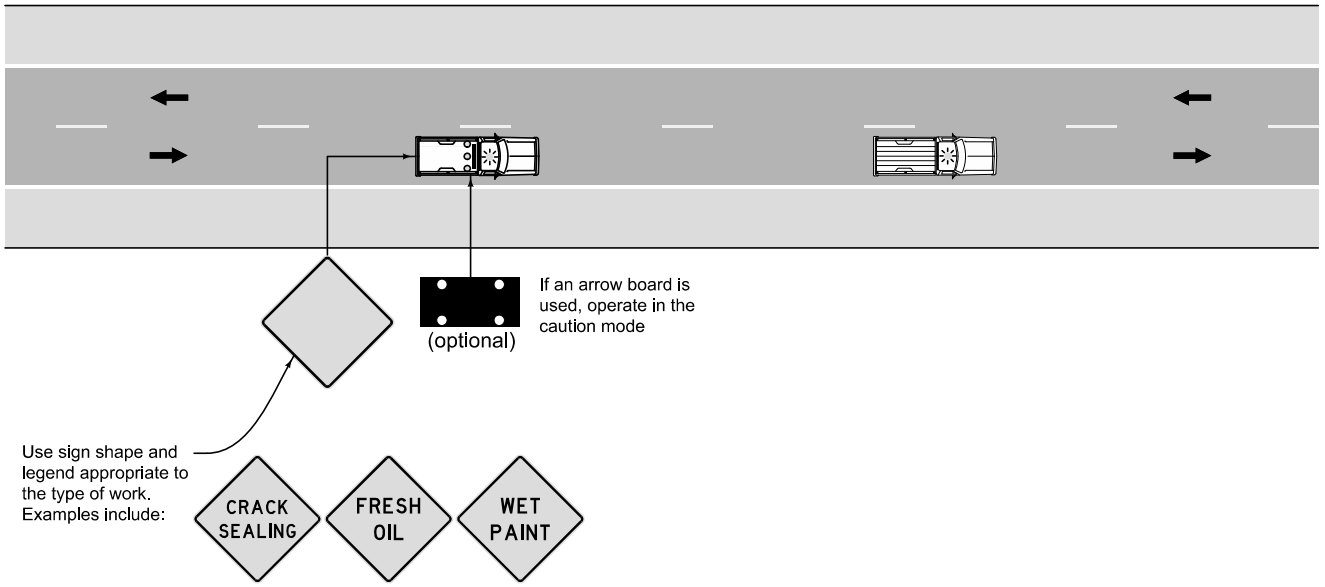


FIGURE 8030.115

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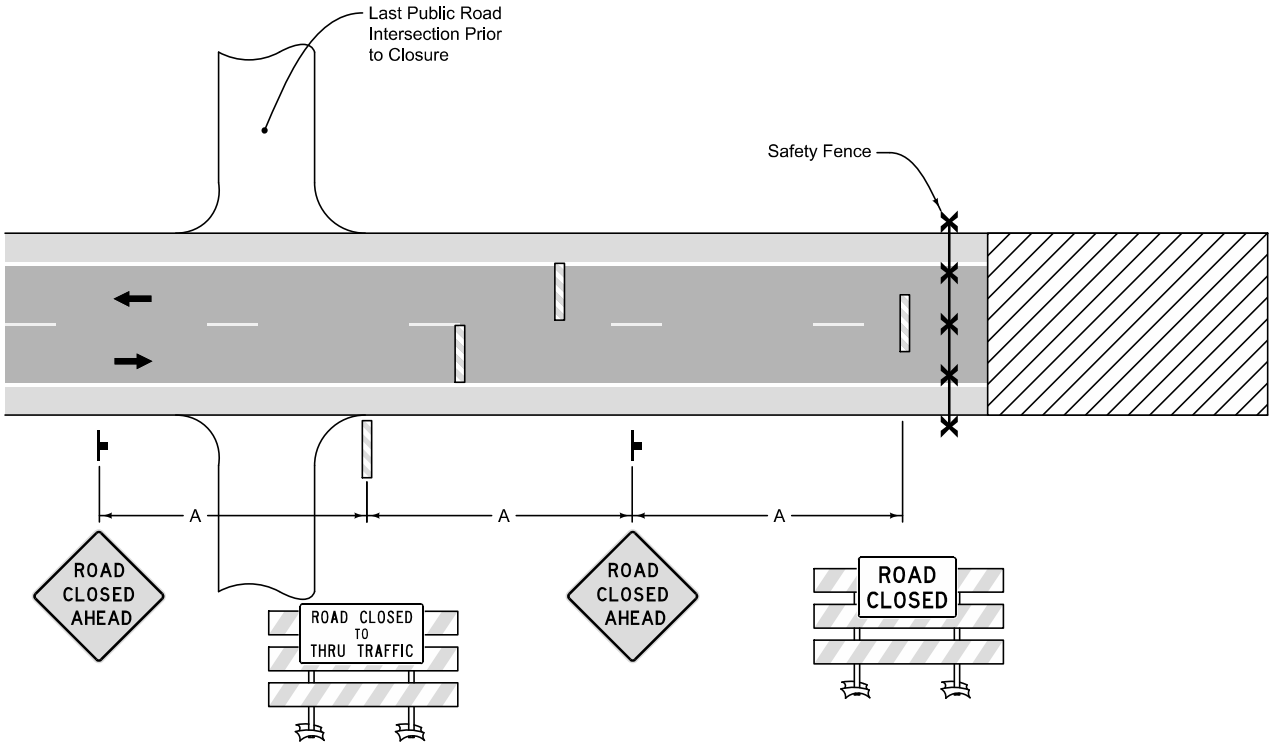
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SUDAS Standard Specifications

MOVING OPERATIONS ON TWO LANE ROADS



When distance "A" is less than 500 feet, place the barricade with the ROAD CLOSED TO THRU TRAFFIC sign in the middle of the traffic lane approaching the work area. The barricade may be omitted if the distance to the work area is less than 250 feet.

Maintain safety fence closures to prevent unauthorized vehicles from passing through.

Place staggered Type III barricades in the roadway after the last public road intersection prior to the closure.

If local traffic is allowed to pass a Type III barricade, retroreflective sheeting is required on both sides of the barricade.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.116

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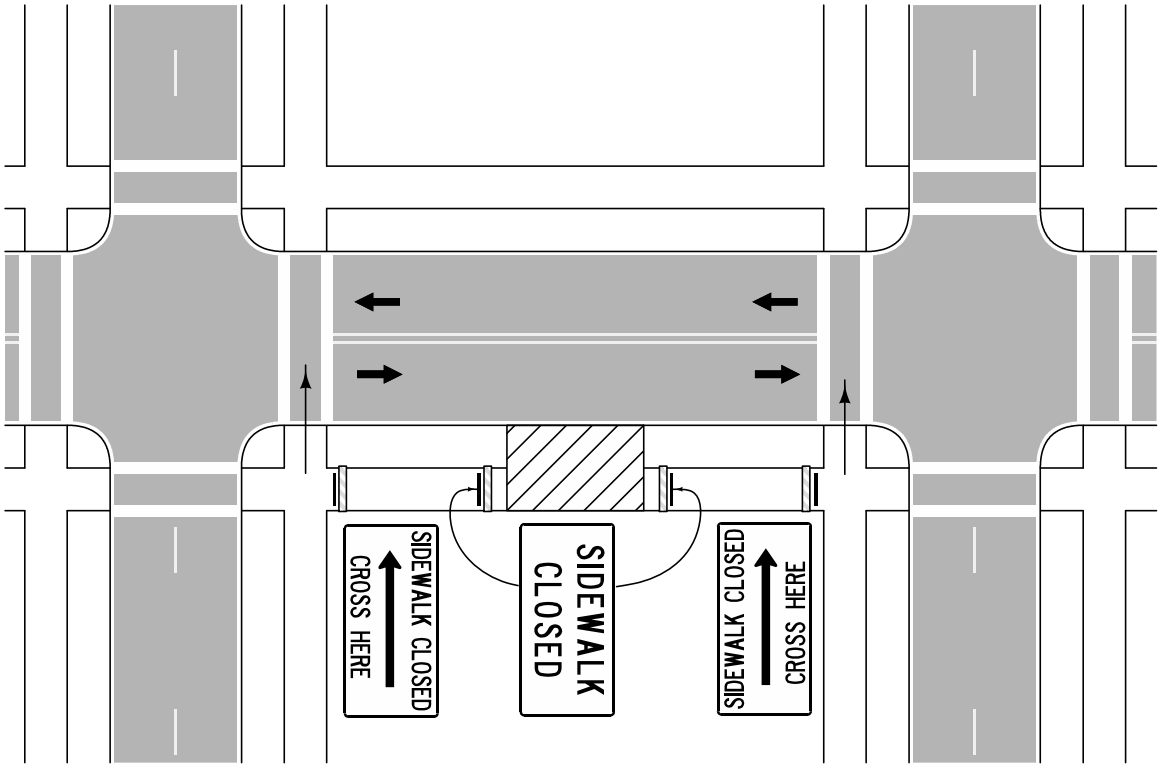
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SUDAS Standard Specifications

STREET OR ROAD CLOSURE



Use when crosswalks, sidewalks, or other pedestrian facilities are closed or relocated. Ensure temporary facilities are detectable and include accessibility features consistent with the features present in the existing pedestrian facility.

Signs such as KEEP RIGHT (LEFT) may be placed to guide or direct pedestrians.

Provide continuous barriers or fencing complying with the requirements of PROWAG to secure work areas from pedestrians.

When required in the contract documents, provide auxiliary lighting or audible information devices to assist pedestrians with visual disabilities.

Only the temporary traffic control devices related to pedestrians are shown. Other devices related to control of vehicular traffic may be necessary.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.117 | SHEET 1 OF 1

SUDAS

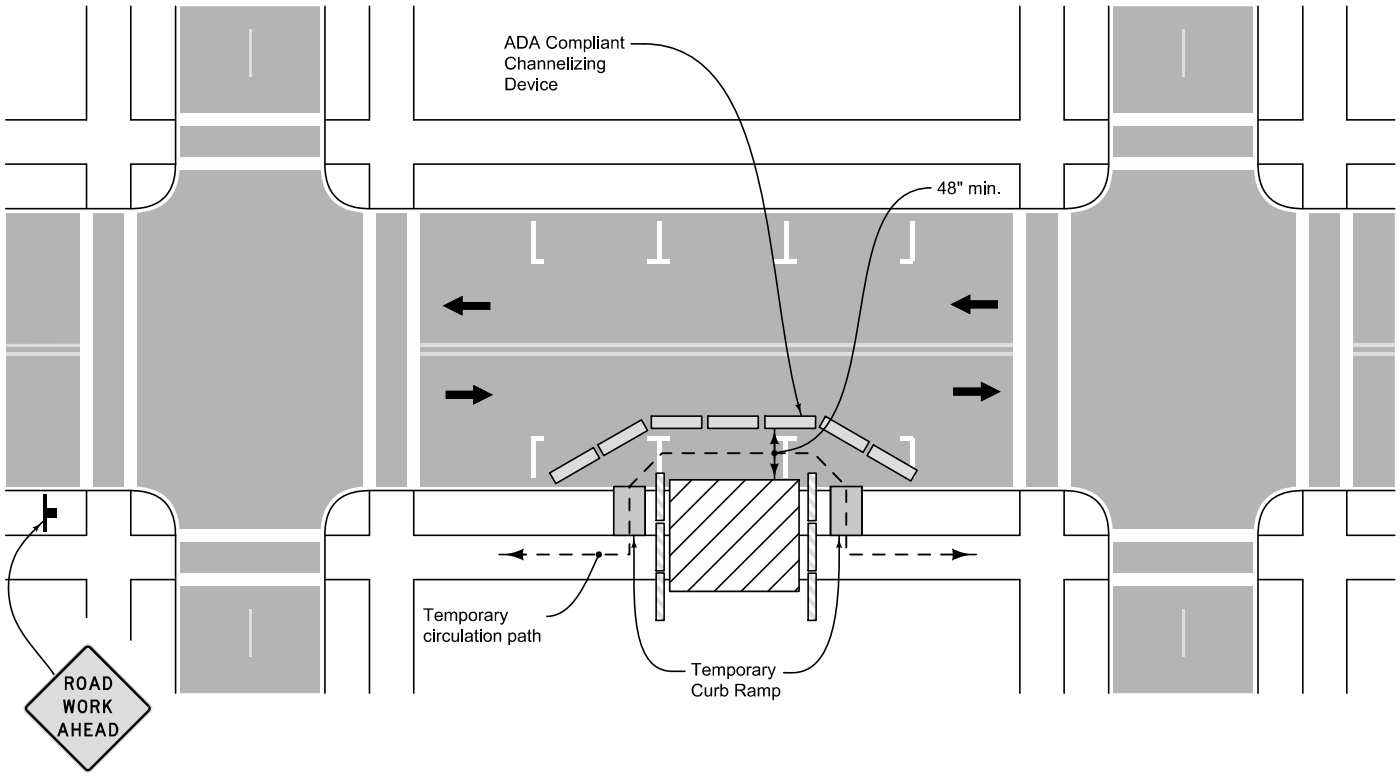
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SUDAS Standard Specifications

SIDEWALK DETOUR



Use when crosswalks, sidewalks, or other pedestrian facilities are closed or relocated. Ensure temporary facilities are detectable and include accessibility features consistent with the features present in the existing pedestrian facility.

Provide continuous barriers or fencing complying with the requirements of PROWAG to secure work areas from pedestrians.

Where pedestrians are diverted onto high-speed roadways, provide a temporary traffic barrier and, if specified in the contract documents, a crash cushion, to separate the temporary sidewalk from vehicular traffic.

When required in the contract documents, provide auxiliary lighting or audible information devices to assist pedestrians with visual disabilities.

Only the temporary traffic control devices related to pedestrians are shown. Other devices related to control of vehicular traffic may be necessary.

Refer to Figure 8030.101 for symbol key and sign spacing.

FIGURE 8030.118

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SUDAS Standard Specifications

SIDEWALK DIVERSION

Use when work activities close crosswalk or reduce width to less than 4 feet. Ensure temporary facilities are detectable and include accessibility features consistent with the features present in the existing pedestrian facility.

When required in the contract documents, provide auxiliary lighting or audible information devices to assist pedestrians with visual disabilities.

Refer to Figure 8030.101 for symbol key and sign spacing.

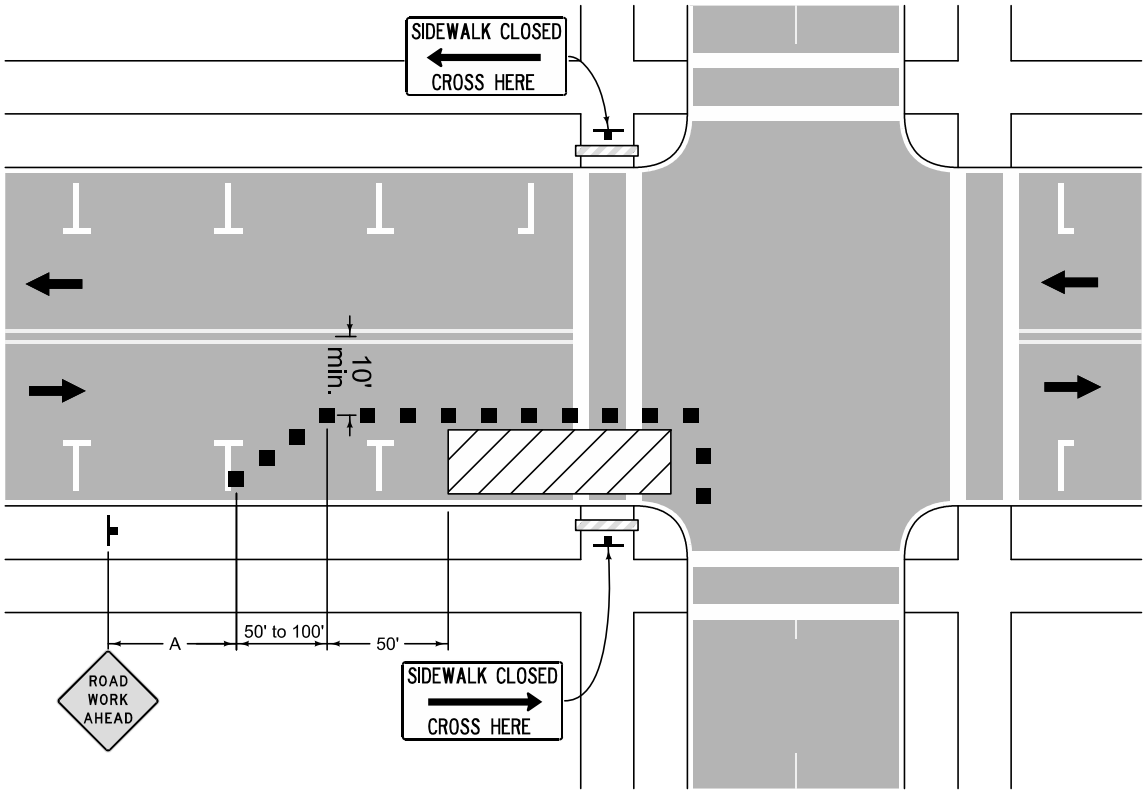


FIGURE 8030.119 SHEET 1 OF 1

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SUDAS Standard Specifications

CLOSURE OF MARKED OR UNMARKED CROSSWALK

TRAFFIC SIGNS AND POSTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Traffic Signs

B. Traffic Posts

C. Removal of Signs and Posts

1.02 DESCRIPTION OF WORK

This part of the specifications includes materials, equipment, and procedures for furnishing, erecting, and removing traffic signs. Comply with the current edition of the MUTCD as adopted by the Iowa DOT.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as submitting shop drawings showing the dimensions of each sign and type of post provided for in the contract documents for review prior to installation.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. When bid items for traffic signs and posts are included on the proposal form, comply with this section for measurement and payment, materials, and execution.

B. When the proposal form does not include a bid item for traffic signs and posts, the Contracting Authority will be responsible for furnishing and installing traffic signs and posts.

1.08 MEASUREMENT AND PAYMENT

A. Traffic Signs by Each:

1. **Measurement:** Each type and size of sign as designated in the contract documents will be counted.

2. **Payment:** Payment will be at the unit price for each type and size of sign.

3. **Includes:** Unit price includes, but is not limited to, the sign blank, application of reflective sheeting, application of screened message, all mounting hardware, and erecting the sign according to the traffic control technician's direction.

B. Traffic Signs by Area:

1. **Measurement:** Measurement will be in square feet of sign area, which will be determined based on the nominal dimensions of each sign. Cutouts for rounded corners will not be deducted.

2. **Payment:** Payment will be at the unit price per square foot of sign.

3. **Includes:** Unit price includes, but is not limited to, the sign blank, application of reflective sheeting, application of screened message, all mounting hardware, and erecting the sign according to the traffic control technician's direction.

C. Wood Posts:

1. **Measurement:** Measurement will be in linear feet for each 4 inch by 4 inch post measured to the nearest foot.

2. **Payment:** Payment will be made at the unit price per linear foot of wood post.

3. **Includes:** Unit price includes, but is not limited to, furnishing and erecting the post, including treatment and other details necessary to provide a complete installation.

D. Perforated Square Steel Tube Posts:

1. **Measurement:** Measurement will be in linear feet for each perforated square steel tube post measured to the nearest foot.

2. **Payment:** Payment will be made at the unit price per linear foot of perforated square steel tube post.

3. **Includes:** Unit price includes, but is not limited to, fabricating, furnishing, and erecting the post and other details required to provide a complete installation.

E. U-Shaped Rail Steel Posts:

1. **Measurement:** Measurement will be in linear feet for each U-shaped rail steel post measured to the nearest foot.

2. **Payment:** Payment will be made at the unit price per linear foot of U-shaped rail steel post.

3. **Includes:** Unit price includes, but is not limited to, fabricating, furnishing, and erecting the post and other details required to provide a complete installation.

1.08 MEASUREMENT AND PAYMENT (Continued)

F. Round Steel Posts:

1. **Measurement:** Measurement will be in linear feet for each round steel post measured to the nearest foot.

2. **Payment:** Payment will be made at the unit price per linear foot of round steel post.

3. **Includes:** Unit price includes, but is not limited to, fabricating, furnishing, and erecting the post and other details required to provide a complete installation.

G. Perforated Square Steel Tube Post Anchors:

1. **Measurement:** Each type and size of anchor will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of anchor.

3. **Includes:** Unit price includes, but is not limited to, furnishing and installing the anchor, coring pavement and filling with concrete, if required, slip base hardware, and other details necessary to provide a complete installation.

H. Round Steel Post Anchors:

1. **Measurement:** Each type and size of anchor will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of anchor.

3. **Includes:** Unit price includes, but is not limited to, furnishing and installing the anchor, coring pavement and filling with concrete, if required, slip base hardware, and other details necessary to provide a complete installation.

I. Remove and Reinstall Traffic Signs:

1. **Measurement:** Each sign removed and reinstalled will be counted.

2. **Payment:** Payment will be at the unit price for each sign removed and reinstalled.

3. **Includes:** Unit price includes, but is not limited to, removing the sign and post, filling the post hole, storing and maintaining the sign and post in good condition, and reinstalling the sign and post. Replacing signs and posts designated for reinstallation that have been damaged is the Contractor's responsibility.

J. Remove and Salvage Traffic Sign Assembly:

1. **Measurement:** Count each sign assembly removed and salvaged.

2. **Payment:** Payment will be at the unit price for each sign assembly removed and salvaged.

3. **Includes:** Unit price includes, but is not limited to, removing the sign assembly, removing the post and anchor hardware, filling the post hole, and delivering the traffic sign and post to the site designated by the Contracting Authority. Replacing signs and posts designated for salvage that have been damaged is the Contractor's responsibility.

PART 2 - PRODUCTS

2.01 GENERAL

Use products and materials complying with the MUTCD and the current edition and approved supplements of the Standard Highway Signs manual as developed by the FHWA.

2.02 SIGNS

A. Blank Material: Sheet aluminum or galvanized steel complying with Iowa DOT Article 4186.02.

B. Size and Type:

1. **Regulatory Signs:** As indicated in the contract documents or complying with Chapter 2B and Table 2B-1 of the MUTCD.

2. **Warning Signs:** Comply with Table 8040.01. For object markers, see Figure 5C-1 of the MUTCD.

Table 8040.01: Warning Signs

Speed Limit (mph)	Minimum Sign Size	Minimum Uppercase Letter Size	Minimum Plaque Size
< 25	30” x 30”	4”	18” x 18”
25 - 35	36” x 36”	5”	18” x 24”
>35	48” x 48”	7”	24” x 30”

3. **Guide Signs:** As indicated in the contract documents or complying with Chapter 2D and Table 2D-1 of the MUTCD.

4. **Bicycle Signs:** As indicated in the contract documents or complying with Chapter 9B and Table 9B-1 of the MUTCD.

C. Retroreflective Sheeting: Comply with Iowa DOT Article 4186.03. Supply Type XI - diamond grade, unless Type IV - high intensity is specified in the contract documents.

D. Fabrication: Comply with Iowa DOT Article 4186.06.

2.03 POSTS

A. Wood Posts: Comply with Iowa DOT Section 4164.04 for treated 4 inch by 4 inch posts.

B. U-Shaped Rail Steel Posts: 3.0 pounds per foot, conforming with ASTM A 499, Grade 60. Punch or drill 3/8 inch diameter holes on the centerline, spaced 1 inch on center, starting 1 inch from the top and extending to the bottom of the post.

C. Perforated Square Steel Tube Posts and Anchors: Minimum 2 inch square perforated steel tubing complying with Iowa DOT Article 4186.10.

D. Round Steel Posts and Anchors: Minimum 2 3/8 inch diameter round 16 gauge galvanized steel with 0.06 inch minimum wall thickness. Furnish anchors 2 3/8 inch diameter 12 gauge galvanized steel with 0.10 wall thickness.

2.04 FASTENING ACCESSORIES

Comply with Iowa DOT Article 4186.09.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Accurately install all signs to comply with the dimensions and location details included in the contract documents.

B. Sign Posts: Comply with Iowa DOT Article 2524.03, B.

3.02 QUALITY CONTROL

A. Traffic Control Technician: Maintain a traffic control technician on staff who has attended and passed the exam in one of the following classes:

1. ATSSA Traffic Control Technician
2. IMSA Work Zone Traffic Control
3. Minnesota DOT Traffic Control Supervisor
4. Texas Engineering Extension Service Work Zone Traffic Control

B. Staking: Traffic Control Technician is to stake each sign location to ensure installation complies with MUTCD and the contract documents.

END OF SECTION

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DIVISION 9
Site Work
and Landscaping

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2.03 Stakes 3

2.04 Water 3

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3.02 Fertilizing - First Application 4

3.03 Sod Installation 4

3.04 Watering 5

3.05 Fertilizing - Second Application 5

3.06 Maintenance 5

3.07 Clean Up 5

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1.03 Submittals 1

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Part 1 - General

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1.06 Scheduling and Conflicts 1

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1.02 Description of Work 1

1.03 Submittals 1

1.04 Substitutions 1

1.05 Delivery, Storage, and Handling 1

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Part 1 - General

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1.02 Description of Work 1

1.03 Submittals 1

1.04 Substitutions 1

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SEEDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Certification of Products

B. Acceptance and Warranty

C. Seed Types and Mixes

D. Equipment

E. Application of Seed

1.02 DESCRIPTION OF WORK

Includes the requirements for seedbed preparation; furnishing, applying, and covering the seed; and compaction of the seedbed.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Submit certification of products to the Engineer prior to seed placement:

1. Seed: Submit a laboratory analysis for all seeds, specifying the purity and germination. Provide a lot number on all submittals and labeling. Ensure lot number is the same on all records pertaining to a particular seed. Provide 48 hours notice prior to mixing the seed and give the Engineer an opportunity to witness the seed mixing. Submit a mechanically printed seed tag from a seed conditioner or grower approved by the Iowa Crop Improvement Association or other state's equivalent association/agency.

2. Fertilizer: Submit certification of the fertilizer analysis with scale weight and statement of guaranteed analysis. Submit from a certified fertilizer dealer, a mechanically printed commercial fertilizer label, or bill of lading. Comply with the inspection and acceptance requirements of Iowa DOT Materials I.M. 469.03.

3. Wood Cellulose Fiber Mulch: Submit certification of the degradable wood cellulose fiber mulch ingredients with applicable use and rate, and the water retention capacity by manufacturer or supplier.

4. Wood Excelsior Mulch: Bale wood excelsior and determine the mass (weight). Use the mass of the material, furnished by the manufacturer, to determine the rate of application.

5. Straw Mulch: Certify weight. Furnish a list of the number of bales and a corresponding ticket from an approved scale for the mulch material to be used on the project.

6. Compost: Submit certification of composted organics analysis with U.S. Compost Council's Seal of Testing Assurance (STA), recommended rates of application, and manufacturer's estimated cubic yards per ton.

7. Inoculant: Furnish information from inoculant packaging.

8. Tackifier: Submit certification of the tackifier ingredients, recommended rates of application, and expiration date.

B. Submit written instructions recommending procedures for maintenance of seeded areas.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Deliver packaged materials in original, unopened, and undamaged containers. Do not mix or blend materials except in the presence of the Engineer.

B. Deliver, handle, and store all materials according to product recommendations, and protect from loss, damage, and deterioration.

C. Materials not meeting these requirements will be rejected.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Coordinate the seeding schedule with all other work on the project. Notify the Engineer at least three calendar days prior to the start of seeding operations.

B. After all land-disturbing activities are complete and the seedbed has been approved by the Engineer, perform seeding operations.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Conventional Seeding:

1. Seeding:
- **a. Measurement:** Measurement will be in acres for each type of seed.
- **b. Payment:** Payment will be in unit price per acre for each type of seed.
- **c. Includes:** Unit price includes, but is not limited to, removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

2. Fertilizing:
- **a. Measurement:** Measurement will be in acres of fertilizer.
- **b. Payment:** Payment will be at unit price per acre of fertilizer.
- **c. Includes:** Unit price includes, but is not limited to, furnishing, applying, and incorporating fertilizer to the area to be seeded.

3. Mulching:
- **a. Measurement:** Measurement will be in acres of mulch.
- **b. Payment:** Payment will be in unit price per acre of mulch.
- **c. Includes:** Unit price includes, but is not limited to, furnishing, applying, and incorporating mulch to the area to be seeded.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Seeding, Fertilizing, and Mulching for Hydraulic Seeding:

1. **Measurement:** Measurement will be in acres for each type of seed.

2. **Payment:** Payment will be in unit price per acre for each type of seed.

3. **Includes:** Unit price includes, but is not limited to, removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

C. Seeding, Fertilizing, and Mulching for Pneumatic Seeding:

1. **Measurement:** Measurement will be in acres for each type of seed.

2. **Payment:** Payment will be in unit price per acre for each type of seed.

3. **Includes:** Unit price includes, but is not limited to, removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

D. Watering:

1. **Measurement:** Measurement will be by metering of water applied. If metering is not available, measurement will be by counting the loads from a transporting tank of known volume and gauging the contents of the transporting truck for partial loads.

2. **Payment:** Payment will be at the unit price per 1,000 gallons (MGAL) of water used.

3. **Includes:** Unit price includes, but is not limited to, water, pumps, meters, equipment, water tanker/container, transportation, hoses, and sprinklers.

E. Warranty:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for the warranty.

3. **Includes:** Lump sum price includes, but is not limited to, all work required to correct any defects in the original placement of the seeding for the period of time designated.

PART 2 - PRODUCTS

2.01 SEED

A. General:

1. Provide fresh, clean, new crop, certified seed complying with tolerance for germination and purity and free of poa annua, bent grass, and noxious weed seed. Furnish all seeds, including grass, legume, forbs, and cereal crop seeds, from an established seed dealer or certified seed grower. All materials and suppliers are to follow Iowa Seed Law and Iowa Department of Agriculture and Land Stewardship regulations, and be labeled accordingly.
   a. Provide turfgrass with a certified “blue tag” or "gold tag."
   b. Provide native grass and forbs that are source-identified as G0-Iowa certified "yellow tag," when available. If G0-Iowa certified "yellow tag" sourced seed is unavailable, or is only available from a single source, a substitution may be approved by the Engineer.

2. Mix seed to the specified proportions by weight. Use methods approved by the Engineer.

B. Seed Quality: Ensure the seed provided meets or exceeds the minimum requirements of purity and germination stated on an independent certificate of seed analysis document according to the Association of Official Seed Analysis (AOSA) rules. The seed certification tag and seed analysis document provided must be from the same lot number as shown on the seed tag. Ensure the date of test results is no greater than 9 months from the seed application date. Approval of all seed for use will be based on the accumulated total of Pure Live Seed (PLS) for each phase of work. PLS is obtained by multiplying purity times germination. PLS shall not be less than the accumulated total of the PLS specified.

If the seed does not comply with minimum requirements for purity and germination and such seed cannot be obtained, the Engineer may approve use of the seed on a basis of PLS or may authorize a suitable substitution for the seed specified.

C. Requirements on Containers:

1. Seed: Provide seed with a tag on each container. Ensure the seed analysis on the label is mechanically printed.

2. Mulch: When packaged, provide mulch in new labeled containers.

3. Tackifier: Provide tackifier packaged in new labeled containers.

4. Inoculant: Use inoculant that has a manufacturer’s container, indicating the specific legume seed to be inoculated and the expiration date. All inoculant must meet requirements of the Iowa Seed Law. Follow precautions specified on the product label.

5. Sticking Agent: Use a commercial sticking agent recommended by the manufacturer of the inoculant. For quantities less than 50 pounds, the sticking agent need not be a commercial agent, but requires approval by the Engineer. Apply sticking agent separately prior to application of inoculant. Follow safety precautions specified on the product label.

2.01 SEED (Continued)

Table 9010.01: Domestic Grasses

Common Name	Scientific Name	Purity (%)	Germination (%)
Bluegrass, Kentucky	Poa pratensis	85	80
Brome, smooth-LINCOLN	Bromus inermis	90	85
Fescue, creeping, red	Festuca rubra	98	85
Fescue, tall, FAWN	Festuca arundinacea-FAWN	98	85
Orchardgrass	Dactylis glomerata	90	90
Red top	Agrostis alba	92	85
Ryegrass, perennial	Lolium perenne	95	90
Wildrye, Canada	Elymus Canadensis	95	85
Wildrye, Russian	Psathyrostachys junceus	95	85

Table 9010.02: Legumes

Common Name	Scientific Name	Purity (%)	Germination (%)
Alfalfa, RANGER/VERNAL	Medicago sativa	99	90*
Alfalfa, travois	Medicoa spp.	99	90*
Clover, Alsike	Trifolium hybridum	99	90*
Clover, red, medium	Trifolium pratense	99	90*
Clover, white	Trifolium repens	98	90*
Hairy vetch	Vicia villosa	96	85*
Lespedeza, Korean	Lespedeza stipulacea	98	80*

* Includes hard seed.

Table 9010.03: Stabilizing Crop

Common Name	Scientific Name	Purity (%)	Germination (%)
Oats	Avena sativa	97	90
Rye	Secale cereale	97	90
Sudangrass, PIPER	Sorghum vulgare var. sudanese	98	85

2.01 SEED (Continued)

Table 9010.04: Native Grasses

Common Name	Scientific Name
Big bluestem*	Andropogon gerardii
Blue grama	Bouteloua gracilis
Blue-joint grass	Calamagrostis Canadensis
Bottlebrush sedge	Carex hystericina
Buffalograss*	Buchloe dactyloides
Common rush	Juncus effusus
Fowl bluegrass	Poa palustris
Fowl manna grass	Glyceria striata
Fox sedge	Carex vulpinoidea
Green bulrush	Scirpus atrovirens
Hairy wood chess	Bromus purgans
Indiangrass*	Sorghastrum nutans
Intermediate wheatgrass	Agropyron intermedium
Little bluestem*	Andropogon scoparius
Prairie dropseed	Sporobolus heterolepis
Reed manna grass	Glyceria grandis
Rice cutgrass	Leersia oryzoides
Rye grass, annual	Lolium italicum
Sand bluestem*	Andropogon gerardii, var. paucipilus
Sand dropseed	Sporobolus cryptandrus
Sand lovegrass	Eragrostis trichodes
Sideoats grama*	Bouteloua curtipendula
Slender wheatgrass	Agropyron trachycaulum, var. unilaterale
Spike rush	Eleocharis palustris
Softstem bulrush	Schoenoplectus tabernaemontani
Switchgrass*	Panicum virgatum
Tussock sedge	Carex stricta
Virginia wild-rye	Elymus virginicus
Weeping lovegrass	Eragrostis curvula
Western wheatgrass*	Agropyron smithii
Wool grass	Scirpus cyperinus

2.01 SEED (Continued)

Table 9010.05: Forbs

Common Name	Scientific Name
Black-eyed Susan	Rudbeckia hirta
Blue-flag iris	Iris virginica-shrevii
Boneset	Eupatorium perfoliatum
Canadian anemone	Anemone canadensis
Common mountainmint	Pycnanthemum virginianum
Common rush	Juncus effusus
Fowl manna grass	Glyceria striata
Golden Alexanders	Zizia aurea
Great blue lobelia	Lobelia siphilitica
Grey-headed coneflower	Ratibida pinnata
Heath aster	Symphyotrichum ericoides
Ironweed	Veronia faxciculate
Joe-pye weed	Eupatorium maculatum
Meadow blazingstar	Liatris ligulistylis
Milkweed, butterfly	Asclepias tuberosa
Milkweed, swamp	Asclepias incarnata
New England aster	Symphyotrichum novae-angliae
Ohio spiderwort	Tradescantia ohiensis
Oxeye sunflower	Heliopsis helianthoides
Pale purple coneflower	Echinacea pallida
Partridge pea	Chamaecrista fasciculate
Prairie blazing star	Liatris pycnostachya
Purple prairie clover	Dalea purpurea
Rattlesnake master	Eryngium yuccifolium
Reed manna grass	Glyceria grandis
Rice cutgrass	Leersia oryzoides
Showy goldenrod	Solidago speciosa
Showy tic-trefoil	Desmodium canadense
Stiff goldenrod	Solidago rigida
Swamp aster	Aster puniceus
White wild indigo	Baptisia alba
Wild bergamot	Monarda fistulosa

2.02 SEED MIXTURES AND SEEDING DATES

See the contract documents for the specified seed mixture. If a mixture is not specified, use the following. The Contractor may submit a modification of the mixture for the Engineer's consideration.

A. Type 1 (Permanent Lawn Mixture): Used for residential and commercial turf site, fertilized, and typically mowed. Use between March 1 and May 31 and between August 10 and September 30.

Table 9010.06: Type 1 Seed Mixture[1]

Common Name	Application Rate lb/acre
Creeping red fescue	25
Turf-type perennial ryegrass[2]	20
Turf-type perennial ryegrass[2]	20
Kentucky bluegrass cultivar[3]	65
Kentucky bluegrass cultivar[3]	65
Kentucky bluegrass cultivar[3]	65

[1] A commercial mixture may be used if it contains a high percentage of similar bluegrasses; it may or may not contain creeping red fescue.
[2] Choose two different cultivars of turf-type perennial ryegrass, at 20 lbs/acre each.
[3] Choose three different cultivars of Kentucky bluegrass, at 65 lbs/acre each.

B. Type 2 (Permanent Cool Season Mixture for Slopes and Ditches): Not typically mowed. Reaches a maximum height of 2 to 3 feet, low fertility requirements, grows in the spring and fall, and can go dormant in the summer. Use between March 1 and May 31 and between August 10 and September 30.

Table 9010.07: Type 2 Seed Mixture

Common Name	Application Rate lb/acre
Tall fescue[1]	100
Kentucky bluegrass	20
Ryegrass, perennial[2]	75

[1] Use endophyte free cultivars including Fawn, K-31, or a combination.
[2] Use cultivars including Linn, Amazon, Noriea, or Nui, or a combination.

C. Type 3 (Permanent Warm-Season Slope and Ditch Mixture): Not typically mowed. Reaches a height of 5 to 6 feet, stays green throughout summer, and responds well to being burned in spring; no fertilizer. Use between March 1 and June 30.

Table 9010.08: Type 3 Seed Mixture

Common Name	Application Rate lb/acre
Big bluestem*	3 PLS
Grain rye	40
Indiangrass*	4 PLS
Little bluestem*	3 PLS
Oats	16
Sideoats grama*	5 PLS
Switchgrass*	1 PLS

* Furnish seed certified as Source Identified Class (Yellow Tag) Source G0-Iowa.

2.02 SEED MIXTURES AND SEEDING DATES (Continued)

D. Type 4 (Urban Temporary Erosion Control Mixture): Short lived (6 to 8 months) mix for erosion control.

Table 9010.09: Type 4 Seed Mixture

Common Name	Application Rate lb/acre
SPRING - March 1 - May 20	
Annual ryegrass	40
Oats*	65
SUMMER - May 21 - August 14	
Annual ryegrass	50
Oats*	95
FALL - August 15 - September 30	
Annual Ryegrass	40
Grain rye	65

* Engineer may delete for previously established urban areas.

E. Type 5 (Rural Temporary Erosion Control Mixture): Short lived mix for erosion control.

Table 9010.10: Type 5 Seed Mixture

Common Name	Application lb/acre
March 1 - October 31	
Canada wildrye	5 PLS/acre
Grain rye	50
Oats	50
November 1 - February 28 (or 29)	
Canada wildrye	7 PLS/acre
Grain rye	62
Oats	62

Seed does not need to be certified Source Identified Class (Yellow Tag).

F. Type 6 (Salt-resistant Mixture): Use for grass medians and areas immediately back of curb on streets subject to regular salt applications for winter de-icing. Apply between March 1 and May 31 and between August 10 and September 30.

Table 9010.11: Type 6 Seed Mixture

Common Name	Application Rate lb/acre	Purity (%)	Germination (%)
Blue chip Kentucky bluegrass	37.5	90	85
Fults alkali grass	75	98	85
Hard fescue	50	95	85
Nublue Kentucky bluegrass	37.5	90	85
Sheeps fescue	50	90	85

2.02 SEED MIXTURES AND SEEDING DATES (Continued)

G. Wetland Seeding: Between April 1 and June 30, use the following seed mixture for wetland grass seeding areas.

Table 9010.12: Wetland Grass Seed Mixture

Common Name	Scientific Name	PLS** (per ac)
Arrowhead	Sagittaria latifolia	4 oz
Big bluestem*	Andropogon gerardii	1 lb
Bluejoint grass	Calamagrostis	1 oz
Blue vervain	Verbena Hastata	1 oz
Boneset	Eupatorium perfoliatum	1 oz
Broom sedge	Carex scoparia	2 oz
Dark green bulrush*	Scirpus atrovirens	1 oz
Fox sedge*	Carex vulpinoidea	4 oz
New England aster*	Symphyotrichum novae-angliae	2 oz
Nodding bur marigold	Bidens cernua	8 oz
Porcupine sedge	Carex hystericina	8 oz
Prairie cordgrass	Spartina pectinata	1 lb
Rice cutgrass	Leersia oryzoides	4 oz
Sneezeweed	Helenium autumnale	2 oz
Softstem bulrush	Schoenoplectus tabernaemontani	8 oz
Spike rush	Eleocharis palustris	4 oz
Swamp milkweed*	Asclepias incarnata	1 lb
Switchgrass*	Panicum virgatum	8 oz
Tussock sedge	Carex stricta	2 oz
Virginia wild-rye*	Elymus virginicus	5 lbs
Water plantain	Alisma plantago-aquatica	4 oz

* Furnish seed certified as Source Identified Class (Yellow Tag) Source G0-Iowa.
** Seeding rates for wetland grasses are given as PLS. Either the germination test or Tetrazolium (TZ) test is acceptable to determine PLS for native species.

2.02 SEED MIXTURES AND SEEDING DATES (Continued)

H. Native Grass and Forbs (Wildflower) Seeding: Between April 1 and June 30, use the following seed mixture for areas designated for native grass and wildflower seeding.

Table 9010.13: Native Grass and Forbs (Wildflower) Seeding Mixture

Common Name	Scientific Name	Application Rate**
GRASSES		**lb/acre**
Big bluestem*	Andropogon gerardii	1.0
Canada wild rye	Elymus Canadensis	1.5
Indiangrass*	Sorghastrum nutans	1.0
Little bluestem*	Schizachyrium scorparium	2.0
Sideoats grama*	Bouteloua curtipendula	2.5
Switchgrass*	Panicum virgatum	0.5
FORBS (WILDFLOWERS)		**oz/acre**
Black-eyed Susan	Rudbeckia hirta	3.0
Butterfly milkweed	Asclepias tuberosa	4.0
Canadian anemone	Anemone canadensis	0.5
Common mountainmint	Pycnanthemum virginianum	0.25
Golden Alexanders	Zizia aurea	8.0
Grey-headed coneflower	Ratibida pinnata	2.75
Heath aster	Symphyotrichum ericoides	0.25
Ironweed	Veronia faxciculate	3.0
New England aster	Symphyotrichum novae-angliae	1.25
Ohio spiderwort	Tradescantia ohiensis	7.0
Oxeye sunflower	Heliopsis helianthoides	12.0
Pale purple coneflower	Echinacea pallida	15.0
Partridge pea	Chamaecrista fasciculate	32.0
Prairie blazing star	Liatris pycnostachya	4.5
Purple prairie clover	Dalea purpurea	2.5
Rattlesnake master	Eryngium yuccifolium	1.75
Showy goldenrod	Solidago speciosa	0.50
Stiff goldenrod	Solidago rigida	1.0
Swamp milkweed	Asclepias incarnata	4.0
White wild indigo	Baptisia alba	2.0
Wild bergamot	Monarda fistulosa	1.25
NURSE CROP		**lb/acre**
Oats (spring seeding - April 1 to June 30)		32
Winter wheat (dormant/frost seeding - November 1 to March 31)		25

* Furnish seed certified as Source Identified Class (Yellow Tag) Source G0-Iowa.

** Seeding rates for native grass and forb species are given as PLS. Either the germination test or Tetrazolium (TZ) test is acceptable to determine PLS for native species.

2.03 FERTILIZER

Use fertilizer of the grade, type, and form specified that complies with rules of the Iowa Department of Agriculture and Land Stewardship and the following requirements:

A. Grade: Identify the grade of fertilizer according to the percent nitrogen (N), percent of available phosphoric acid (P_2O_5), and percent water soluble potassium (K_2O), in that order, and base approval on that identification.

The Contractor may substitute other fertilizer containing analysis percentages different from those specified, provided that the minimum amounts of actual nitrogen, phosphate, and potash per acre are supplied, and that in no case does the total amount per acre of the three fertilizer elements be exceeded by 30% of the following minimum amounts.

1. **For Conventional Seeding, Permanent:** Apply a 6-24-24 commercial fertilizer or the equivalent units of nitrogen, phosphate, and potash at the rate of 300 pounds per acre.

2. **For Conventional Seeding, Temporary:** Apply commercial fertilizer to all seeded areas at the rate of 250 pounds per acre of 13-13-13 (or equivalent) for rural mixes and 300 pounds per acre of 6-24-24 (or equivalent) for urban mixes, unless otherwise specified in the contract documents.

3. **For Hydraulic Seeding:** Apply fertilizer in combination with seeding by a hydraulic seeder and as specified in Iowa DOT Article 2601.03, B. Apply a commercial fertilizer or the equivalent units of nitrogen, phosphate, and potash at the rate specified for the type of seeding being applied.

4. **For Pneumatic Seeding:** Based on the compost nutrient analysis, supply any additional commercial fertilizer necessary to meet the 13-13-13 units of nitrogen, phosphate, and potash at the rate of 450 pounds per acre as the compost is applied.

B. Type: Use fertilizer that can be uniformly distributed by the application equipment. Furnish fertilizer either as separate ingredients or in chemically-combined form.

2.04 STICKING AGENT

A. Use a sticking agent that is a commercial material recommended by the manufacturer to improve adhesion of inoculant to the seed. For small quantities less than 50 pounds, the sticking agent need not be a commercial agent, but it must be approved by the Engineer and must be applied separately, prior to application of inoculant.

B. Follow safety precautions specified on the product label. A sticking agent is not required if a liquid formulation of inoculant is used.

2.05 INOCULANT FOR LEGUMES

An inoculant is a culture of bacteria specifically formulated for each legume seed (alfalfa, clovers, lespedesa, and hairy vetch). Ensure the manufacturer's container indicates the specific legume seed to be inoculated and the expiration date. Use inoculant that meets the requirements of the Iowa Seed Law. Follow the safety precautions specified on the product label.

2.06 WATER

Use water that is free of any substance harmful to seed germination or plant growth.

2.07 MULCH

A. For Conventional Seeding:

1. Material used as mulch may consist of the following:
   a. Dry cereal straw (oats, wheat, barley, or rye)
   b. Prairie hay
   c. Wood excelsior composed of wood fibers, at least 8 inches long, based on an average of 100 fibers, and approximately 0.024 inch thick and 0.031 inch wide. The fibers must be cut from green wood and be reasonably free of seeds or other viable plant material.

2. Do not use other hay (bromegrass, timothy, orchard grass, alfalfa, or clover).

3. All material used as mulch must be free from all noxious weed, seed-bearing stalks, or roots and will be inspected and approved by the Engineer prior to its use.

4. The Contractor may use other materials, subject to the approval of the Engineer.

B. For Hydraulic Seeding:

1. Wood Cellulose:
   a. Use material that is a natural or cooked cellulose fiber processed from whole wood chips, or a combination of up to 50% of cellulose fiber produced from whole wood chips, recycled fiber from sawdust, or recycled paper (by volume).
   b. Product contains a colloidal polysaccharide tackifier adhered to the fiber to prevent separation during shipment and avoid chemical co-agglomeration during mixing.
   c. Form a homogeneous slurry of material, tackifier, and water.
   d. Use a slurry that can be applied with standard hydraulic mulching equipment.
   e. Dye the slurry green to facilitate visual metering during application.
   f. Do not use materials that have growth or germination-inhibiting factors or any toxic effect on plant or animal life when combined with seed or fertilizer.

2. Bonded Fiber Matrix (BFM):
   a. Manufactured to be applied hydraulically.
   b. Dyed to facilitate visual metering.
   c. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
   d. Meet the following requirements:
      1) Contain non-toxic tackifiers that upon drying become insoluble and non-dispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
      2) Contain no germination or growth inhibiting factors and do not form a water-resistant crust that can inhibit plant growth.
      3) Hydraulic mulch that is completely photo-degradable or biodegradable.
      4) Have a rainfall event (R-factor) of 140 < R according to ASTM D 6459.
      5) Have a cover factor of C ≤ 0.03 according to ASTM D 6459.
      6) Vegetation Establishment of 400% minimum according to ASTM D 7322.
      7) Water Holding Capacity 600% minimum according to ASTM D 7367.

3. Mechanically-Bonded Fiber Matrix (MBFM):
   a. Manufactured to be applied hydraulically.
   b. Dyed to facilitate visual metering.
   c. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.

2.07 MULCH (Continued)

d. Meet the following requirements:
   1) Contain non-toxic tackifiers that upon drying become insoluble and non-dispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
   2) Contain no germination or growth inhibiting factors and do not form a water-resistant crust that can inhibit plant growth.
   3) Hydraulic mulch that is completely photo-degradable or biodegradable.
   4) Have a rainfall event (R-factor) of 162 < R according to ASTM D 6459.
   5) Have a cover factor of C ≤ 0.01 according to ASTM D 6459.
   6) Vegetation establishment of 500% minimum according to ASTM D 7322.
   7) Water holding capacity of 700% minimum according to ASTM D 7367.

C. For Pneumatic Seeding: Use compost meeting the following requirements.

1. Derived from a well-decomposed source of organic matter.

2. Produced using an aerobic composting process, meeting Code of Federal Regulations (CFR) 503 for time, temperature, and heavy metal concentrations.

3. No visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.

4. Certified by the U.S. Composting Council's Seal of Testing Assurance (STA) program.

5. Conforms to chemical, physical, and biological parameters of AASHTO R 52, with the following additional requirements:
   a. Follow U.S. Composting Council's TMECC guidelines for all testing.
   b. Organic Matter Content: 30% minimum.
   c. pH: between 6.0 and 8.0.
   d. Maturity (growth screening): Minimum 90% emergence for all compost to be vegetated.
   e. Particle Size:

Sieve Size	Percent Passing*
2"	100
1"	90-100
3/4"	65-100
3/8"	0-75

*6 inch maximum particle length.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Aerial Equipment: When aerial application of seed and fertilizer is specified, use aerial equipment capable of providing a uniform distribution of seed and fertilizer on the specified area.

B. Compost Blower: A compost blower is pneumatic equipment to blow compost over the desired area. It may be equipped with a supplemental seed injection system. Use equipment with sufficient power to cover the required area without driving on the prepared seedbed.

C. Cultipacker: Use a pull-type cultipacker with individual rollers or wheels. Cultipackers with sprocket-type spacers between the wheels may be used. The cultipacker must produce a corrugated surface on the area being compacted. Operate the cultipacker separately from all other operations, and do not attach the cultipacker to the seeder or disk, unless combined cultipacker seeder is manufactured to operate as a unit. Make provisions for addition of weight.

D. Disk: When preparing a seedbed on ground having heavy vegetation, use a disk with cutaway blades. Make provisions for the addition of weight to obtain proper cutting depth.

E. Drop Seeder: Use one piece of equipment containing pulverizer rollers in front of the seed tubes, ground driven seed meters, maximum seed tube spacing of 3 inches delivering seed between the pulverizer rollers and packer wheels, and packer wheels that press and firmly pack seed into the soil.

F. Endgate Cyclone Seeders: Endgate cyclone seeders must be suitably mounted. Movement must be provided by mechanical means. The seed drops through an adjustable flow regulator onto a rotating, power driven, horizontal disk or fan.

G. Expanded Mesh Roller: Use equipment that is an open grid type or a cultipacker type, modified by covering with expanded metal mesh.

H. Field Tiller: Use equipment designed for the preparation of the seedbed to the degree specified.

I. Gravity Seeders: Gravity seeders must provide agitation of the seed, have an adjustable gate opening, and uniformly distribute seed on the prepared seedbed. Use a seed hopper equipped with baffle plates spaced no more than 2 feet apart. The baffle plates must extend from the agitator shaft to within approximately 2 inches of the top of the seed hopper. Wind guards are required to facilitate seeding when moderate wind conditions exist and when ordered by the Engineer. Place wind guards in front or in back (or both) of the seed outlet and extend them to near the ground line. This seeder may be used for application of fertilizer.

J. Hand Cyclone Seeders: Hand cyclone seeders are carried by the person dispensing seed. The seed drops through an adjustable flow regulator onto a rotating, hand driven, horizontal disk or fan.

K. Hydraulic Seeder: Use hydraulic seeding equipment with a pump rated at no less than 100 gallons per minute. Inoculant, seed, and fertilizer may be applied in a single operation. The equipment must have a suitable working pressure and a nozzle adapted to the type of work. Supply tanks must have a means of agitation. Calibrate tanks and provide them with a calibration stick or other approved device to indicate the volume used or remaining in the tank.

L. Mowers: Use mowers that are rotary, flail, disk, or sickle type. Do not use mowers that bunch or windrow the mowed material.

3.01 EQUIPMENT (Continued)

M. Mulch Anchoring Equipment: Use mulch anchoring equipment designed to anchor straw or hay mulch into soil by means of dull blades or disks. It should have flat blades or disks, may have cutaway edges and must be spaced at approximately 8 inch intervals. The mulch anchoring equipment must be pulled by mechanical means and weigh approximately 1,000 pounds. When directed by the Engineer, increase the weight by addition of ballast.

N. Native Grass Seed Drill: Use a native grass seed drill designed to provide uniform distribution of native grass and wildflower seeds. Provide separate seed boxes to apply both small seeds as well as fluffy bearded seeds. If a no-till attachment is specified, use an attachment of the same manufacturer as the drill.

O. Pneumatic Seeder: Use an air blown system with sufficient power and hose to reach 300 feet.

P. Pulverizer: Use equipment designed to break up compacted soil to prepare a seedbed.

Q. Rotary Tiller: Use equipment with rotary-type blades designed for the preparation of seedbed to the degree specified.

R. Slit Seeder: Use a gas, diesel or electric powered mechanical slit seeder that is capable of cutting vertical grooves a maximum of 1/4 inch deep into the soil with a maximum horizontal blade spacing of 3 inches, deposits metered seed directly after the formation of the vertical grooves, and contains packer wheels that press and firmly pack seed into the soil.

S. Slope Harrow: Use a slope harrow, consisting of a rolling weight attached by heavy chain to a tractor. The chain must be of suitable length, with picks attached, and a means of rotating the picks as the rolling weight is pulled in a direction parallel to the movement of the tractor.

T. Spike Tooth Harrow: Use equipment designed to provide adjustment of the spike teeth to level the ground, or to be used as specified by the Engineer.

U. Straw Mulching Machine: Use a machine to uniformly apply mulch material over the desired area without excessive pulverization. Excessive pulverization is the general absence of straw longer than 6 inches after distribution.

3.02 AREA OF SEEDING

Place seed only in the areas specified in the contract documents. Repair damaged areas that are disturbed outside the contract limits at the expense of the Contractor. Do not disturb areas having a satisfactory growth of desirable grasses or legumes.

3.03 FINISH GRADING AND TOPSOIL

See Section 2010 for finish grading and topsoil placement.

3.04 CONVENTIONAL SEEDING

A. Order of Operations: 1) fertilizing, 2) seedbed preparation, 3) seed preparation/application, and 4) mulching.

B. Fertilizing:

1. Apply fertilizer immediately prior to seedbed preparation. Incorporate the fertilizer into the top 2 to 3 inches of topsoil during the seedbed preparation. Equipment that results in ruts or excessive compaction will not be allowed.

2. Do not apply fertilizer with native grass, wildflower, or wetland seeding.

3.04 CONVENTIONAL SEEDING (Continued)

C. Seedbed Preparation, Permanent:

1. Limit preparation of seedbed to areas that will be seeded immediately upon completion.

2. Work areas accessible to field equipment to a depth of no less than 3 inches. Use mechanical rotary tillage equipment for the preparation of seedbed on earth shoulders, urban or raised medians, and rest areas. Prepare by hand areas inaccessible to field machinery, to a depth of no less than 2 inches. Use care that the entire width of the shoulder and areas around headwalls, wingwalls, flumes, and other structures are prepared in the manner specified. Where weed growth has developed extensively, they may be disked into the ground. If weed growth develops sufficiently to interfere with proper seedbed preparation, mow the weeds and remove them from the project at no additional cost to the Contracting Authority.

   Use crawler type or dual-wheeled tractors for seedbed preparation. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Harrow ridging in excess of 4 inches due to operation of tillage equipment prior to rolling with the cultipacker. Roll the area with no less than one pass of the cultipacker prior to permanent seeding.

3. Shape and fine grade to remove rills or gullies, water pockets, undesirable vegetation, and irregularities to provide a smooth, firm, and even surface true to grade and cross-section. For Type 1 (lawn seeding), prepare to a fine texture and without soil lumps. Coordinate preparation of all ditches designated for special ditch control with the seedbed preparation. Till parallel to the contours.

4. Smooth the seedbed with a cultivator-type tillage tool having a rake bar or a rock rake. Pick up and remove all debris, such as rocks, stones, concrete larger than 2 inches (1/2 inch maximum for lawn seeding), or roots and other objectionable material that will interfere with the seeding operation. A spring tooth cultivator may be used in lieu of a rock picker. Remove the rock by hand after each use of the cultivator; repeat the process until the soil is relatively free of rock as determined by the Engineer.

5. Choose equipment to minimize soil compaction. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Roll the area with at least one pass of the cultipacker. Remove ruts that develop during the sequence of operations before subsequent operations are performed. This must be completed just prior to seeding and the work approved by the Engineer before the seeding application.

D. Seedbed Preparation, Temporary: Till the soil to a minimum depth of 5 inches with a disk, harrow, or field cultivator.

E. Seeding:

1. Seed Preparation:

a. Thoroughly mix all seed specified for the contract prior to placing the seed in the seed hopper. Provide 48 hours notice prior to mixing the seed, and give the Engineer an opportunity to witness the seed mixing. The mixing of a certified blue tag seed mix at an approved (by Iowa Crop Improvement Association) seed conditioner's facility need not be witnessed.

b. Treat all legume seed with a commercial sticking agent to be applied prior to application of inoculant, or as a mixture when the sticking agent is compatible with other materials. A sticking agent is not required if a liquid formulation of inoculant is used. Use mechanical mixing equipment to apply sticking agent and inoculant on seed quantities over 50 pounds.

3.04 CONVENTIONAL SEEDING (Continued)

c. Inoculate all legumes with a standard product humus culture before being mixed with other seeds for sowing.
d. Inoculate all legumes with a standard culture at the rate specified by the manufacturer of the inoculant according to Iowa DOT Article 4169.04. Do not expose inoculated seed to direct sunlight for more than 30 minutes. Re-inoculate seed that is not sown within 8 hours after inoculation prior to use. Pre-inoculated seed with manufacturer's recommended protective coating may be used in lieu of seed with Contractor-applied inoculant.
e. When the gravity or cyclone seeder is used for application of seed, inoculate legume seed according to the manufacturer's recommended procedures, before mixing with other grass seeds for sowing. Furnish and apply inoculant.

2. Seed Application, Permanent:
a. Prior to seeding, the seedbed will be inspected and approved by the Engineer. Use methods and procedures consistent with equipment manufacturer's recommendations; however, do not operate ground-driven equipment at speeds greater than 10 mph.
b. On all areas accessible to machinery, sow seed with a gravity seeder, endgate cyclone seeder, or seed drill.
c. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be allowed, but no other hand-seeding methods will be accepted.
d. The application of grass and legume seed with hand seeders on early spring work must be performed as separate operations. No mixing of the two types of seed will be allowed.
e. All seeded areas will have one pass with a roller or cultipacker to firm the soil.

3. Seed Application, Temporary:
a. On areas accessible to field machinery, sow seed with an endgate cyclone seeder.
b. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be allowed, but no other hand-operated seeding methods will be accepted.
c. Cover the seed and fertilizer by lightly tilling the seeded area with a disk, rigid harrow, spring tooth harrow, or field cultivator.

4. Seeding Outside of the Specified Seeding Dates: With the agreement of the Engineer and at the full responsibility of the Contractor, seeding operations for all seed types may be conducted outside the specified seeding dates. Should the seeded areas require reseeding, it must be done as specified and at no additional cost to the Contracting Authority.

a. Dormant Seeding: When winter dormant seeding is allowed or specified by the Jurisdiction, complete it when air temperatures are consistently below 40°F and prior to December 25 of a given year. Dormant seeding is not allowed on snow.
1) Prepare the seedbed before the ground freezes.
2) To ensure protection of the seed, apply on a frosty morning or before a predicted snow.
3) Seeding may be done by hand or with seeding equipment.
4) For hydraulic seeding, apply the fertilizer at no more than 0.5 pounds nitrogen per 1000 square feet, followed by the seed.

b. Frost Seeding (Overseeding):
1) Complete frost seeding, also referred to as overseeding, in the spring when the ground is friable from frost action (February 1 to April 1).
2) Frost seeding is not allowed on more than 1 inch of snow.
3) Seeding can be done with a hand-operated cyclone seeder or other equipment.
4) Seedbed preparation will not be required provided the ground is friable from frost action.

3.04 CONVENTIONAL SEEDING (Continued)

F. Mulching:

1. Mulch all conventionally seeded areas the same day the seed is sown. Uniformly distribute the mulch over the required areas at a rate of 1.5 tons/acre for dry cereal straw, or native grass straw. Prairie hay is not suitable for Type 1 (lawn seeding).

2. Work the mulch into the soil with mulch anchoring equipment designed to anchor the mulch into the soil by means of dull blades or disks with a minimum of two passes. Operate equipment in a manner to minimize displacement of the soil and disturbance of the design cross-section.

3. Do not operate mulch-blowing equipment on slopes steeper than 2.5 to 1 or on slopes that may rut. Use attachments to apply mulch without traversing slopes.

4. Do not mulch when wind velocities exceed 15 mph.

3.05 HYDRAULIC SEEDING

A. Order of Operations:

1. Seedbed preparation

2. Seed application, fertilizing, and mulching

B. Seedbed Preparation: Follow seedbed preparation for conventional seeding in Section 9010, 3.04.

C. Seed Preparation: Inoculant, in the quantities specified above, may be applied directly into the supply tank with seed, water, and other material.

D. Seed Application, Fertilizing, and Mulching:

1. Application Process:
   a. Combination: Place all material, seed, fertilizer, mulch, and tackifier (if applicable) in hydraulic mulching equipment specifically manufactured for hydraulic seeding.
   b. Separate: At the Contractor's option and at no additional cost to the Contracting Authority, the hydraulic seeding, fertilizing, and mulching may be undertaken separately. If hydraulic seeding is done separately, add 50 pounds of wood cellulose fiber complying with Section 9010, 2.07, B as a tracer for each 500 gallons of water in the hydraulic seeder tank. If operations are undertaken separately, complete fertilizing and mulching application within 24 hours of completing seeding work. Do not separate the applications if inclement weather is forecasted within 24 hours of the scheduled application period.

2. Ensure the hydraulic equipment, pump, and application process do not damage or crack seeds.

3. Mix materials with fresh potable water using a combination of both recirculation through the equipment's pump, and mechanical agitation to form a homogeneous slurry.

4. Apply mixture within 1 hour after seed and fertilizer are placed in the hydraulic seeder.

5. If necessary, dampen dry, dusty soil, to prevent balling of the material during application.

3.05 HYDRAULIC SEEDING (Continued)

6. Apply the slurry evenly over all specified areas at component material rates specified.
   a. Wood Cellulose Mulch:
      1) Mulch: Minimum 3,000 lb/acre dry weight.
      2) Tackifier: Minimum 50 lb/acre.
   b. Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
   c. Mechanically-bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.

7. Retain and count empty bags of mulch to ensure final application rate.

8. Hydromulching may be done over conventional seeding and/or fertilizing, if approved by the Engineer.

E. Native Grass, Wildflower, and Wetland Grass Seeding: Hydraulic seeding of native grasses, wildflowers, and wetland grasses is allowed only if approved by the Engineer. If allowed, increase specific seed rates by 25%. Do not apply fertilizer.

3.06 PNEUMATIC SEEDING

A. Order of Operations: 1) seedbed preparation, 2) seed preparation, and 3) seed application.

B. Seedbed Preparation: Follow seedbed preparation for conventional seeding in Section 9010, 3.04.

C. Seed Preparation: Follow seed preparation for conventional seeding in Section 9010, 3.04. Pre-inoculate seed in the quantities specified above prior to placing in the seed equipment.

D. Seed Application:

1. Place all material, seed, fertilizer, and compost in equipment with a calibrated seeder attachment specifically designed for pneumatic seeding. Do not apply fertilizer with native grass, wildflower, or wetland seeding.

2. Apply compost to a 1 inch minimum depth on all designated disturbed areas. Apply the compost with a pneumatic (air blower) system with sufficient power and hose to reach 300 feet. Driving on the soil to apply compost will not be allowed.

3. Inject seed and fertilizer into the top 1/4 inch to 1/2 inch of compost during application with a calibrated seed injector at the specified rate. Do not inject native grasses and forbs more than 1/4 inch.

3.07 WATERING

A. Provide water, equipment, transportation, water tanker, hoses, and sprinklers.

B. Use enough water to keep the soil and mulch moist to a depth of 1 inch and ensure growth of the seed. For turfgrass seeding areas, sufficiently water to keep the soil moist for a minimum of 21 days. If natural rainfall is adequate to keep the soil and mulch moist, artificial watering may not be needed.

3.08 RE-SEEDING

A. When all work related to seeding, fertilizing, and/or mulching has been completed on an area, and is washed out or damaged, re-seed, fertilize, and/or mulch the area at the contract unit price(s) when so ordered by the Engineer.

B. When work related to seeding, fertilizing, and/or mulching has not been completed in an area and is washed out or damaged, re-seed, fertilize, and/or mulch the area as necessary at no additional cost to the Contracting Authority.

3.09 CLEAN UP

All work related to clean up throughout the project and upon completion is the responsibility of the Contractor, at no additional cost to the Contracting Authority.

A. Remove all excess materials, debris, and equipment upon completion of work.

B. Clean all paved surfaces open for public use at the end of each day and prior to forecasted precipitation.

C. Repair any damage resulting from seeding operations.

D. Remove hydraulic slurry and other excess debris related to seeding operations from buildings, landscaping, mulch, pavement, signs, sign posts, and any other areas not specified for application, at the end of each day.

3.10 ACCEPTANCE AND WARRANTY

A. Acceptance:

1. Guarantee in writing that all work has been completed as specified and provide the date that all activities were completed. When a warranty is a separately-bid item, this also establishes the beginning of the warranty period.

2. Acceptance will occur, provided seeded areas are in a live, healthy, growing, and well-established condition without eroded areas, bare spots, weeds, undesirable grasses, disease, or insects.
   a. Projects without a separately-bid warranty will be accepted no sooner than 60 days from the date that all activities were completed.
   b. When a warranty is established as a bid item and the warranty period exceeds 60 days, projects may be accepted after all specified work, excluding the warranty, is satisfactorily completed, and a supplemental contract for the warranty is executed according to the Code of Iowa Section 573.27.

B. Warranty:

1. Required only when established as a bid item by the Engineer.

2. The warranty is to guarantee completed seeding areas for a maximum period of twelve months.

3. During the warranty period, correct and reseed any defects in the seeded areas and grass stand, such as weedy areas, eroded areas, and bare spots, until all affected areas are accepted by the Engineer.

4. Replace or repair to original condition, all damages to property resulting from the seeding operation or from the remedying of defects, at the Contractor’s expense.

5. Replacement costs are the Contractor’s responsibility, except for those resulting from loss or damage due to occupancy of the project in any part, vandalism, civil disobedience, acts of neglect on the part of others, physical damage by animals, vehicles, fire, or losses due to curtailment of water by local authority, or by "Acts of God.”

END OF SECTION

SODDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

Sod Installation

1.02 DESCRIPTION OF WORK

This section includes preparation of the sodbed, furnishing and installing sod, fertilizing, watering, and maintenance for completed sodded areas.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Sod grower's certification of grass species and location of sources.

B. Certification of the fertilizer analysis.

C. Written instructions recommending procedures for maintenance of sodded lawns, prior to final acceptance of sod.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Harvest, deliver, and transplant sod within a period of 24 hours unless a suitable preservation method is approved by the Engineer prior to delivery.

B. Do not harvest or transport sod when moisture content may adversely affect sod survival.

C. Protect sod that cannot be placed immediately on delivery from sun, wind, dehydration, and rain prior to installation.

D. Sod showing visible signs of heating or dehydration will be rejected.

E. Do not tear, stretch, or drop sod during handling and installation.

F. Deliver fertilizer to the site in original, unopened, and non-damaged containers, each bearing the manufacturer's guaranteed analysis.

G. Store packaged materials off the ground and protect from moisture and deterioration.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Notify the Engineer at least 3 calendar days prior to start of sodding operations.

B. Perform sod installation after planting and other work affecting ground surface has been completed, or as approved by Engineer.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Sod:

1. Measurement: Measurement will be in square yards of sod placed.

2. Payment: Payment will be at the unit price per square yard of sod placed.

3. Includes: Unit price includes, but is not limited to, preparation of sod and sodbed, stakes, fertilizing, watering, maintenance, and clean up. Also includes any necessary sod replacements during maintenance period.

PART 2 - PRODUCTS

2.01 SOD

A. Provide a well-established (no less than 12 months old), well rooted, healthy, nursery-grown sod blend of improved Kentucky Bluegrass with a uniform color, leaf texture, density, and varieties consisting of a minimum of two and no more than four cultivars selected from the following list:

Allowed Kentucky Bluegrass Cultivars:

4-Seasons	Bluenote	NuBlue
Arrowhead	Concerto	NuGlade
Award	Everest	Prosperity
Bewitched	Impact	Ridgeline
Beyond	Jackpot	Rubicon
Blue Chip Plus	Liberator	Rugby II
Blue Devil	Midnight	Skye
Blueberry		

B. Sod grown in peat bedded soil will not be accepted.

C. Ensure sod is free from objectionable grasses and broadleaf weeds, roots of trees or shrubs, stones, thatch, and other objectionable materials, nematodes and soil-born insects, and free from disease. Sod will be considered free of weeds if less than two such plants are found per 100 square feet of area.

D. Mow at a height of 2 inches prior to cutting.

E. Cut sod with a sod machine in strips of uniform width and length, with square ends. Cut to a uniform soil thickness of approximately 1/2 inch to 1 inch; thickness measurement excludes top growth.

F. Ensure sod is moist when placed.

2.02 FERTILIZER

Comply with Iowa DOT Article 4169.03.

2.03 STAKES

A. Softwood Stakes: 3/4 inch diameter and 8 inches long.

B. Steel Pins: Tee shaped with a 4 inch head and 8 inch leg.

2.04 WATER

Unless otherwise specified in the contract documents, provide water and watering equipment such as hoses and sprinklers. Provide water free of substances harmful to plant growth.

PART 3 - EXECUTION

3.01 PREPARATION OF SODBED

A. Limit preparation to areas that will be immediately sodded.

B. Where weed growth has developed, remove all weeds and weed debris.

C. Shape and fine grade sodbed to remove washes or gullies, water pockets, and irregularities. Provide an even surface, true to grade and cross-section.

D. Rototill and cultivate sodbed to a fine and mellow condition to a minimum depth of 3 inches. Clear the top 3 inches of soil lumps, stones over 3/4 inch, and foreign material using hand labor as required.

3.02 FERTILIZING - FIRST APPLICATION

A. Provide a guaranteed analysis of 20-26-6 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) by weight at the rate of 200 pounds per acre.

B. Incorporate fertilizer into soil to a depth of 1 1/2 inches prior to placing sod.

3.03 SOD INSTALLATION

A. Do not install sod between the dates of June 15 and August 15, unless authorized by the Engineer.

B. Do not lay frozen sod; do not lay sod on frozen soil or when freezing conditions are forecasted within 24 hours.

C. Dampen dry soil prior to placing sod.

D. Firm or heal in soil along the edges of the sodded areas.

E. Carefully place sod in rows or strips evenly, with the longest edge parallel to the finished contours, and at right angles to the centerline of ditches and channels. On slopes, begin placing sod at the bottom and progress upward.

F. Minimize traffic on newly laid sod during installation. Provide plank or wood sheets to protect sod already laid from equipment and vehicles.

G. Tightly fit each strip against each other without voids. Do not overlap edges. Stagger joints at the ends of sod strips with adjacent strips of sod.

H. Finish sod edges at walks, curbs, planting, mulch edges, and other vertical surface by cutting and fitting tightly to edge.

I. Place sod mat approximately 1 inch below finished surface of walks, pavement, curbs, or other permanent features. Remove any sod not conforming to this requirement, adjust the subgrade, and re-lay the sod.

J. Where new sod joins existing lawns, cut straight and neatly into existing lawn and level subgrade to match height.

K. Stake sod on grades exceeding 4:1 and in drainage channels. Stake each roll at 2 foot intervals or as required to prevent movement during rainfall and stormwater runoff events.

L. Roll lightly-watered sod with a small mechanical or hand sod roller to sufficiently set or heal sod into soil and remove lumps. Roll as required to firm and level the sodded areas.

3.04 WATERING

A. Water sod within 1 hour of placement. During initial watering, thoroughly wet sod and sodbed.

B. Water all sodded areas during the maintenance period as necessary to maintain sod and soil moisture, supplement rainfall, promote growth and proper rooting, ensure sod survival, and prevent dormancy. As a guideline, watering of sod should provide a minimum of the following:

1. Week 1: 1/4 inch per day

2 Week 2: 1/4 inch every other day

3. Week 3: 1/4 inch every third day

4. Week 4: 1/4 inch every fourth day

C. Actual watering quantities depend upon weather conditions during the maintenance period. Ensure waterings are sufficient to thoroughly saturate sod, sodbed, and adjacent disturbed areas to a depth of approximately 4 inches.

D. Apply water uniformly and consistently on all sodded areas to prevent damage to sod, trees, and shrubs.

3.05 FERTILIZING - SECOND APPLICATION

Apply second application of fertilizer with a guaranteed analysis of 10-10-10 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) at the rate of 300 pounds per acre 3 weeks after laying sod and prior to final acceptance.

3.06 MAINTENANCE

A. Begin maintenance immediately following installation of sod and continue for a period until the sod is well established with sod rooted in place. The maintenance period will be for 30 days.

B. Maintenance of sodded areas includes:

1. Watering.

2. Weeding.

3. Mowing. Each time sod has grown to a height between 3 and 4 inches, mow to a 2 to 2 1/2 inch height.

4. Remove and replace sodded areas that fail to survive.

3.07 CLEAN UP

A. Remove all excess materials, debris, and equipment from site.

B. Clean all paved surfaces.

C. Repair any damage resulting from sodding operations.

3.08 ACCEPTANCE

A. Sod acceptance will be based on the following criteria:

1. All requirements for the completed installation and maintenance have been met.

2. Sodded areas are healthy and even-colored, and a viable lawn is established, free from weeds, undesirable grass species, disease, and insects.

3. Sod is knit down to the soil so that it cannot be pulled up.

4. Sodded areas are without scattered bare spots and dead or dormant sod.

5. Clean up operations are completed.

B. Replacement sod work will be re-inspected before acceptance.

END OF SECTION

PLANT MATERIAL AND PLANTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Plant Material and Planting

B. Tree Drainage Wells

C. Warranty for Plant Material

1.02 DESCRIPTION OF WORK

A. Furnishing, preparing, and installing plant material.

B. Constructing tree drainage wells.

C. Maintaining and replacing plants for completed planting work.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Submit copy of current certification that the Supplier is an Iowa Department of Agriculture and Land Stewardship Certified Nursery Dealer or Grower prior to starting work.

B. Prior to final acceptance, submit written maintenance instructions recommending procedures for maintenance of all plant material types, including watering, insect and disease control, fertilizing, pruning, tree protection, and staking.

C. When requested, provide certification stating container-grown material has been grown in the container for no less than 1 year.

D. Provide a sample of the proposed mulch for approval by the Engineer.

E. When requested, submit a schedule of unit prices for each size and variety of tree, shrub, and ground cover plant specified in the contract documents.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Where evidence is submitted that a specified plant cannot be obtained, substitution may be made upon approval of the Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Protect plant root systems during transportation and storage, as necessary, with wet straw, moss, or other suitable material that will ensure root systems are maintained in a moist, healthy condition.

B. Protect all plants with a tarpaulin when being transported in an open vehicle.

C. When approved by the Engineer, temporary storage of plants on the project site may be allowed. When temporary on-site storage is not approved, provide such facilities and location at no additional cost to the Contracting Authority.

1.05 DELIVERY, STORAGE, AND HANDLING (Continued)

D. During temporary storage, heel-in plants and maintain them by providing moist straw, moss, or other suitable material to protect root systems; watering; and protecting from excessive sun, wind, and inclement weather conditions.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Comply with the optimum planting dates specified in Section 9030, 3.01.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Plants, By Count:

1. **Measurement:** Each tree, shrub, or ground cover plant accepted in place will be counted.

2. **Payment:** Payment will be at the unit price for each tree, shrub, or ground cover plant. Payment will be made in increments according to the following schedule:
   a. 70% of unit price at acceptance.
   b. 30% of unit price at end of 1 year establishment period, upon installation of replacements.

3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment period; and replacements.

B. Plants, By Count, With Warranty:

1. **Measurement:** Each tree, shrub, or ground cover plant accepted in place will be counted.

2. **Payment:** Payment will be at the unit price for each tree, shrub, or ground cover plant. Payment will be made in increments according to the following schedule:
   a. 70% of unit price at acceptance.
   b. 15% of unit price at end of 1-year establishment period, upon installation of replacements.
   c. 15% of unit price at end of 2-year warranty period, upon installation of replacements.

3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment and warranty periods; and replacements.

1.08 MEASUREMENT AND PAYMENT (Continued)

C. Plants, Lump Sum:

1. Measurement: Lump sum item; no measurement will be made.

2. Payment: Payment will be at the lump sum price for plants. Payment will be made in increments according to the following schedule:
a. 70% of lump sum price at acceptance.
b. 30% of lump sum price at end of 1 year establishment period, upon installation of replacements.

3. Includes: Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment period; and replacements.

D. Plants, Lump Sum, With Warranty:

1. Measurement: Lump sum item; no measurement will be made.

2. Payment: Payment will be at the lump sum price for plants. Payment will be made in increments according to the following schedule:
a. 70% of lump sum price at acceptance.
b. 15% of lump sum price at end of 1 year establishment period, upon installation of replacements.
c. 15% of lump sum price at end of 2 year warranty period, upon installation of replacements.

3. Includes: Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment and warranty period; and replacements.

E. Tree Drainage Wells:

1. Measurement: Each tree drainage well will be counted.

2. Payment: Payment will be at the unit price for each tree drainage well.

3. Includes: Unit price includes, but is not limited to, excavation, furnishing and placing rock, engineering fabric, and placing backfill material.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

A. General:

1. Ensure plant material meets the minimum requirements of size and grade as stated in the latest edition of American Standard for Nursery Stock, ANSI Z60.1.

2. Provide all plants true to name and tagged legibly as to name according to nursery standards of practice as recommended by the American Nursery and Landscape Association. Plant names indicated comply with the latest edition of "Standardized Plant Names" as adopted by the American Joint Committee of Horticultural Nomenclature.

3. Plants larger than those specified in the plant list with corresponding root system may be used upon approval of the Engineer.

4. Match plants planted in rows in form and size, unless otherwise specified in the contract documents.

B. Plant Material Quality:

1. Provide nursery plants suitable to and grown in the same USDA Plant Hardiness Zone as the project location.

2. One-sided branching plants from tightly planted nursery rows will be rejected.

3. Provide healthy specimens without objectionable deformities, voids, and open spaces, with well-developed branch and root systems. Ensure specimens are true to height, shape, and character of growth of the species or varieties. Provide plants showing appearance of good health and vigor.

4. Provide plants free of the following:
   a. Harmful insects, insect eggs, borers, and all forms of infestation
   b. Plant diseases and moldy or dried roots
   c. Damage to trunk, bark, branches, leaders, root systems, or cut-leaders
   d. Defects, disfiguring knots, sunscald injuries, and frost cracks
   e. Rodent damage to bark and buds

5. Plants with broken or cut back terminal leaders or with circling roots may be rejected.

C. Balled and Burlapped Plants:

1. Provide firm, moist, unbroken root balls of the specified size.

2. Broken or loose root balls will be rejected.

3. No manufactured or artificially produced or mudded-in root balls will be accepted.

4. A container grown plant, in lieu of a balled and burlapped root ball, will be accepted provided it meets the specified size, species, complies with American Standard for Nursery Stock, ANSI Z60.1, and meets criteria for container grown plants.

D. Container Grown Plants:

1. Grow plants in sufficiently sized container for a minimum of 1 year, with a root system developed to hold its soil together, firm, whole, and moist when taken from the container.

2.01 PLANT MATERIALS (Continued)

2. No loose root systems in the container, root-bound, or circling of the root system will be accepted (ANSI Z60.1).

3. Containers with holes, shaping, or made of fabric as a means of preventing root growth from reaching the sides of the container, or pruning, or training roots to grow laterally rather than encircling the container are acceptable (ANSI Z60.1).

E. Bare Root Plants:

1. Only use where specified in the contract documents or as approved by Engineer.

2. Ensure plants have substantially all of the root system intact, with clean cuts on roots. Root system is to be packed in moisture-retaining material and bagged to protect the root system from drying out.

3. Prior to planting, properly prune and sweat according to the nursery source instructions.

4. Ensure plants are dormant or breaking bud if sweated at the time of planting.

5. Do not plant later than May 15.

2.02 MULCH

Provide hardwood or softwood mulch complying with the following:

A. Shredded bark and shredded wood mixture containing no more than 50% wood chips.

B. Produced by a mechanical debarker and chipping machine.

C. Reasonably free from leaves, twigs, dust, toxic substances, and any other foreign material.

D. Not in an excessively wet or decomposed condition.

2.03 BACKFILL MATERIAL

A. Retain backfill material for plantings from soil excavated from the planting pit.

B. Ensure backfill material is loose, friable, and free of clods, sod, vegetation, and rocks 2 inches in diameter or larger. Do not use frozen or muddy soil as backfill material.

2.04 STAKING MATERIAL

A. Stakes: Comply with Iowa DOT Article 4154.09. Minimum length of 6 feet.

B. Trunk Support Strapping:

1. Breathable, flexible strap material or arbor tie or other material approved by the Engineer.
2. Provide strapping material of adequate length to prevent restriction of trunk, branches, or stems and contact of staking or guying wire with tree trunk.

C. Wire: Provide minimum 17 gauge, rust inhibitive wire to resist breaking during high winds and natural weathering conditions.

2.04 STAKING MATERIAL (Continued)

D. Manufactured Staking System: Upon approval of the Engineer, manufactured staking systems may be used in lieu of stakes, wire, and trunk support strapping.

2.05 GUYING MATERIAL

A. Earth Anchors:

1. Steel auger type with looped end; minimum 3/4 inch diameter, 36 inch long anchor shank, with 5 inch minimum diameter anchor disk.

2. Driven style earth anchors with a minimum 1,000 pound capacity in normal soils.

B. Trunk Support Strapping: Comply with Section 9030, 2.04, B.

C. Cable: 1/8 inch galvanized wire rope or equivalent cable with a minimum 1,500 pound capacity. Provide cable with ends clean and unfrayed.

D. Cable Clamps: Match size and strength of cable. Provide two for each end of cable.

E. Flagging Material: Brightly colored, minimum 12 square inches.

2.06 TREE PROTECTION

Install a correctly fitted mesh (corrugated or vinyl plastic) or corrugated or crepe paper, specifically manufactured for tree trunk protection, having qualities to resist insect infestation and to allow free air flow to trunk tissues, or similar material approved by the Engineer.

2.07 WATER

Provide water and watering equipment such as hoses, tanks, reels, bags or bladders, mobile equipment, nozzles, and sprinklers for the purpose of regular watering activities during the establishment period. Provide water free of substances harmful to plant growth. No fertilizers, pesticides, or growth regulators will be used in the water.

2.08 TREE DRAINAGE WELLS

A. Porous Backfill Material: Comply with Iowa DOT Section 4131.

B. Engineering Fabric: Comply with Iowa DOT Article 4196.01.

2.09 HERBICIDE

Provide a granular pre-emergent herbicide as approved by the Engineer.

PART 3 - EXECUTION

3.01 ALLOWABLE PLANTING DATES

Install plant material during the following times:

A. Evergreen Plants: September 1 to September 30 and March 1 to April 30, but not after candles exceed 1 inch.

B. Deciduous Plants (Balled and Burlapped and Container): October 1 to November 30 and March 1 to May 15.

C. Deciduous Plants (Bare Root): In the spring prior to May 15.

D. Weather Restrictions: Planting may be conducted under unseasonable conditions, except in weather below 32°F or above 90°F. No variance from plant warranty or other requirements will be given for plants installed outside the specified periods.

3.02 PREPARATION

A. Provide notice to the Engineer 3 days prior to planting.

B. All plants will be inspected by the Engineer prior to planting. Plants may be inspected and approved at the place of growth by the Engineer for compliance with the specifications for quality, size, and variety. Such approval does not waive the right to reject any plant material after it has been delivered to the site and/or installed.

C. Provide barriers or fencing as approved by Engineer to protect the public from injury when planting installation is within the right-of-way.

3.03 LOCATION OF PLANTS

A. Mark the location of all plants with flags or lathe according to the contract documents. Mark trees individually. Stake the outline of bedded plants or shrub groups for the quantity on the plans without marking individual plants. The Engineer will approve the locations marked prior to excavation of planting pits.

B. Make field adjustments in plant locations where underground or overhead obstruction is encountered, or where changes have been made as approved by the Engineer.

3.04 EXCAVATION OF PLANTING PIT

A. Excavate the plant pit, centered at the location marks, cylindrical in shape with a diameter 3 times larger than ball or root condition, with sloped sides and flat bottom. Excavate plant pit to a depth to match the nursery grade of the root flare for all balled and container root systems with well-draining soils. Do not over excavate the pit for container or balled and burlapped plants. Excavate plant pit to a depth 6 inches deeper for bare-rooted systems.

B. Scarify sides of excavated pit.

C. If specified, following excavation of planting pit for all trees, fill the pit full of water; allow to stand (without adding water) for an 18 hour period to determine porosity of the soil.

D. If the soils are too impervious, provide a tree drainage well per Figure 9030.103 or plant 2 to 3 inches above the surrounding grade, per Figure 9030.101, as directed by the Engineer.

3.05 TREE DRAINAGE WELLS

Install drainage wells when specified in the contract documents or when directed by the Engineer due to the presence of impervious soils.

A. Locate the drainage well at the edge of the excavated planting pit.

B. Auger an 8 inch to 12 inch diameter hole to existing pervious soil or to a maximum depth of 10 feet. If pervious soil is encountered, extend hole a minimum of 12 inches into the pervious layer.

C. Fill the excavated hole with porous backfill material and cover the aggregate with engineering fabric.

D. Following completion of drainage well, fill the pit full of water; allow to stand for an 18 hour period to verify sufficient drainage exists. The Engineer will determine if the drainage is sufficient.

3.06 PLANTING

A. Bare Root Plants:

1. Remove all ties, ribbons, wrap, and other items except plant identification from the branch system.

2. Remove all root packing and prune broken roots to sound wood with clean cuts.

3. Build a firm cone-shaped mound of soil in the middle of the planting pit.

4. Place the plant centered, upright, plumb, and with desired orientation in the planting pit, with the root flare matching existing grade.

5. Spread and arrange roots in their natural position laterally away from the central trunk to prevent kinking or circling. Do not fold, crimp, or mat roots together.

6. Carefully place backfill material in layers, filling all voids and avoiding injury to the root system until two thirds of the planting pit is complete; fill the pit with water and allow the soil to settle.

7. Continue placing backfill material up to grade level. Water in the tree. Allow water to completely soak into soil.

B. Balled and Burlapped and Container Plants:

1. Ensure root systems are moist at the time of planting.

2. Remove all ties and wrap from branch system, except plant identification.

3. Container Plants:
   a. Remove plant root system carefully from container prior to planting without disturbance to root systems.
   b. Inspect root system and cut any circled (girdled) roots.
   c. Place plants centered, upright, plumb, and with desired orientation in planting pit with the root flare matching existing grade.

3.06 PLANTING (Continued)

4. Balled and Burlapped Plants:
   a. Place plants centered, upright, plumb, and with desired orientation in planting pit with the root flare at or slightly above existing grade or 2 to 3 inches above grade if in compacted clay or poorly drained soils.
   b. After plant placement, cut and remove the top 1/2 of the wire, burlap, and twine from root ball

5. Carefully place and lightly tamp a small amount of backfill material around the root ball base to stabilize the root ball.

6. Place loose excavated soil 2/3 of the depth of the planting pit. Water in the tree. Allow water to completely soak into soil.

7. Continue placing backfill material up to grade level. Lightly tamp but do not compact the soil around the plant. Water in a second time.

8. If specified, rototill soil in a 4 foot radius around the planting pit to break up compacted soil.

C. Planting on Slopes:

1. Place the top of the root flare at or slightly above the finished grade at the center of the planting pit.

2. For all plants planted on significant slope, form a saucer as a dam or shoulder on the downhill side to catch and hold water and to discourage erosion.

3.07 WATERING

A. Water each plant immediately after planting.

B. Water plants a minimum of 10 to 15 gallons per plant per week when less than 1 inch of precipitation is received in the immediate location. Apply sufficient water to soak the plant's root zone. Follow this watering procedure throughout the establishment period.

3.08 MULCHING

A. Dig edges of mulched areas to ensure the top of the mulch at the edge of the planting area matches the existing ground surface.

B. Place mulch 3 inches deep in the planting saucer within 2 calendar days of planting.

C. Mulch an area around tree trunks and shrub branch lines a minimum of 6 inches larger than the tree canopy.

D. Provide a continuous mulch area around plant groupings.

E. Following mulch placement, pull mulch back 6 inches from the base of all trees and shrubs to allow air circulation.

3.09 TREE PROTECTION

A. When specified in the contract documents, or when directed by the Engineer, protect the trunk of deciduous trees in the fall of the year in which the tree is planted.

B. Inspect the trunk for injuries and evidence of insect infestation prior to wrapping.

C. Protect trunk from the ground line to the height of the first branch. If plant has multiple stems, cover each stem separately.

D. Remove tree protection by April 1 of the next spring.

3.10 STAKING AND GUYING

A. General:

1. Maintain all plants in an upright and plumb condition.

2. Complete staking or guying by the end of the day in which they were installed for all single stem plants over 1 inch diameter.

3. Do not stake clump form plants and plants in paved pedestrian areas unless approved by the Engineer.

B. Staking:

1. Provide two stakes for each tree for trees 2 1/2 inches in diameter and smaller. Place one of the stakes on the southwest side of the tree, or as directed by the Engineer, and place the second stake directly opposite the first.

2. Provide three stakes for each tree for trees 2 1/2 to 4 inches in diameter. Locate one stake on the southwest side of the tree with remaining stakes equally spaced around the tree.

3. Locate stakes uniformly from the trunk of the tree at a distance equal to 1/4 to 1/3 of the height of the tree, or 2 feet minimum. Place stakes outside of the planting pit and within the mulch area.

4 Set posts vertically into unexcavated soil at a minimum 2 foot depth or until firm, providing a required post height above grade.

5. Attach wire with trunk protection to trunk at a minimum of 4 feet above grade or between one half and two thirds distance from finished grade to the top of the tree with slight slack in wire to allow for tree movement.

6. Secure wire to stakes at 6 inches from the top of the stake; mark all wire with flagging material.

7. Install manufactured staking system according to manufacturer’s published recommendations.

3.10 STAKING AND GUYING (Continued)

C. Guying:

1. Provide three earth anchors and cables for evergreen trees 10 feet and taller and deciduous trees over 4 inches in diameter. Locate one anchor on the southwest side of the tree with remaining anchors equally spaced.

2. Locate the anchor a distance from the trunk equal to 1/3 of the tree height.

3. Attach the cable with a trunk protector to the trunk between 1/3 and 1/2 of the tree height, or near the lowest main branches for deciduous trees.

4. Screw an auger style anchor into unexcavated soil until only the looped top is exposed. Install driven style anchors a minimum of 2 1/2 feet into the soil.

5. Secure cable to anchor with slight slack in cable; mark all anchor cables with flagging material.

6. Install manufactured staking system according to the manufacturer's published recommendations.

D. Removal: Remove all staking and anchoring materials from all plants at the end of the 1 year establishment period and remove from site.

3.11 PRUNING

A. General:

1. Provide proper and sharp pruning tools to provide a clean cut without injuring the branch collar.

2. Prune in such a manner as to retain the natural shape of the plant. Do not prune the terminal leader of a plant. Leave no protruding stubs, and prune to the closest outward growing bud.

3. Plant materials incorrectly pruned will be rejected.

B. Deciduous Trees:

1. Prune broken, damaged, or otherwise defective branches. Remove all branches that may not develop properly. Also, eliminate narrow crotches or competing leaders.

2. Prune to develop an upright leader that will promote the symmetry of the tree. Prune flowering or specimen trees to develop their natural form.

3. Prune all trees in Class A sidewalks or other paved pedestrian areas to provide a 7 foot height clearance, unless otherwise directed by the Engineer.

C. Evergreen Trees and Shrubs: Remove dead and broken branches.

D. Deciduous Shrubs: Remove dead or irregular branches. Prune to develop their natural form.

3.12 CLEAN UP

A. Perform cleaning during installation and upon completion of work.

B. Remove all excess materials, trimmings, branches, soils, debris, and equipment from the site.

C. Repair any damage resulting from planting operations.

D. Clean all paved areas with a broom.

E. Remove all tags and labels from plants following acceptance by the Engineer.

3.13 ESTABLISHMENT AND WARRANTY PERIODS AND ACCEPTANCE

A. Establishment Period: The plant establishment period is 1 year after the installation is accepted by the Engineer. A plant inspection will be made by the Engineer prior to the expiration of the establishment period.

B. Warranty Period: If a plant warranty is specified in the contract documents, the 1 year warranty period begins immediately after the expiration of the 1 year establishment period. Inspection of plants will be made by Engineer at the end of the 1 year establishment period and again prior to the expiration of the warranty period.

C. Maintenance: Care for all plants during the establishment or warranty period as required to keep plants in a live, healthy growing condition.

1. Prune plants to maintain a desirable shape and to remove any dead or broken limbs.

2. Remove weeds and grasses from planting beds and mulch areas. Apply a pre-emergent herbicide to control weed growth when directed by the Engineer.

3. Water as required to enhance early root growth and maintain a moist soil.

4. Adjust stakes and ties to maintain plant in an upright and plumb condition.

5. Re-set settled plants to proper grades and position. Restore planting saucer and mulch; add backfill material and mulch as may be required.

6. Apply appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.

D. Plant Condition: Ensure all plants are in a live, healthy, and growing condition both at the date of acceptance of the installation by the Engineer, at the end of the plant establishment period, and at the end of the warranty period.

E. Replacement: Replace all plants not found to be in a live, healthy, and growing condition during inspection at the 1 year establishment period and again at the warranty period (if specified) at no additional cost to the Contracting Authority.

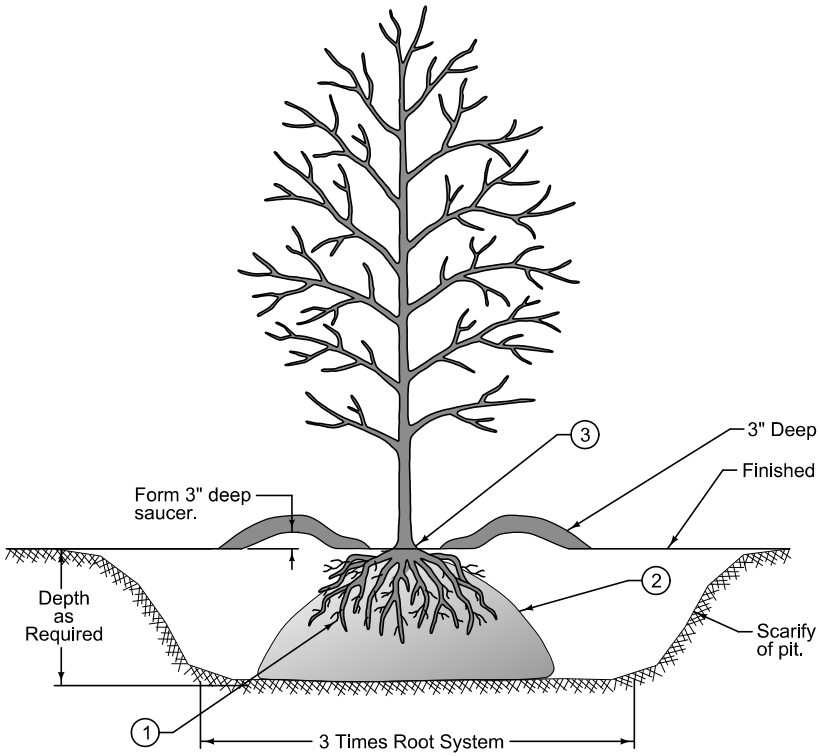
1. Upon notice from Engineer, remove rejected plants from the site and replace with plant material of the same species and size as originally specified. Install replacement plants complying with the contract documents.

2. Plants damaged due to fire or flooding beyond the contractors control or ice storms, hail, tornados, or acts of vandalism do not require replacement.

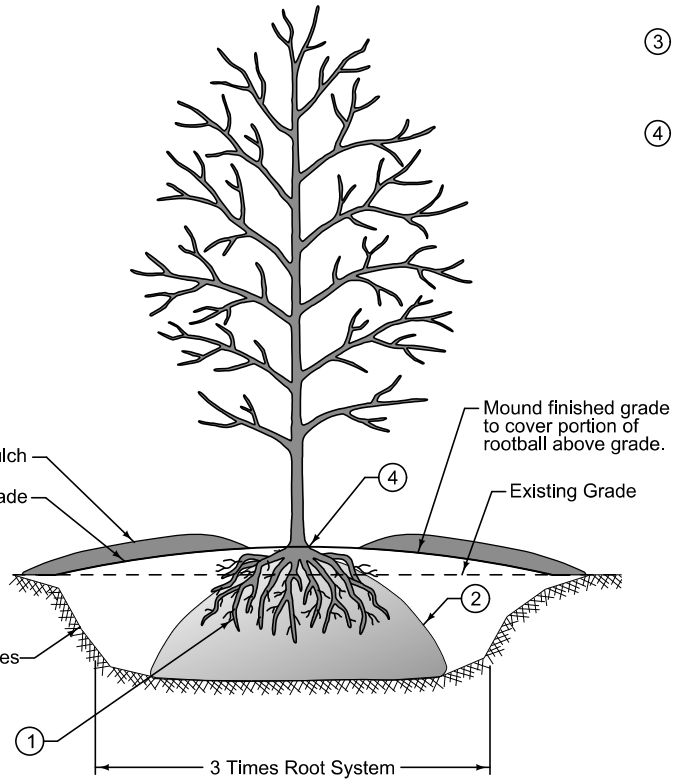
END OF SECTION

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1. Spread root system in natural position with soil excavated from pit.
2. Build a firm cone-shaped mound of soil in the middle of the planting pit.
3. Install with root flare at or slightly above grade. Do not place mulch within 6 inches of trunk.
4. Install root flare 2 to 3 inches above grade. Do not place mulch within 6 inches of trunk.



PLANTING PIT
(Bare Root Plants)



PLANTING PIT
(Bare Root Plants on Poorly Drained Soils)

FIGURE 9030.101

SHEET 1 OF 2

SUDAS

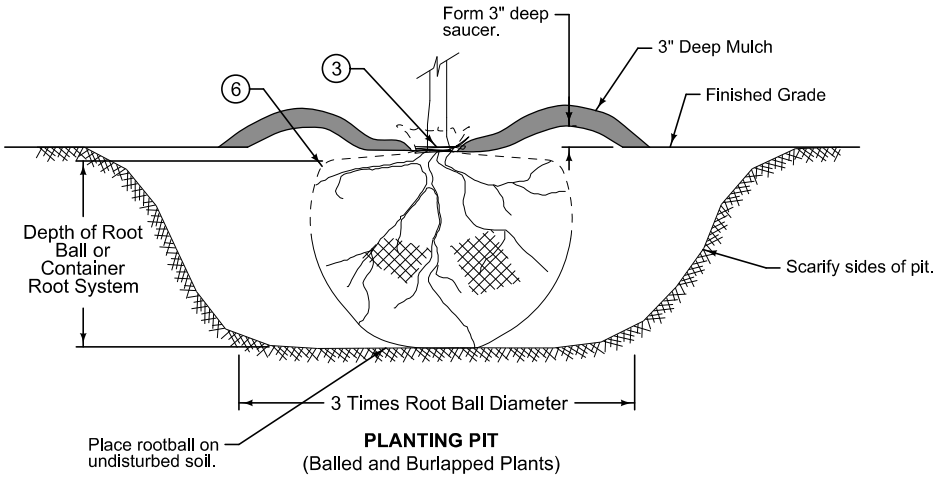
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9030.101

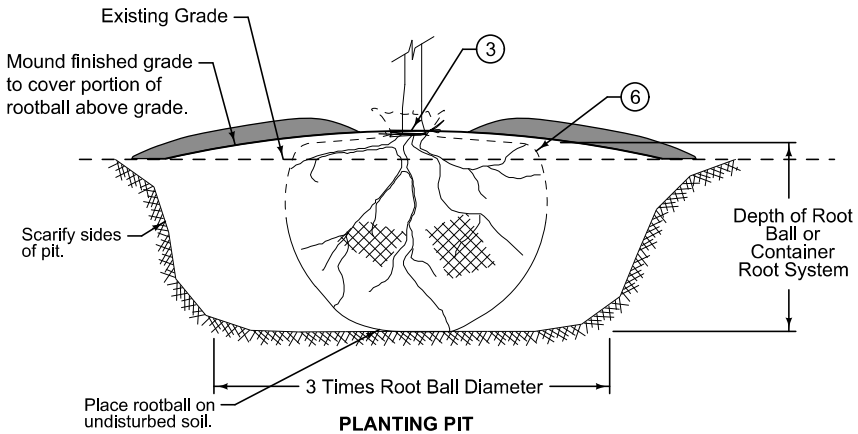
SHEET 1 of 2

SUDAS Standard Specifications

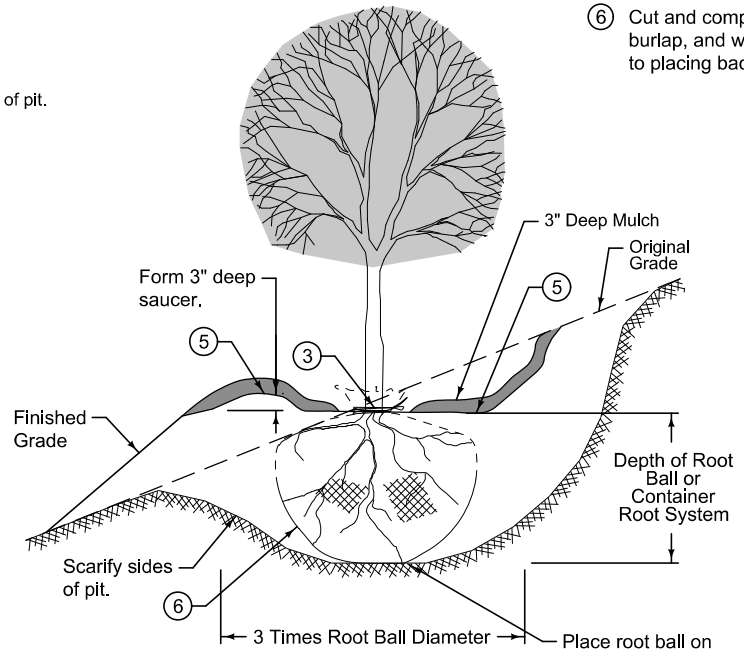
PLANTING PIT



PLANTING PIT
(Balled and Burlapped Plants)



PLANTING PIT
(Balled and Burlapped Plants on Poorly Drained Soils)



PLANTING PIT
(On Slopes)

3. Install with root flare at or slightly above grade. Do not place mulch within 6 inches of trunk.
4. Install root flare 2 to 3 inches above grade. Do not place mulch within 6 inches of trunk.
5. Begin transition at edge of root ball.
6. Cut and completely remove top 1/2 of twine, burlap, and wire baskets from root ball prior to placing backfill material.

FIGURE 9030.101 | SHEET 2 OF 2

SUDAS

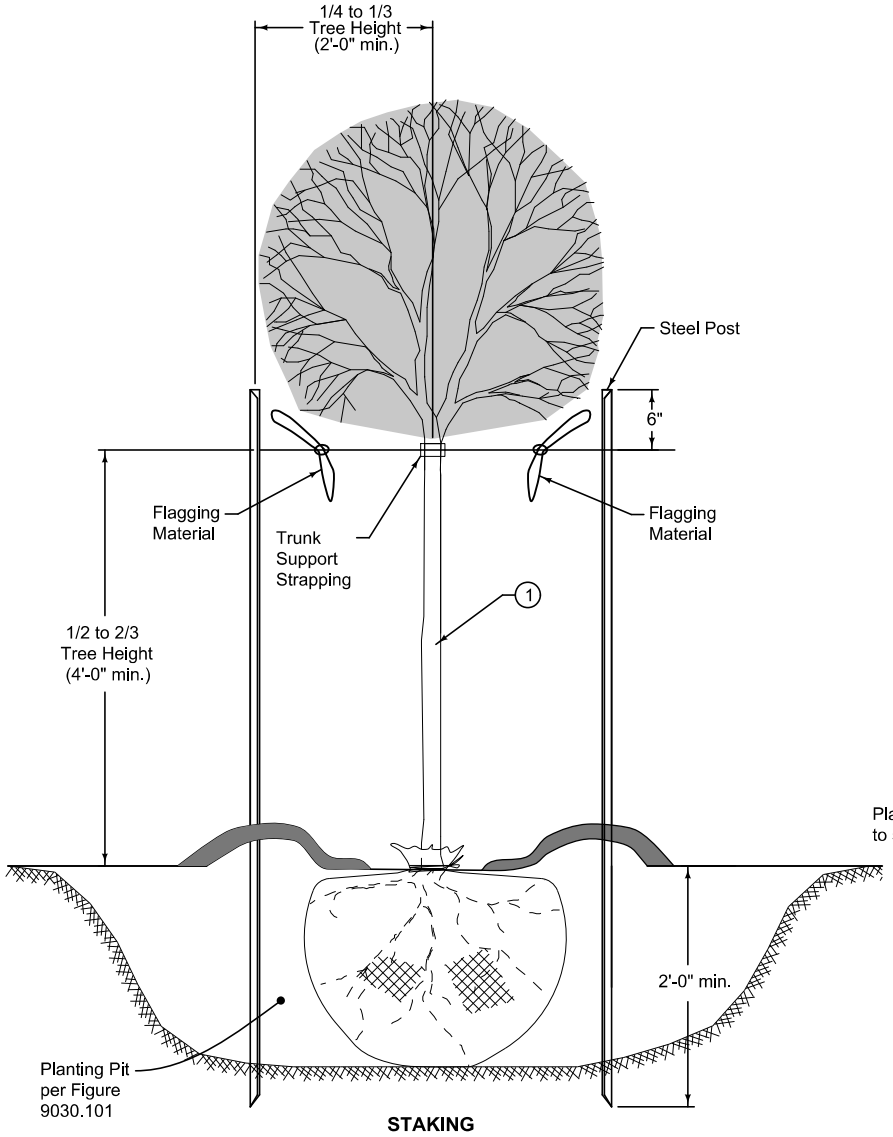
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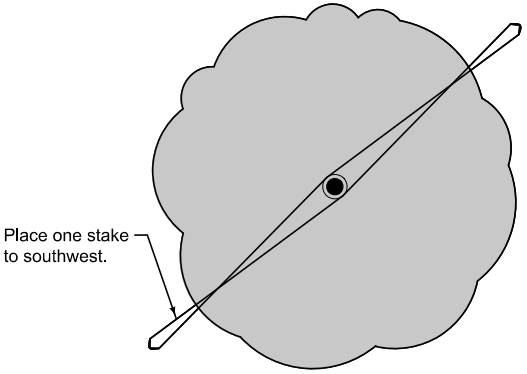
SHEET 2 of 2

SUDAS Standard Specifications

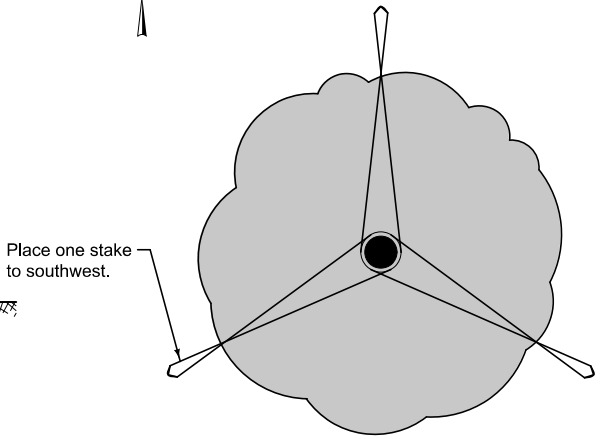
PLANTING PIT



STAKING



STAKING PLAN
(Trees 2 1/2 inch diameter or smaller)



STAKING PLAN
(Trees larger than 2 1/2 inch diameter)

1. Protect trunk from ground line to first branch when specified in the contract documents.

FIGURE 9030.102

SHEET 1 OF 2

SUDAS

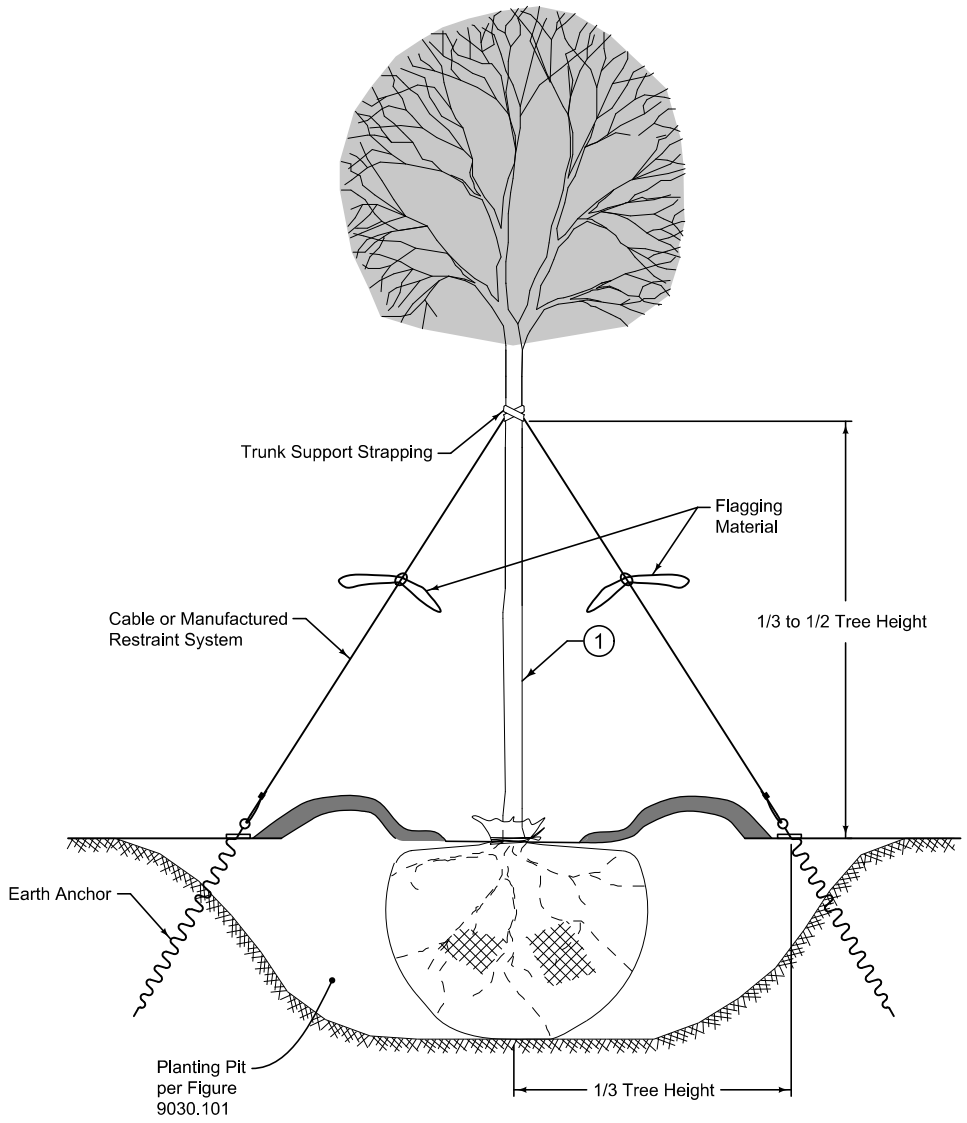
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SHEET 1 of 2

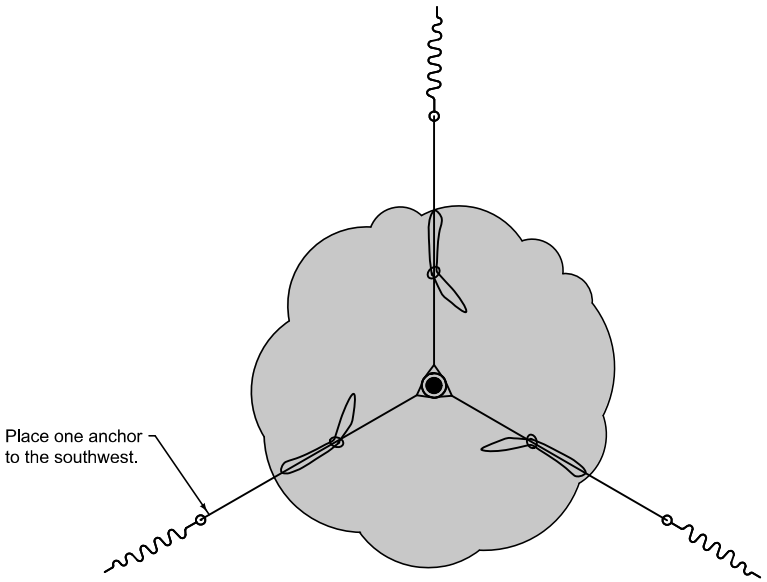
SUDAS Standard Specifications

TREE STAKING, GUYING, AND WRAPPING



GUYING

1 Protect trunk from ground line to first branch when specified in the contract documents.



GUYING PLAN

FIGURE 9030.102 | SHEET 2 OF 2

SUDAS

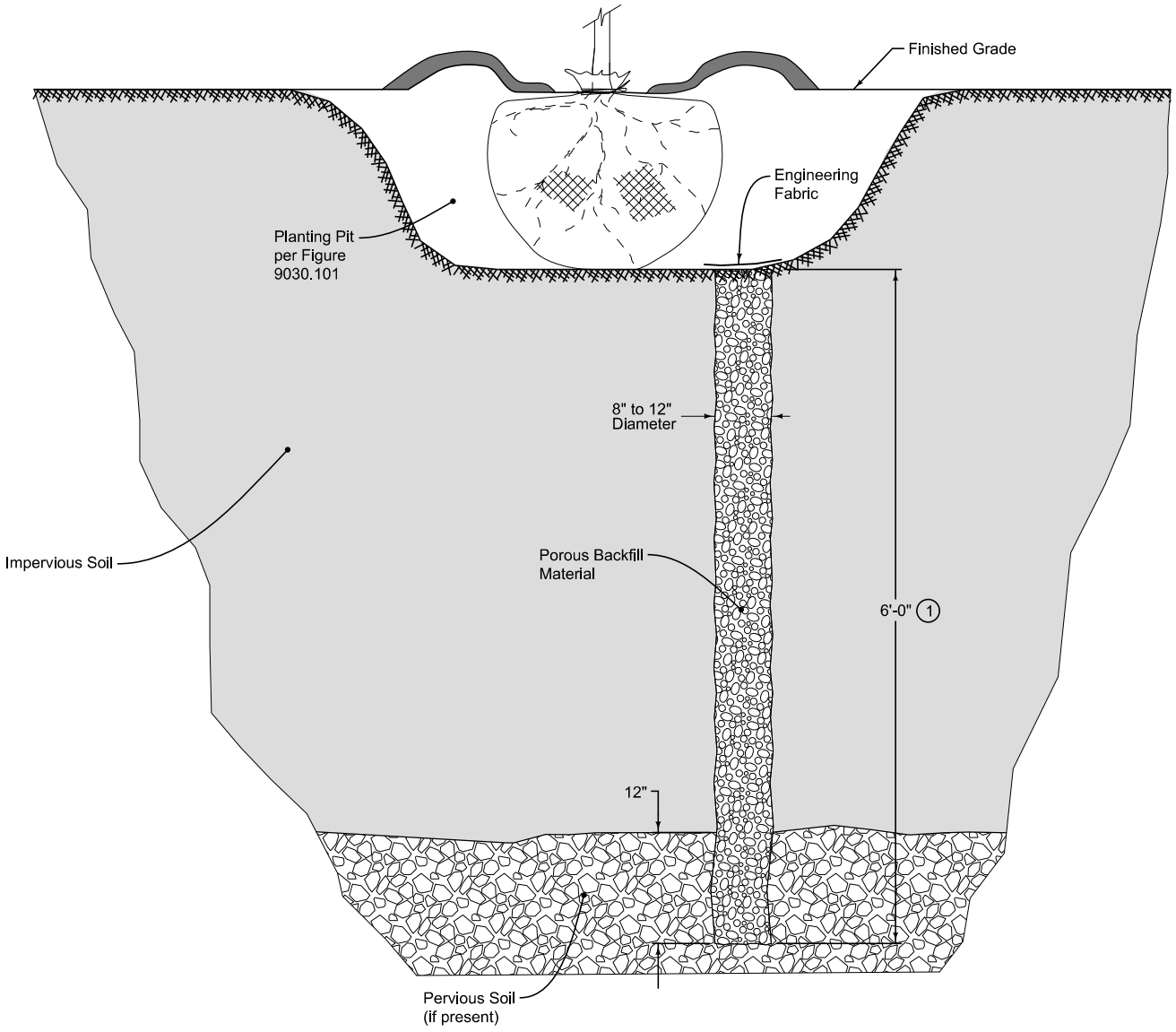
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9030.102

SHEET 2 of 2

SUDAS Standard Specifications

TREE STAKING, GUYING, AND WRAPPING



(1) If pervious soil is encountered at a depth less than 6 feet, the drainage well may be terminated when the well extends a minimum of 12 inches into the pervious soil layer.

FIGURE 9030.103

SHEET 1 OF 1

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9030.103

SHEET 1 of 1

SUDAS Standard Specifications

TREE DRAINAGE WELL

EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. NPDES General Permit No. 2

B. Stormwater Pollution Prevention Plan (SWPPP)

C. Erosion Control Measures

D. Velocity and Flow Control Measures

E. Sediment Control Measures

F. Application/Installation of Measures

G. Removal/Replacement of Measures

1.02 DESCRIPTION OF WORK

A. Furnish all materials; install, construct, maintain, and remove specified erosion control devices; at locations specified in the contract documents, or where specified by the Engineer.

B. Complete the required construction work on this project, while minimizing soil erosion and controlling water pollution. Maintain these features as specified, from initial construction stages to final completion of the project.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Upon request, provide copies of all records and documentation related to compliance with the Iowa DNR NPDES Permit.

B. For grid-tied concrete block mat, submit all manufacturer details, recommendations, and installation instructions for approval.

C. For manufactured track-out devices, submit a copy of shop drawings and installation instructions per the manufacturer.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Implement erosion and sediment control measures at the appropriate time(s).

B. Coordinate construction to minimize damage to erosion and sediment control devices.

1.07 SPECIAL REQUIREMENTS

A. Permit:

1. When applicable, comply with the requirements of the Iowa Department of Natural Resources, *NPDES (National Pollutant Discharge Elimination System) General Permit No. 2 for Stormwater Discharge Associated with Industrial Activity for Construction Activities*, and the Stormwater Pollution Prevention Plan.

2. For projects covered under the Iowa DNR General Permit No. 2, sign on as a co-permittee with the owner and any other contractors or subcontractors.

3. When applicable, comply with the local jurisdiction's permitting requirements.

B. Protection of Property: Prevent accumulation of soil, sediment, or debris from project site onto adjoining public or private property. Remove any accumulation of soil or debris immediately, and take remedial actions for prevention.

C. Permit Compliance: When applicable, conduct all operations in compliance with the Iowa DNR NPDES General Permit No. 2. Labor, equipment, or materials not included as a bid item, but necessary to prevent stormwater contamination from construction related sources, are considered incidental. Incidental work related to compliance with the permit may include, but is not limited to: hazardous materials protection, fuel containment, waste disposal, and providing employee sanitary facilities.

D. Project Staging: Replacing erosion and sediment control practices that are damaged or removed by the contractor in a manner that is inconsistent with the current project staging or SWPPP is the Contractor's responsibility and will be at the Contractor's expense.

1.08 MEASUREMENT AND PAYMENT

A. Stormwater Pollution Prevention Plan (SWPPP):

1. Preparation:
- **a. Measurement:** Lump sum item; no measurement will be made.
- **b. Payment:** Payment will be at the lump sum price for SWPPP preparation.
- **c. Includes:** Lump sum price includes, but is not limited to, development of a SWPPP by the Contractor meeting local and state agency requirements, filing the required public notices, filing a Notice of Intent for coverage of the project under the Iowa DNR NPDES General Permit No. 2, and payment of associated NPDES permit fees.
- **d. Other:** Item will be paid for upon approval of the SWPPP by the Engineer, and after the Notice of Intent has been filed by the Contractor.

2. Management:
- **a. Measurement:** Lump sum item; no measurement will be made.
- **b. Payment:** Payment will be at the lump sum price for SWPPP management.
- **c. Includes:** Lump sum price includes all work required to comply with the administrative provisions of the Iowa DNR NPDES General Permit No. 2; including record keeping, documentation, updating the SWPPP, filing the Notice of Discontinuation, etc. Item also includes weekly inspections required to satisfy the provisions of General Permit No. 2, unless otherwise specified in the contract documents.
- **d. Does Not Include:** Unit price does not include installation or maintenance of erosion and sediment control practices.
- **e. Other:** The Engineer may make partial payments based on estimates of the project completion. Final payment will be made when the site reaches final stabilization and the Notice of Discontinuation is filed.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Compost Blankets:

1. **Measurement:** Measurement will be in square feet for each thickness of compost blanket.

2. **Payment:** Payment will be at the unit price per square foot for each thickness of compost blanket.

3. **Includes:** Unit price includes, but is not limited to, furnishing and spreading compost over the designated area.

C. Filter Berms:

1. **Measurement:** Measurement will be in linear feet for each size of filter berm, measured longitudinally along the top of the berm.

2. **Payment:** Payment will be at the unit price per linear foot for each size of berm.

3. **Includes:** Unit price include, but is not limited to, furnishing material and constructing the filter berm, including vegetation if specified.

D. Filter Socks:

1. **Installation:**
   a. **Measurement:** Measurement will be in linear feet for each size of filter sock.
   b. **Payment:** Payment will be at the unit price per linear foot for each size of filter sock.
   c. **Includes:** Unit price includes, but is not limited to, anchoring stakes.

2. **Removal:**
   a. **Measurement:** Measurement will be in linear feet of filter sock removed.
   b. **Payment:** Payment will be at the unit price per linear foot of filter sock removed.
   c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of filter socks and accumulated sediment.

E. Temporary Rolled Erosion Control Products (RECP):

1. **Measurement:** Measurement will be in square yards, based on the width specified in the contract documents and actual measured length, for each type of temporary RECP.
   a. Areas of RECP buried in trenches or covered by overlaps along seams will not be measured.
   b. For each blanket check installed, the Engineer will add 4 feet of length to the measured quantity.

2. **Payment:** Payment will be at the unit price per square yard for each type of temporary RECP.

3. **Includes:** Unit price includes, but is not limited to, excavation, staples, anchoring devices, and material for anchoring slots.

F. Wattles:

1. **Installation:**
   a. **Measurement:** Measurement will be in linear feet for each type and size of wattle.
   b. **Payment:** Payment will be at the unit price per linear foot for each type and size of wattle.
   c. **Includes:** Unit price includes, but is not limited to, anchoring stakes.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Removal:
- **a. Measurement:** Measurement will be in linear feet of wattle removed.
- **b. Payment:** Payment will be at the unit price per linear foot of wattle removed.
- **c. Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of wattle and accumulated sediment.

G. Check Dams:

1. Rock Check Dams:
- **a. Measurement:** Measurement will be in ton of stone installed.
- **b. Payment:** Payment will be at the unit price per ton of stone installed.
- **c. Includes:** Unit price includes, but is not limited to, engineering fabric.

2. Manufactured Check Dams:
- **a. Installation:**
  - **1) Measurement:** Measurement will be in linear feet for each type and size of manufactured check dam.
  - **2) Payment:** Payment will be at the unit price per linear foot for each type and size of manufactured check dam.
  - **3) Includes:** Unit price includes, but is not limited to, anchoring stakes.
- **b. Removal:**
  - **1) Measurement:** Measurement will be in linear feet for each type of manufactured check dam removed.
  - **2) Payment:** Payment will be at the unit price per linear foot for each type of manufactured check dam removed.
  - **3) Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of manufactured check dam and accumulated sediment.

3. Fiber Logs: Filter sock and wattles utilized for check dams will be measured and paid for according to 9040, 1.08, D and 9040, 1.08 F respectively.

H. Temporary Earth Diversion Berms:

1. Measurement: Measurement will be in linear feet for each type and size of temporary earth diversion berm.

2. Payment: Payment will be at the unit price per linear foot of temporary earth diversion berm.

3. Includes: Unit price includes, but is not limited to, removal of the berm upon completion of the project.

I. Level Spreaders:

1. Measurement: Measurement will be in linear feet of level spreaders.

2. Payment: Payment will be at the unit price per linear foot of level spreader.

3. Includes: Unit price includes, but is not limited to, maintaining the spreader during the period of construction and removal upon completion of the project, unless otherwise specified in the contract documents.

1.08 MEASUREMENT AND PAYMENT (Continued)

J. Rip Rap:

1. **Measurement:** Measurement will be in tons for each type of rip rap.

2. **Payment:** Payment will be at the unit price per ton of rip rap.

3. **Includes:** Unit price includes, but is not limited to, engineering fabric.

K. Temporary Pipe Slope Drains:

1. **Measurement:** Measurement will be in linear feet for each type and size of temporary pipe slope drain, measured from end of apron to end of apron.

2. **Payment:** Payment will be at the unit price per linear foot for each type and size of pipe.

3. **Includes:** Unit price includes, but is not limited to, excavation, furnishing and installing pipe and pipe aprons, grading, and removal of the slope drain upon completion of the project.

L. Temporary Sediment Basin:

1. **Outlet Structure:**
   a. **Measurement:** Each size of temporary sediment basin outlet structure will be counted.
   b. **Payment:** Payment will be at the unit price for each temporary sediment basin outlet structure.
   c. **Includes:** Unit price includes, but is not limited to, concrete base, dewatering device, anti-vortex device, outlet pipe, and anti-seep collars (if specified).
   d. **Does Not Include:** Unit price does not include earthwork required for construction of the temporary sediment basin.

2. **Removal of Sediment:**
   a. **Measurement:** Each occurrence of sediment removal will be counted.
   b. **Payment:** Payment will be at the unit price for each occurrence of sediment removal.
   c. **Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.

3. **Removal of Outlet Structure:**
   a. **Measurement:** Each temporary sediment basin outlet structure removed will be counted.
   b. **Payment:** Payment will be at the unit price for each temporary sediment basin outlet structure removed.
   c. **Includes:** Unit price includes, but is not limited to, dewatering and off-site disposal of the outlet structure, concrete base, emergency spillway, and accumulated sediment.
   d. **Does Not Include:** Unit price does not include earthwork required to remove the temporary sediment basin and restoration of the area to finished grade.

M. Sediment Trap Outlet:

1. **Installation:**
   a. **Measurement:** Measurement will be in tons of crushed stone placed.
   b. **Payment:** Payment will be at the unit price per ton of crushed stone.
   c. **Includes:** Unit price includes, but is not limited to, engineering fabric.
   d. **Does Not Include:** Unit price does not include earthwork required for construction of the sediment trap.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Removal of Sediment:
- **a. Measurement:** Each occurrence of sediment removal will be counted.
- **b. Payment:** Payment will be at the unit price for each occurrence of sediment removal.
- **c. Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.

3. Removal of Device:
- **a. Measurement:** Each sediment trap outlet removed will be counted.
- **b. Payment:** Payment will be at the unit price for each sediment trap outlet removed.
- **c. Includes:** Unit price includes, but is not limited to, dewatering and off-site disposal of sediment trap outlet and accumulated sediment.
- **d. Does Not Include:** Unit price does not include earthwork required to remove the sediment trap outlet and restoration of the area to finished grade.

N. Silt Fence or Silt Fence Ditch Check:

1. Installation:
- **a. Measurement:** Measurement will be in linear feet of silt fence or silt fence ditch check.
- **b. Payment:** Payment will be at the unit price per linear foot of silt fence or silt fence ditch check.
- **c. Includes:** Unit price includes, but is not limited to, anchoring posts.

2. Removal of Sediment:
- **a. Measurement:** Each occurrence of sediment removal will be counted.
- **b. Payment:** Payment will be at the unit price for each occurrence of sediment removal.
- **c. Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.

3. Removal of Device:
- **a. Measurement:** Measurement will be in linear feet of silt fence removed.
- **b. Payment:** Payment will be at the unit price per linear foot of silt fence removed.
- **c. Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of fence, posts, and accumulated sediment.

O. Stabilized Construction Exit:

1. Track-out Control by Square Yard:
- **a. Measurement:** Measurement will be in square yards of material or manufactured track-out pad placed.
- **b. Payment:** Payment will be at the unit price per square yard of material or manufactured track-out pad placed.
- **c. Includes:** Unit price includes, but is not limited to, subgrade stabilization fabric, removal and disposal of accumulated sediment, and removal and disposal of track-out control stone and manufactured pad.

2. Track-out Control by Ton:
- **a. Measurement:** Measurement will be in tons of material placed.
- **b. Payment:** Payment will be at the unit price per ton of material placed.
- **c. Includes:** Unit price includes, but is not limited to, subgrade stabilization fabric.

1.08 MEASUREMENT AND PAYMENT (Continued)

P. Dust Control:

1. Water for Dust Control:
- **a. Measurement:** Measurement will be by metering of water applied to haul roads and other areas to control dust. If metering is not available, measurement will be by counting the loads from a transporting tank of known volume and gauging the contents of the transporting truck for partial loads.
- **b. Payment:** Payment will be at the unit price per 1,000 gallons of water used.
- **c. Includes:** Unit price includes, but is not limited to, furnishing, transporting, and distributing water to the haul road.

2. Dust Control Product:
- **a. Measurement:** Measurement will be in square yards of the treated area.
- **b. Payment:** Payment will be at the unit price per square yard of product applied.
- **c. Includes:** Unit price include, but is not limited to, furnishing and incorporating the dust control product.

Q. Erosion Control Mulching:

1. Conventional Mulching:
- **a. Measurement:** Measurement will be in acres of conventional mulch.
- **b. Payment:** Payment will be at the unit price per acre of conventional mulch.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and incorporating mulch in the area designated in the contract documents.

2. Hydromulching:
- **a. Measurement:** Measurement will be in acres for each type of hydromulch.
- **b. Payment:** Payment will be at the unit price per acre for each type of hydromulch.
- **c. Includes:** Unit price includes, but is not limited to, furnishing mulch and tackifier (if applicable), providing equipment specific to hydromulching, and applying the mulch to the specified area.

R. Turf Reinforcement Mats (TRM):

1. Measurement: Measurement will be in square yards for each type of turf reinforcement mat.

2. Payment: Payment will be at the unit price per square yard for each type of turf reinforcement mat.

3. Includes: Unit price includes, but is not limited to, excavation, staples, anchoring devices, and material for anchoring slots.

S. *Intentionally left blank*

T. Inlet Protection Device:

1. Installation:
- **a. Measurement:** Each type of inlet protection device will be counted.
- **b. Payment:** Payment will be at the unit price for each inlet protection device.
- **c. Includes:** Unit price includes, but is not limited to, removal of the device upon completion of the project.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Maintenance:
- **a. Measurement:** Each inlet protection device maintenance occurrence will be counted.
- **b. Payment:** Payment will be at the unit price for each inlet protection device maintenance occurrence.
- **c. Includes:** Unit price includes, but is not limited to, removal and off-site disposal of accumulated sediment.

U. Flow Transition Mat:

1. Measurement: Measurement will be in square feet of flow transition mat.

2. Payment: Payment will be at the unit price per square foot of flow transition mat.

3. Includes: Unit price includes, but is not limited to, anchoring devices.

V. End of Season Temporary Erosion Control:

1. Measurement: Measurement will be in acres of end of season temporary erosion control applied.

2. Payment: Payment will be at the unit price per acre for end of season temporary erosion control.

3. Includes: Unit price includes, but is not limited to, furnishing, placing, and maintaining the end of season temporary erosion control throughout the winter season.

W. Linear Erosion Control:

When linear erosion control is specified, select an appropriate erosion control practice for use as perimeter control, inlet protection, slope length reduction, or flow diversion. Allowable linear erosion control practices include filter socks, wattles, or silt fence as described in Section 9040.

1. Installation:
- **a. Measurement:** Measurement will be in linear feet of linear erosion control installed. No distinction will be made between practices.
- **b. Payment:** Payment will be at the unit price per linear foot for linear erosion control.
- **c. Includes:** Unit price includes, but is not limited to, anchoring posts and anchoring stakes.

2. Removal:
- **a. Measurement:** Measurement will be in linear feet of linear erosion control removed. No distinction will be made between practices.
- **b. Payment:** Payment will be at the unit price per linear foot of linear erosion control removed.
- **c. Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of fence, filter socks, wattles, anchoring posts, anchoring stakes, and accumulated sediment.

1.08 MEASUREMENT AND PAYMENT (Continued)

X. Grid-Tied Concrete Block Mat (GTCBM):

1. Grid Tied Concrete Block Mat:

a. Measurement: Measurement will be the plan quantity in square yards of the finished surface of GTCBM. Areas of GTCBM placed in edge trenches, anchor trenches, or overlapped at mat seams will not be measured.

b. Payment: Payment will be at the unit price per square yard of grid-tied concrete block mat installed.

c. Includes: Unit price includes, but is not limited to, anchor trenches, underlayments, ground anchors, ties, and splicing.

2. GTCBM Concrete Anchor Trench:

a. Measurement: Measurement will be in linear feet of GTCBM concrete anchor trench.

b. Payment: Payment will be at the unit price per linear foot of GTCBM concrete anchor trench.

c. Includes: Unit price includes, but is not limited to, excavation, concrete, and installation.

PART 2 - PRODUCTS

2.01 COMPOST BLANKETS

Comply with Section 9010, 2.07, C for compost material requirements for compost blankets.

2.02 COMPOST BLANKET TACKIFIER

A. Use a biodegradable, organic binding agent or polyacrylamide that can be mixed with, or injected into, compost as it is placed, which is not detrimental to the establishment of vegetation.

B. Use in compost blankets when specified in the contract documents.

C. Apply at the rate recommended by the manufacturer.

2.03 FILTER MATERIAL

Material for use in filter socks and other areas, as specified in the contract documents.

A. Use material derived from wood, bark, or other, non-toxic vegetative feedstocks.

B. Use material with no visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.

C. Use material meeting the following particle sizes:

Table 9040.01: Filter Material Size

Sieve Size	Percent Passing[1]
2”	100
1”	90-100
3/8”	0-30

[1] The target flow rate of in-place material is 10 gal/min/lf. The Engineer may approve use of alternate materials meeting the target flow rate.

2.04 SLASH MULCH

Material for use in filter berms, and other areas as specified in the contract documents, to slow, filter, and divert stormwater runoff.

A. Raw wood slash from hard or soft timber harvested during clearing and grubbing operations within the project area.

B. Product of a mechanical chipper, hammermill, or tub grinder.

C. Maximum length of individual pieces shall not exceed 20 inches.

D. Maximum width of individual pieces shall not exceed 2 inches.

2.05 FILTER SOCK

A. For slope and sediment control applications, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 5 mil thickness, photodegradable HDPE.

B. For inlet protection, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 500 denier polypropylene.

C. Use 1 inch by 2 inch (minimum) hardwood stakes or stakes of equivalent strength.

2.06 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP)

Use temporary rolled erosion control products that are classified and have material properties according to the Erosion Control Technology Council's (ECTC) guidelines as follows:

A. Material Classification:

1. **RECP Type 1 (Ultra Short-term):** Functional longevity of 3 months and classified as follows:
   - **a. RECP Type 1.A:** Mulch control netting or open weave textile consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
   - **b. RECP Type 1.B:** Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.
   - **c. RECP Type 1.C:** Single-net erosion control blankets consisting of processed degradable natural and/or polymer fibers, mechanically bound together by a single rapidly-degrading, synthetic or natural fiber netting.
   - **d. RECP Type 1.D:** Double-net erosion control blankets, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two rapidly-degrading, synthetic or natural fiber nettings.

2. **RECP Type 2 (Short-term):** Functional longevity of 12 months and classified as follows:
   - **a. RECP Type 2.A:** Netting or open weave textile consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
   - **b. RECP Type 2.B:** Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.
   - **c. RECP Type 2.C:** Single-net erosion control blankets and open weave textiles, consisting of an erosion control blanket composed of processed degradable natural or polymer fibers, mechanically bound together by a single degradable synthetic or natural fiber netting.
   - **d. RECP Type 2.D:** Double-net erosion control blanket, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two degradable synthetic or natural fiber nettings.

3. **RECP Type 3 (Extended Term):** Functional longevity of 24 months and classified as follows:
   - **a. RECP Type 3.A:** Open weave textiles consisting of a slow-degrading synthetic mesh or woven natural fiber netting.
   - **b. RECP Type 3.B:** Erosion control blankets consisting of processed slow-degrading natural or polymer fibers, mechanically bound together between two slow-degrading synthetic or natural fiber nettings to form a continuous matrix.

2.06 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)

4. **RECP Type 4 (Long Term):** Functional longevity of 36 months and classified as follows:
   a. **RECP Type 4.A:** Open weave textiles consisting of processed slow-degrading natural or polymer yarns or twines woven into a continuous matrix.
   b. **RECP Type 4.B:** Erosion control blankets consisting of processed slow degrading natural or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix.

B. Properties and Performance:

1. Testing performed according to the ECTC's Testing Procedures for Rolled Erosion Control Products. Verify manufacturer's test results by independent testing.

2. Material properties meeting the ECTC Standard Specifications for Rolled Erosion Control Products are summarized as follows:

Table 9040.02: Rolled Erosion Control Products

Type	Shear Stress[2] (lbs/ft^2)	Max. Slope[3] (H:V)	Material Thickness (in)	C Factor[4]	Tensile Strength	
					MD[5] (lbs/ft)	TD[5] (lbs/ft)
1.A[1]	≥ 1.0	5:1	≥ 0.03	≤ 0.10	≥ 125	≥ 10
1.B	≥ 1.0	3:1	≥ 0.30	≤ 0.10	≥ 125	≥ 10
1.C	≥ 1.5	3:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 60	≥ 20
1.D	≥ 1.75	2:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 75	≥ 40
2.A[a]	≥ 1.0	5:1	≥ 0.03	≤ 0.10	≥ 125	≥ 10
2.B	≥ 1.0	3:1	≥ 0.30	≤ 0.10	≥ 125	≥ 10
2.C	≥ 1.5	3:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 60	≥ 20
2.D	≥ 1.75	2:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 75	≥ 40
3.A	≥ 2.0	2:1	≥ 0.20 - ≤ 0.40	≤ 0.05	≥ 100	≥ 40
3.B	≥ 2.0	1.5:1	≥ 0.25 - ≤ 0.50	≤ 0.05	≥ 100	≥ 40
4.A	≥ 2.25	1:1	≥ 0.20 - ≤ 0.40	≤ 0.05	≥ 100	≥ 40
4.B	≥ 2.25	1:1	≥ 0.25 - ≤ 0.50	≤ 0.05	≥ 100	≥ 40

[1] C Factor and permissible shear stress for Types 1.A and 2.A mulch control netting must be obtained with netting used in conjunction with pre-applied mulch material.
[2] Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (≥ 0.5 in soil loss) during a 30 minute flow event in large-scale performance testing, ASTM D 6460 or equivalent test acceptable to the Engineer.
[3] This value represents the maximum gradient on which the product should be utilized for rainfall/slope application.
[4] Maximum C Factor from standardized large-scale rainfall performance testing, ASTM D 6459 or equivalent test acceptable to the Engineer.
[5] Machine direction and transverse direction (cross-machine direction).

C. RECP Anchors: Stakes or staples as recommended by manufacturer, with a minimum length of 6 inches.

2.07 WATTLES

A. Netting: Open weave, degradable netting. Nominal diameter of 9 inches, or as specified.

B. Fill Material: Straw, wood excelsior, coir, or other natural materials approved by the Engineer.

C. Stakes: 1 inch by 1 inch (minimum) wooden stakes, or stakes of equivalent strength.

2.08 CHECK DAMS (DITCH CHECK)

A. Synthetic Permeable Check Dam (HDPE):

1. Ditch Berm:
a. Installed height of 9 to10 inches.
b. Manufactured check dam constructed from sheets of perforated, UV-stabilized HDPE.
c. Perforations of 30 to 40% open area.

2. RECP for Permeable Check Dam (when specified): RECP Type 4, 4 feet wide.

3. Anchors: As recommended by the manufacturer.

B. Triangular Foam Check Dam: Triangular-shaped device with a height of 8 to 10 inches and a base of 16 to 20 inches.

1. Inner Support Material: Urethane foam.

2. Outer Cover: Woven geotextile material shaped to fit around the inner support material, extending 2 to 3 feet beyond the bottom edge of the triangular-shaped inner support.

3. RECP for Triangular Foam Check Dam: RECP Type 4, 4 feet wide.

C. Rock Check Dam:

1. Aggregate: Erosion stone complying with Iowa DOT Article 4130.04.

2. Engineering Fabric: Comply with Section 9040, 2.22.

D. Fiber Log: Provide filter sock complying with 9040, 2.05 or wattle complying with 9040, 2.07.

E. RECP Blanket Pillow Check: Utilize standard RECP specified for ditch or swale lining to form RECP blanket pillow check.

F. Rock/Sand Bags:

1. Bags:
a. Woven polypropylene fabric sewn together with double stitching.
b. Overall size of at least 14 inches by 26 inches.
c. Minimum grab strength of 90 pounds per ASTM D 4632.
d. UV stability of 70% per ASTM D4355

2. Aggregate: Clean 1 inch nominal crushed stone or gravel.

2.09 LEVEL SPREADERS

A. Provide 2 inch by 8 inch (minimum) pressure-treated timber of the length specified.

B. Use timbers that are relatively straight and have a minimum length of 5 feet each.

2.10 RIP RAP

A. Class A Revetment: Comply with Iowa DOT Section 4130.

B. Class B Revetment: Comply with Iowa DOT Section 4130.

C. Class D and E Revetment: Comply with Iowa DOT Section 4130.

D. Erosion Stone: Comply with Iowa DOT Section 4130.

2.11 TEMPORARY PIPE SLOPE DRAINS

A. PVC, HDPE, and metal pipes as specified in Section 4020, 2.01.

B. HDPE, Type C (corrugated interior).

C. All pipes listed are allowed for use within the right-of-way.

2.12 TEMPORARY SEDIMENT BASIN OUTLET STRUCTURES

A. Base: Class C concrete unless otherwise specified in the contract documents.

B. Riser: CMP complying with Section 4020; diameter as specified in the contract documents.

C. Dewatering Device:

1. Drill holes in the riser of the number, diameter, and at the elevation specified in the contract documents.

2. 1/4 inch by 1/4 inch or 1/2 inch by 1/2 inch wire mesh for hardware cloth.

D. Barrel: CMP complying with Section 4020; diameter as specified in the contract documents.

E. Anti-Vortex Device: CMP complying with Section 4020; diameter according to Figure 9040.116 and riser diameter as specified in the contract documents.

F. Anti-Seep Collar:

1. Manufactured anti-seep collar constructed of Corrugated metal, HDPE, or gum rubber.

2. Size according to manufacturer's recommendations. Ensure overall collar width and height is at least 3 feet larger than outlet pipe's nominal diameter.

G. Sediment Baffle: Provide silt fence complying with Section 9040, 2.14.

2.13 SEDIMENT TRAPS

A. Erosion Stone: Comply with Section 9040, 2.10.

B. Engineering Fabric: Comply with Section 9040, 2.22.

2.14 SILT FENCE

A. Fabric: Comply with Iowa DOT Article 4196.01.

B. Posts: 4 foot minimum steel (T-section) weighing at least 1.25 pounds per foot, exclusive of anchor plate. Painted posts are not required.

C. Fastener: Wire or plastic ties with a minimum tensile strength of 50 pounds.

2.15 STABILIZED CONSTRUCTION EXIT

A. Stone Exit: Comply with Iowa DOT Section 4122, Gradation 13, Macadam crushed stone.

B. Subgrade Stabilization Material: Use woven, UV-stabilized geotextile with a minimum tensile strength of 135 lb/ft.

C. Manufactured Track-out Pad:

1. Must be approved by the Engineer.
2. Provide a manufactured device intended to reduce track-out of sediment by flexing and vibrating tires as vehicles pass across the surface.
3. Capable of supporting anticipated construction vehicle and equipment loads per manufacturer's recommendations.

2.16 DUST CONTROL

A. Water: Use potable water or water from a source approved by the engineer.

B. Calcium Chloride: Comply with Iowa DOT Article 4194.01.

C. Lignosulfonate (Tree Sap): Use a commercially-available product with known lignin content.

D. Soapstock (Soybean Oil):

1. Use a commercially-available, undiluted, soybean oil soapstock emulsion.
2. Comply with manufacturer's recommendations for storage, transportation, temperature, and application equipment requirements.

2.17 EROSION CONTROL MULCH

A. Conventional Mulch:

1. Use dry cereal straw (oats, wheat, barley, or rye) or native grass straw.
2. Use material that is free of noxious weeds, seed-bearing stalks, or roots, and will be inspected and approved by the Engineer prior to use.
3. Other materials, subject to the approval of the Engineer, may be used.

2.17 EROSION CONTROL MULCH (Continued)

B. Hydromulch:

1. **Wood Cellulose Mulch:** Comply with Section 9010, 2.07.
2. **Bonded Fiber Matrix (BFM):** Comply with Section 9010, 2.07.
3. **Mechanically Bonded Fiber Matrix (MBFM):** See Section 9010, 2.07.

2.18 TURF REINFORCEMENT MATS (TRM)

A. Material Classification:

1. **Type 5.A, 5.B, 5.C, 5.D, and 5.E Turf Reinforcement Mat:** Composed of UV-stabilized non-degradable synthetic fibers, filaments, nets, wire mesh and/or other elements processed into a permanent, three dimensional matrix that may be supplemented with degradable components.
2. **Type 5.F High Performance Turf Reinforcement Mat:** A product composed of UV-stabilized, non-degradable, synthetic fibers, filaments, nets, wire mesh and/or other elements, processed into a permanent, three dimensional matrix.

B. Properties and Performance: Meet the minimum material and performance requirements contained in the following table:

Table 9040.03: Turf Reinforcement Mats

Property		Test Method	Type					
			5.A	5.B	5.C	5.D	5.E	5.F
Material	Tensile Strength (MD)	ASTM D 6818	≥ 150 lbs/ft^2	≥ 175 lbs/ft^2	≥ 200 lbs/ft^2	≥ 325 lbs/ft^2	≥ 1,500 lbs/ft^2	≥ 3,000 lbs/ft^2
	Tensile Strength (TD)	ASTM D 6818	≥ 150 lbs/ft^2	≥ 175 lbs/ft^2	≥ 200 lbs/ft^2	≥ 225 lbs/ft^2	≥ 1,500 lbs/ft^2	≥ 3,000 lbs/ft^2
	Material Mass / Unit Area	ASTM D 6566	≥ 8.0 oz./yd^2	≥ 8.0 oz./yd^2	≥ 8.0 oz./yd^2	≥ 8.0 oz./yd^2	≥ 8.0 oz./yd^2	≥ 8.0 oz./yd^2
	Thickness	ASTM D 6525	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in
	UV Stability	ASTM D 4355	80% @ 500 hrs	80% @ 500 hrs	80% @ 1,000 hrs	80% @ 1,000 hrs	90% @ 1,000 hrs	80% @ 3,000 hrs
Performance	Slope Application Max. Gradient (H:V)	N/A	1:1	1:1	0.5:1	0.5:1	0.5:1	0.5:1
	Unvegetated Shear Stress[4]	ASTM D 6460	≥ 2.0 lb/ft^2	≥ 2.0 lb/ft^2	≥ 2.0 lb/ft^2	≥ 2.0 lb/ft^2	≥ 2.0 lb/ft^2	≥ 2.0 lb/ft^2
	Vegetated Shear Stress	ASTM D 6460	≥ 6.0 lb/ft^2	≥ 8.0 lb/ft^2	≥ 10.0 lb/ft^2	≥ 12.0 lb/ft^2	≥ 12.0 lb/ft^2	≥ 14.0 lb/ft^2
	Seedling Emergence	ASTM D 7322	≥ 250%	≥ 250%	≥ 250%	≥ 250%	≥ 250%	≥ 250%

Refer to the ECTC Specifications for details of testing requirements and assumptions.

2.19 INLET PROTECTION

A. Drop-in Intake Protection:

1. Use a manufactured device that is inserted into the intake and is capable of trapping or filtering sediment from runoff prior to entering the storm sewer.

2. All components must be contained entirely below the surface of the intake grate.

3. Incorporate means of emergency outflow to prevent flooding if plugged with sediment.

B. Surface-applied Intake Protection:

1. Use devices or filter socks, placed around or over the intake, that are capable of trapping or filtering sediment from runoff prior to entering the storm sewer.

2. Do not allow the device to completely block or plug the intake, preventing inflow.

2.20 FLOW TRANSITION MATS

Comply with the following and Iowa DOT Materials I.M. 469.10.

A. Mat: Constructed of 85% minimum UV resistant material with a maximum ground cover of 80%. Meet the requirements of Table 9040.04.

Table 9040.04: Flow Transition Mats

Property	Test Method	Value
Mass/Unit Area (max.)	ASTM D 6566	3 lbs/SF
Minimum Thickness	ASTM D 6525	0.4 inch
Maximum Thickness	ASTM D 6525	1 inch
Wide Width Tensile Strength	ASTM D 6818	2,500 lbs/ft
Minimum Percent Open Area	ASTM D 6567 Calculated	20%
UV Stability	ASTM D 4355	85%
Manning's n	Calculated	0.039

B. Anchoring Devices:

1. Furnish bullet tip style anchors made of a metal alloy attached to a wire rope.

2. Anchors capable of withstanding a minimum 300 pounds (136 kg) of pull out resistance in cohesive soils.

3. Wire rope a minimum of 30 inches (762 mm) in length with a minimum breaking strength of at least 300 pounds (136 kg).

4. The top washer a minimum of 3 inches (76 mm) in diameter and constructed of a UV resistant plastic.

5. Each anchor equipped to allow the retightening of the anchor when deemed necessary by the Engineer.

2.21 Grid Tied Concrete Block Mat

Grid tied concrete block mat is manufactured from individual concrete blocks that are cast integrally with a geogrid to form an erosion control mat. The resulting mat is supplied and transported in a rolled form.

A. Blocks:

1. Manufacture blocks with concrete complying with the cement requirements of ASTM C 150 and the aggregate requirements of ASTM C 33.

2. Minimum compressive strength of 5,000 psi at 28 days.

3. Furnish blocks that have a minimum weight of 3 pounds per block. Do not allow completed mat weight to exceed 10 pounds per square foot.

4. Ensure blocks have a flat-top pyramid shape with a nominal base of 6.5 inches by 6.5 inches and a height between 2.25 and 2.5 inches.

5. Place blocks no further than 1.5 inches apart.

6. Ensure missing concrete due to chipping or cracking does not exceed 15% of the average concrete unit weight.

B. Grid:

1. Open-knitted fabric composed of high tenacity, multifilament polypropylene yarns knitted and coated tension to form a stable grid structure. Comply with the material requirements of Table 9040.05.

2. Embed the grid within the base of each of the concrete blocks.

3. When mats will be installed adjacent to each other:
   a. Extend the geogrid 12 inches beyond one long edge of the mat to allow for overlap with the adjacent mat.
   b. Extend the geogrid 12 inches beyond one end of the roll to allow for overlap with an abutting mat.

Table 9040.05: Grid Tied Concrete Block Mat Grid Properties

Property[1]	Test Method	Value
Aperture Size	Measured Length	1.4 to 1.9 inches
Ultimate Tensile Strength	ASTM D 6637	2,055 lb/ft
Elongation at Break	ASTM D 6637	6% (max.)
Tensile Strength @ 2%	ASTM D 6637	822 lb/ft (min.)
Tensile Strength @ 5%	ASTM D 6637	1,640 lb/ft (min.)
Tensile Modulus @ 2%	ASTM D 6637	41,000 lb/ft (min.)
Tensile Modulus @5%	ASTM D 6637	32,800 lb/ft (min.)

[1] All values apply to both the machine direction and cross machine direction.

2.21 Grid Tied Concrete Block Mat (Continued)

C. Underlayment Materials:

1. Use a Type 2D or 3B RECP base layer composed of curled wood excelsior.

2. If required by the manufacturer, provide five-pick leno weave polypropylene netting top layer to add strength and support to the underlying RECP.

3. Depending on the site conditions, additional or alternative underlayment materials may be specified in the contract documents.

4. The underlayments may be attached to the GTCBM during manufacture.

5. When GTCBM will be installed adjacent to each other:
   a. Extend the RECP underlayment 6 inches beyond one long edge of the mat to allow for overlap with the adjacent mat.
   b. Extend the RECP underlayment 6 inches beyond one end of the roll to allow for overlap with an abutting mat.

D. Anchors and Ties:

1. U-Anchors: Provide No. 3 deformed bars shaped in a “U” with 18 inch long legs.

2. Ties: Provide 20 inch long, type 304 stainless steel zip ties with a minimum tensile strength of 250 pounds.

E. Performance: Comply with the minimum requirements of Table 9040.07 when tested with a backing material on a non-vegetated surface. Verify performance with full-scale laboratory testing performed by an independent third-party testing facility.

Table 9040.07: Grid Tied Concrete Block Mat Performance

Property	Test Method	Bed Slope	Value
Shear Stress	ASTM D 6460	10% & 20%	18 lb/ft^2
Velocity	ASTM D 6460	10% & 20%	30 ft/sec

2.22 ENGINEERING FABRIC

Comply with Iowa DOT Article 4196.01, B, 3.

PART 3 - EXECUTION

3.01 SWPPP PREPARATION

A. Prepare a SWPPP according to the requirements of the Iowa DNR NPDES General Permit No. 2.

B. Ensure that controls utilized in the SWPPP conform to the type and quantity of erosion and sediment controls specified in the contract documents.

C. Submit the completed SWPPP to the Engineer for review and approval prior to filing the Notice of Intent.

D. Upon approval of the Engineer, file public notices, as required by the NPDES General Permit No. 2.

E. File the Notice of Intent and fee, as required by the NPDES General Permit No. 2.

3.02 SWPPP MANAGEMENT

Coordinate and carry out all requirements of Iowa DNR NPDES General Permit No. 2 and any local ordinance requirements, including:

A. Update the SWPPP according to the requirements of the NPDES General Permit No. 2.

B. Revise the SWPPP and implement changes, as necessary, to prevent sediment or hazardous materials from being transported off the site.

C. Submit all SWPPP revisions to the Engineer for review and approval.

D. Perform and maintain records of weekly erosion and sediment control site inspections, unless otherwise specified in the contract documents.

E. Maintain records of transfer of responsibility under the NPDES General Permit No. 2.

F. Retain all records on-site, or as required by the NPDES General Permit No. 2.

G. After final stabilization, file a Notice of Discontinuation, according to the NPDES General Permit No. 2.

H. Provide all records and documentation to the Engineer upon completion of the project. Retain a copy of all records for the period required under the Permit.

I. Continue to perform the work required under this item throughout the duration of the project, and until final stabilization is achieved and a Notice of Discontinuation is filed.

3.03 EROSION AND SEDIMENT CONTROL INSPECTION

A. Perform inspections according to and at frequency required by the Iowa DNR NPDES General Permit No. 2.

B. Schedule necessary maintenance or improvements for items included in the contract documents.

C. Notify the Engineer immediately of situations requiring attention beyond that provided for in the contract documents.

D. Provide copies of the inspection reports to the Engineer.

3.04 EQUIPMENT

Comply with Iowa DOT Article 2601.03.

3.05 COMPOST BLANKETS (Figure 9040.101)

A. Loosen the ground surface to a minimum depth of 1 inch.

B. Evenly spread compost, as specified in the contract documents, or as directed by the Engineer.

C. Divert concentrated flows away from the slope.

D. Do not operate heavy equipment over the compost blanket after placement, or throughout the required period of protection.

E. Inspect the ground under the blanket at regular intervals for signs of erosion.

3.06 FILTER BERMS (Figure 9040.102)

A. Install filter berm along the contour of the slope and perpendicular to sheet flow as specified in the contract documents, or as directed by the Engineer.

B. Turn the beginning and ends of the filter berm installation uphill to create a “J” shape at each end to prevent runoff from flowing around the end of the berm.

C. For slopes that receive runoff from above, place a filter berm at the top of the slope to control the velocity and spread flow.

D. Ditch Checks:

1. When filter berms are allowed for ditch checks, extend the berm up the side slopes of the ditch to prevent flow from bypassing around the edges of the berm.

2. Ensure the bottom of the berm on the slope is higher in elevation than the top of the berm in the middle of the ditch.

3. Construct standard filter berm with a base of 5 to 7 feet and minimum height of 24 inches.

4. Construct compact filter berm with a base of 3 to 5 feet and minimum height of 18 inches.

E. Replace the berm when sediment accumulation reaches one-half of the height of the berm.

3.07 FILTER SOCKS (Figure 9040.102)

A. Installation:

1. Fill mesh filter sock with filler material to the size and length specified in the contract documents.

2. Place the filter sock along the contour as specified in the contract documents, or as directed by the Engineer.

3. Construct a “J-hook” at each end of a continuous run of filter sock, by turning the end of the sock uphill, as necessary to prevent runoff from flowing around the ends when water behind the sock ponds up to a level even with the top of the sock.

3.07 FILTER SOCKS (Continued)

4. Drive stakes into the ground at a maximum spacing of 10 feet, and as required to secure the sock and prevent movement.

5. Repair or replace non-functioning filter socks that allow water to flow under the sock, are torn, or are otherwise damaged, due to inadequate installation.

6. Remove filter material from damaged socks that are located along streambanks, around intakes, in ditches, or in other locations where the material may be carried to surface waters.

B. Removal: When specified in the contract documents, or as directed by the Engineer; remove the filter sock upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

1. Upon completion of the project, completely remove socks and filter material that are located along streambanks, around intakes, in ditches, or in other locations where the filter material may be carried to surface waters if the sock degrades and/or tears.

2. Slice the sock longitudinally. Remove and dispose of the filter sock material and stakes.

3. Spread the filter material and accumulated sediment to match finished grade and to ensure proper drainage.

4. If the site has been brought to finished grade and prepared for permanent seeding, spread and incorporate the filter material into the surface by tilling, or as required to break up any large particles and provide a finished surface suitable for permanent seeding.

C. Replacement:

1. When accumulated sediment reaches a level one-half the height of the sock, or when the sock becomes clogged with sediment and no longer allows runoff to flow through, remove the sock as described above, and replace according to the installation instructions above.

2. At the Engineer's option, the existing filter sock and accumulated sediment may be left in place, and a new filter sock installed up-slope from the existing filter sock.

3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Figures 9040.103 and 9040.104)

Install temporary RECPs according to the manufacturer's published installation recommendations, subject to the following minimum requirements:

A. Anchor Trenches, Seams, and Terminal Ends:

1. Upslope Anchor Trenches:
a. Excavate a 6 inch by 6 inch trench along the top of the slope.
b. Extend the upslope terminal end of the RECP 3 feet past the anchor trench.
c. Use staples at 1 foot centers to fasten the RECP to the bottom of the trench.
d. Backfill and compact the trench.
e. Apply seed and fertilizer to the trench surface if seeding is specified.
f. Fold top end of RECP over compacted trench and secure upslope terminal end with a single row of staples on 1 foot centers.

2. Adjacent Seams:
a. Overlap edges of adjacent RECPs by 2 to 4 inches.
b. Install a sufficient number of staples to prevent seam or abutted rolls from separating.

3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)

3. Consecutive Rolls (End Lap):
a. Shingle and overlap consecutive rolls 2 to 6 inches in the direction of flow.
b. Secure staples through seam at 1 foot intervals.

4. Intermediate Anchor Trench:
a. Excavate a 6 inch by 6 inch trench.
b. Use staples at 1 foot centers to fasten the RECP to the bottom of the trench.
c. Fold the RECP over upslope material and backfill and compact the trench.
d. Apply seed and fertilizer to the trench surface if seeding is specified.
f. Continue rolling material downslope over the trench.

5. Staple Check: Install two rows of staggered stakes or staples 4 inches on center and 4 inches apart.

6. RECP Blanket Check:
a. For use in conjunction with an RECP blanket lined channel.
b. During RECP blanket installation, gather a 4 foot section of the blanket.
c. Fold the blanket back upon itself, with the overlap pointing in the downhill direction, shingle style, to form a shallow, 2 foot long, check dam.
d. Secure blanket check with long staples or wood stakes spaced at 12 inch intervals.

7. Terminal End Anchor Trench:
a. Excavate a 6-inch by 6-inch trench.
b. Extend the terminal end of the RECP 3 feet past the anchor trench.
c. Use staples at 1-foot centers to fasten the RECP to the bottom of the trench.
d. Backfill and compact the trench.
e. Apply seed and fertilizer to the trench surface if seeding is specified.
f. Fold the remaining end of the RECP over the compacted trench and secure the terminal end of the RECP with staples on 1 foot centers.

B. Slope Application:

1. Grade and smooth surface. Remove all rocks, clods, vegetation, or other obstructions that will prevent direct contact between the RECP and the soil surface.

2. When specified, prepare seedbed and place seed and fertilizer according to Section 9010 prior to placing RECP.

3. Install anchor trench at top of slope.

4. Unroll the RECP down or horizontally across the slope.

5. Securely fasten RECP to the soil with staples according to the density and pattern recommended by the manufacturer with a minimum rate of 1.3 staples per square yard within the body of the blanket.

6. Place consecutive blankets down the slope end-over-end, shingle style.

7. Overlap ends of consecutive rolls and secure with staples.

8. Overlap edges of adjacent rolls and secure with staples.

9. Anchor the terminal end of the RECP with an anchor trench or staple check slot.

3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)

C. Channel/Ditch Application:

1. When specified, prepare seedbed and place seed and fertilizer according to Section 9010, prior to placing RECP.
2. Construct an anchor trench at the beginning of the channel across its entire width.
3. Position adjacent rolls in the anchor slot and overlap.
4. Unroll RECP downstream.
5. Follow the manufacturer's recommendations for the installation of intermediate anchor trenches or staple checks at intervals along the channel.
6. Construct consecutive roll lap at end of roll and beginning of new roll.
7. Terminate installation at downstream end with an anchor trench or staple check.
8. Install anchors in a regular pattern over entire area covered according to manufacturer's published recommendations (minimum 1.7 anchors per square yard). Significantly higher anchor rates and longer staples may be necessary in sandy, loose, or wet soils and in severe applications.

3.09 WATTLES (Figure 9040.105)

A. Installation:

1. Construct a shallow trench, 2 to 4 inches deep, matching the width and contour of the wattle.
2. Install wattle along contour of slope.
3. Turn ends of wattle uphill to prevent water from flowing around ends.
4. Place and compact excavated soil against the wattle, on the uphill side.
5. Drive stakes through the center of the wattle, into the ground at a maximum spacing of 4 feet along the length of the wattle, and as needed to secure the wattle and prevent movement.
6. Abut ends of adjacent wattles tightly. Wrap joint with a 36 inch wide section of silt fence and secure with stakes.

B. Removal: When specified in the contract documents, or as directed by the Engineer, remove the wattle upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

1. Completely remove the wattle netting, filler material, and stakes.
2. Spread the accumulated sediment to match finished grade and to ensure proper drainage.
3. When allowed by the Engineer, the wattle netting may be sliced open and the filler material spread out over the ground. Removal of netting and stakes and spreading of sediment is still required.

3.09 WATTLES (Continued)

C. Replacement:

1. When accumulated sediment reaches a level one-half the height of the wattle, or when the wattle becomes clogged with sediment and no longer allows runoff to flow through, remove the wattle as described above, and replace according to the installation instructions above.

2. At the Engineer's option, the existing wattle and accumulated sediment may be left in place, and a new wattle installed up-slope from the existing wattle.

3.10 CHECK DAMS (Figure 9040.106)

A. Synthetic Permeable Check Dam (HDPE):

1. Install according to the manufacturer's recommendations.

2. When specified in the contract documents, provide an RECP under the check dam, installed according to the manufacturer's recommendations.

B. Triangular Foam Check Dam:

1. Install according to the manufacturer's recommendations.

2. When specified in the contract documents, provide an RECP under the check dam, installed according to the manufacturer's recommendations.

C. Rock Check Dam: Construct according to Figure 9040.107.

D. Fiber Log:

1. When specified in the contract documents, install fiber log check dam over RECP blanket.

2. Install fiber log across ditch or swale perpendicular to flow in a crescent shape with the ends facing upstream.

3. Install fiber log so the center section is one log diameter lower than the ends.

4. Space stakes at 1 foot intervals. Place two stakes at a 45 degree angle to the surface in a crisscross pattern with the fiber log in-between.

F. Rock/Sand Bag:

1. Fill bags only three-fourths full of rock to reduce gaps in the check dam.

2. Stack bags forming a check dam with a height of 1.5 to 2 feet and side slopes 2:1.

3. Tightly abut and overlap rock bags to prevent flow between bag joints.

4. Extend bags up the side slopes of the ditch to prevent flow from bypassing around the edges of the check dam.

3.10 CHECK DAMS (Continued)

G. Removal: When specified in the contract documents, or as directed by the Engineer, remove check dams upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

1. Remove the check dam and dispose of materials, or salvage to the contractor.

2. Remove the accumulated sediment or spread to match finished grade; ensure proper drainage.

3. Stabilize the area disturbed by removal operations.

3.11 TEMPORARY EARTH DIVERSION BERMS (Figure 9040.108)

A. Ensure positive drainage along the diversion toward the outlet area.

B. Adequately compact fill to prevent failures or seepage.

C. Outlet the diversion to undisturbed and/or stabilized areas only.

D. Stabilize the surface of the earth diversion with temporary erosion control seeding, as specified in Section 9010.

3.12 LEVEL SPREADERS (Figure 9040.109)

A. Butt multiple timbers together, as necessary to provide the required length.

B. Ensure the spreader is installed level in all directions. Adjust as necessary during construction to maintain spreader in a level condition.

C. Excavate a depression behind the spreader to the depth specified in the contract documents. The depression may be over-excavated up to 1 foot to provide an area for sediment accumulation.

D. Grade as required to prevent flow around the ends of spreader.

E. Remove the accumulated sediment from the depression when the depth is reduced below that specified in the contract documents.

3.13 RIP RAP (Figures 9040.110 and 9040.111)

Install rip rap (revetment stone or erosion stone) as shown on Figures 9040.110 and 9040.111.

3.14 TEMPORARY PIPE SLOPE DRAINS (Figure 9040.112)

A. Place slope drain on undisturbed soil or well compacted fill.

B. Carefully compact cohesive soils around inlet ends of the drain in 6 inch lifts.

C. Discharge slope drain to a stable outlet or to a sediment retention device.

3.15 TEMPORARY SEDIMENT BASIN (Figures 9040.113 and 9040.114)

A. Basin Construction:

1. Construct the storage area to the size and elevations specified in the contract documents.

2. Stabilize the side slopes and internal surfaces of the temporary sediment basin.

3. When specified in the contract documents, install internal baffles to enhance sediment capture. Refer to Figure 9040.117.

B. Outlet Structure:

1. **Concrete Base:** Construct the concrete base and anchor riser section, as shown on Figure 9040.115.

2. **Dewatering Device**:
   a. Drill holes in the riser section. The number, diameter, and configuration will be specified in the contract documents.
   b. Wrap the perforated section of the riser pipe with metal hardware cloth.

3. **Anti-vortex Device:** If required by the contract documents, firmly attach the cylinder to the top of the riser by welding or other means. Comply with Figure 9040.116.

C. Anti-Seep Collar:

1. Provide anti-seep collars at locations shown in the contract documents.

2. Install according to the collar manufacturer's recommendations.

3. Place backfill material and compact over-excavation areas to a minimum of 95% Standard Proctor Density per Section 3010.

3.16 SEDIMENT TRAPS (Figure 9040.118)

A. Construct the storage area to the size and elevations specified in the contract documents.

B. Stabilize the side slopes and internal surfaces of the sediment trap.

C. When specified in the contract documents, install internal baffles to enhance sediment capture. Refer to Figure 9040.117.

3.17 SILT FENCES (Figure 9040.119)

A. Installation:

1. Install material along the contour of the ground, as specified in the contract documents, or as directed by the Engineer.

2. Install silt fence with a mechanical soil slicing machine that creates a slit in the ground while simultaneously installing the fabric. The trenching method may be used when situations will not allow soil slicing, as determined by the Engineer.

3. Construct a "J-hook" at each end of a continuous run of silt fence, by turning the end of the silt fence uphill, as necessary to prevent runoff from flowing around ends when water behind the fence ponds to a level even with the top of the fence.

3.17 SILT FENCES (Continued)

4. Insert 12 inches of fabric to a minimum depth of 6 inches (fabric may be folded below the ground line).

5. Compact installation by driving along each side of the silt fence, or by other means, as necessary to adequately secure the fabric in the ground, to prevent pullout and water flow under the fence.

6. Drive steel posts into the ground alongside the silt fence, to a minimum depth of 20 inches, unless otherwise specified by the Engineer. Space posts as shown on Figure 9040.119 or as required to adequately support silt fence.

B. Maintenance: Repair or replace non-functioning silt fence that allows water to flow under the fence, is torn, or is otherwise damaged, due to inadequate installation, at no additional cost to the Contracting Authority.

C. Removal:

1. Remove the silt fence upon final stabilization of the project area, or according to the staging indicated in the SWPPP.

2. Remove and dispose of silt fence and posts.

3. Remove sediment or spread to match finished grade; ensure proper drainage.

4. Stabilize the area disturbed by removal operations.

D. Replacement:

1. When accumulated sediment reaches a level one-half the height of the fence, remove the silt fence as described above, and replace according to the installation instructions above.

2. At the Engineer's option, the existing silt fence and accumulated sediment may be left in place, and a new silt fence installed up-slope from the existing silt fence.

3. When allowed by the Engineer, the existing silt fence may be left in place and the accumulated sediment removed to the original ground line and within 6 inches of the silt fence. Carefully inspect the existing silt fence for structural integrity and signs of undermining. Make any necessary repairs.

3.18 STABILIZED CONSTRUCTION EXIT (Figure 9040.120)

A. Install a stabilized construction exit at all locations where construction traffic leaving the site presents the potential for sediment track-out.

B. Remove vegetation and excavate soft soils from entrance area. Thoroughly compact subgrade prior to placing stone or manufactured pad.

C. Install culvert under entrance if necessary to maintain drainage.

D. Grade entrance to prevent runoff from flowing onto street. Direct all runoff from entrance to a sediment retention device.

E. When specified, install subgrade stabilization fabric prior to placing crushed stone or manufactured track-out pad.

3.18 STABILIZED CONSTRUCTION EXIT (Continued)

F. For stone track-out control, install a layer of crushed stone to the thickness (6 inches minimum) and dimensions specified in the contract documents.

G. For manufactured track-out pad, install according to manufacturer's recommendations and Figure 9040.120. If soil conditions are poor, provide aggregate base, geotextile, or geogrid as recommended by the manufacturer.

H. Remove the accumulated sediment and install new stone or clean manufactured device, as required to prevent track-out.

3.19 DUST CONTROL

A. Water: Apply frequent light watering to ground surface, as required to control dust.

B. Calcium Chloride: Apply according to Iowa DOT Section 2314.

C. Lignosulfonate (Tree Sap):

1. Loosen the top 1 to 2 inches of the roadway surface.
2. Apply solution with a 50% residual concentration, at a rate of 0.50 gal/yd^2, to deliver a 25% residual. For diluted solutions, increase the application rate, as required, to deliver an equivalent 25% residual.
3. Allow product to penetrate through the loosened material.
4. Tight-blade road surface.

D. Soapstock (Soybean Oil):

1. Loosen the top 1 to 2 inches of the roadway surface.
2. Apply undiluted soapstock at a rate of 0.70 gal/yd^2.
3. Allow product to penetrate through the loosened material.
4. Tight-blade road surface.

3.20 EROSION CONTROL MULCHING

A. Conventional Mulching:

1. Use conventional mulching when the surface cannot be stabilized by seeding, due to season or ground conditions.
2. Uniformly distribute mulch over the required areas, at a rate of 2 tons/acre for dry cereal straw, or 2.5 tons/acre for prairie hay.
3. Work the mulch into the soil with a mulch tucker, designed to anchor the mulch into the soil, by means of dull blades or disks.

3.20 EROSION CONTROL MULCHING (Continued)

B. Hydromulching:

1. Place mulch and tackifier (if applicable) in equipment specifically manufactured for hydraulic mulching.

2. Mix materials with fresh, potable water using a combination of re-circulation through the equipment's pump and mechanical agitation to form a homogeneous slurry.

3. If necessary, dampen any dry, dusty soil as required to prevent balling of the material during application.

4. Apply hydromulch in multiple layers from opposing directions, where possible.

5. Apply the slurry evenly over all specified areas, at the minimum component material rates specified:
   a. Wood Cellulose Mulch:
      1) Mulch: Minimum 3,000 lb/acre dry weight.
      2) Tackifier: Minimum 50 lb/acre.
   b. Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
   c. Mechanically Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.

6. Retain and count empty bags of mulch to ensure final application rate.

3.21 TURF REINFORCEMENT MATS

Install according to the manufacturer's published installation literature for the product specified and application (slope or channel).

3.22 INLET PROTECTION

A. Install inlet protection devices according to the manufacturer's recommendations.

B. Remove the accumulated sediment, as required to maintain the inlet protection device in working order. Remove any accumulated sediment from streets open to traffic if it encroaches into the traveled roadway.

3.23 FLOW TRANSITION MATS

Install according to the manufacturer's published recommendations.

3.24 GRID TIED CONCRETE BLOCK MAT

Install according to the GTCBM supplier's recommendations, details, and the following:

A. Installation Practices:

1. **Standard Anchor Trench:** Excavate an 18 inch deep vertical trench. Bury 18 inches, or three blocks, of the mat in the trench, backfill, and compact.

2. **Edge Trench:** Excavate a 12 inch trench at a 45 degree angle to the surface. Bury 12 inches, or two blocks, of the mat in the trench, backfill, and compact.

3.24 GRID TIED CONCRETE BLOCK MAT (Continued)

3. Leading and Ending Anchor Trench:
a. Excavate an 18 inch deep vertical trench. Bury 18 inches, or three blocks, of the mat in the trench, backfill, and compact.
b. Install U-anchors at 2 foot increments perpendicular to flow directly behind the first exposed block.

4. Seams: Supply GTCBM in lengths and widths that minimize seams to the extent possible. Where required, construct seams as follows:
a. Standard Seams: Seams in channels parallel with the direction of flow and all seams on slopes that are not exposed to concentrated flow:
1) Extend geogrid 12 inches and RECP 6 inches under the adjacent mat.
2) Secure seam with U-anchors at 2 foot increments directly behind the first row of blocks on the adjacent mat. Alternatively, secure adjacent mats with zip ties at 1 foot intervals. Encompass at least 3 cords of each mat with zip ties.
b. Overlap Seams: Where seams are perpendicular to flow in a channel:
1) Install upstream mat and flip trailing edge back 24 inches.
2) Excavate 2.25 inches of soil 18 inches from the trailing end of the upstream mat.
3) Place the leading edge of the downstream mat into the shallow trench. Backfill and tamp soil into the mat filling voids between blocks. Place seed over the soil.
4) Flip the end of the upstream mat over the soil-covered and seeded area.
5) Secure overlap with U-anchors at 2 foot increments directly behind the first block of the up-channel mat. Alternatively, secure overlap with zip ties at 1 foot intervals. Encompass at least 3 cords of each mat with zip ties.

5. Concrete GTCBM Trench: Where GTCBM is installed at a culvert or storm pipe outlet, construct a concrete GTCBM trench to secure the end of the mat and prevent undermining of the outlet.
a. Excavate an 18 inch wide by 18 inch deep trench at the end of the pipe apron.
b. Install 36 inches of GTCBM in trench with 18 inches flat along the bottom of the trench and 18 inches extending vertically up the wall of the trench to the top of the surface of the channel.
c. Backfill channel with Class C concrete.
d. If a concrete footing is specified for the apron, and a cast-in-place footing is provided, the concrete GTCBM trench may be combined with the footing by extending 36 inches of GTCBM into the footing in lieu of constructing a separate trench.

B. General Site Preparation:

1. Complete final grading and restore topsoil if previously stripped.

2. Ensure ground surface is smooth and free of rocks, clods, roots, or debris.

3. Perform seedbed preparation and apply seed according to Section 9010 prior to placement of the GTCBM.

C. Slopes:

1. Construct an anchor trench at the top and bottom of the slope.

2. Begin the installation at the top of the slope.

3. Unroll GTCBM down the slope to the bottom anchor trench.

3.24 GRID TIED CONCRETE BLOCK MAT (Continued)

4. If slope length exceeds the allowable length of GTCBM roll, install subsequent mats end to end with a standard seam.

5. Install adjacent rolls and splice with a standard seam.

D. Channels:

1. GTCBM Perpendicular to Flow:
a. Place mats continuously across the width of the channel, including side slopes, without any seams parallel to the direction of flow.
b. Begin installation downstream and move up the channel.
c. Place the first mat across the channel.
d. Install an ending anchor trench at the terminal end of the downstream mat.
e. Install subsequent mats upstream, splicing each abutting mat with a standard seam.
f. Construct a leading anchor trench at the upstream end of the installation or a concrete GTCBM trench if specified.

2. GTCBM Parallel to Flow:
a. Begin at the upstream end of the installation, utilizing multiple mats as necessary to achieve the width specified in the contract documents.
b. Construct a leading anchor trench at the upstream end of the installation or a concrete GTCBM trench if specified.

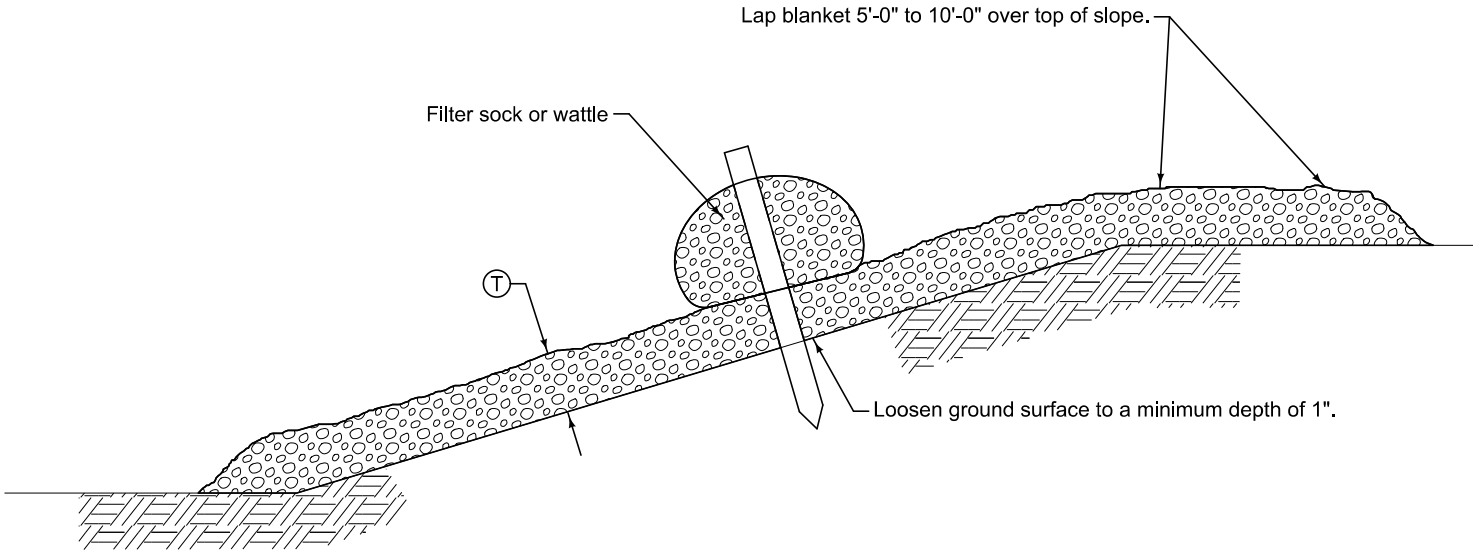
c. Unroll mats downstream, securing parallel edges with standard seams.
d. If installation length requires multiple rolls of GTCBM, join ends of subsequent mats together with an overlap seam.
e. Install an ending anchor trench at the terminal end of the downstream mat.

3.25 TEMPORARY EROSION CONTROL SEEDING

Comply with Section 9010.

END OF SECTION

Compost blanket may be vegetated or unvegetated as specified in the contract documents.



COMPOST BLANKET DETAIL

MINIMUM COMPOST BLANKET THICKNESS

SLOPE	BLANKET THICKNESS Ⓣ
3:1	3"
≤ 4:1	2"

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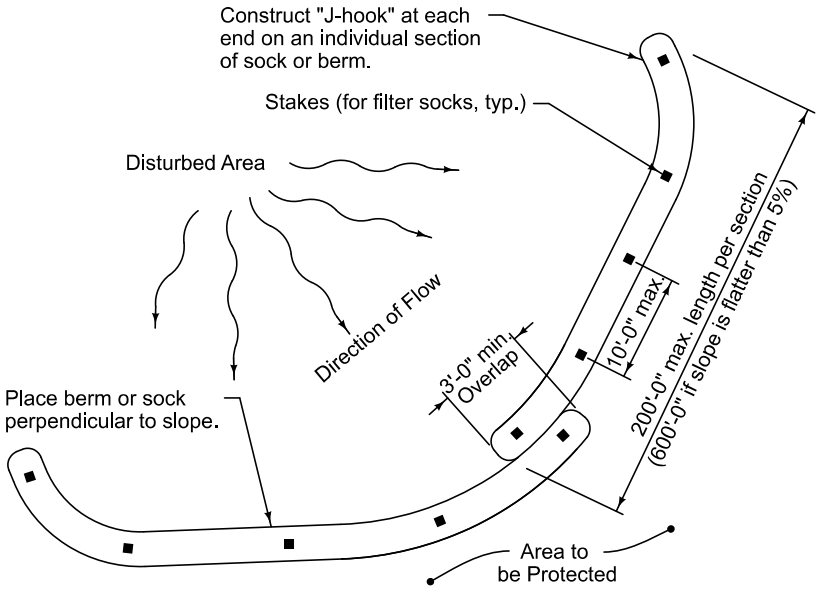
9040.101

SHEET 1 of 1

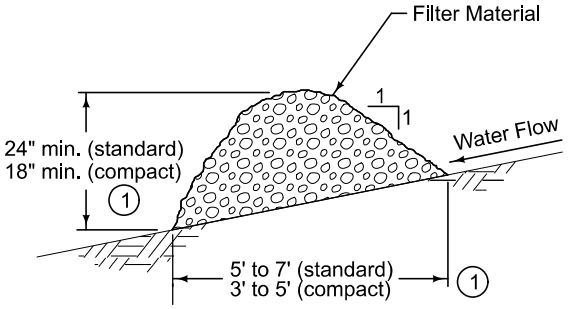
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COMPOST BLANKET

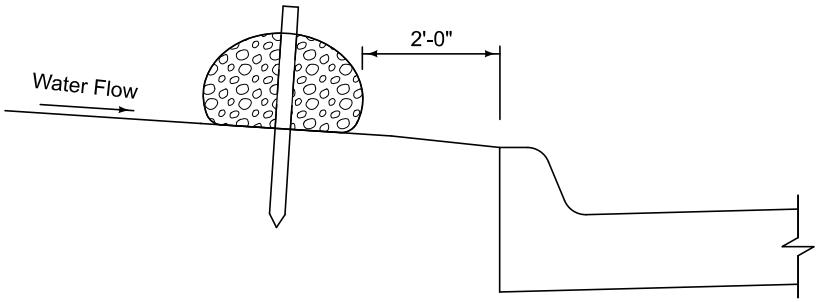
FIGURE 9040.101 | SHEET 1 OF 1



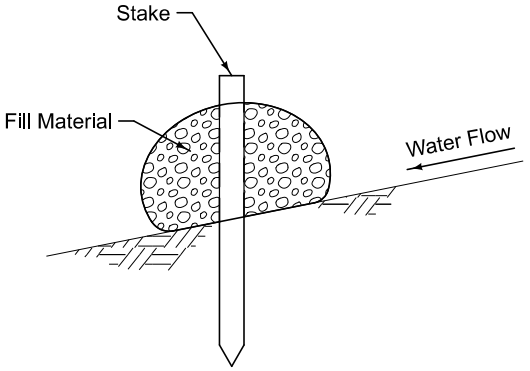
PLAN VIEW OF SLOPE
(for sediment and slope control)



FILTER BERM



SECTION VIEW AT STREET
(for perimeter control along street)



FILTER SOCK

Berm shown is typical for slopes flatter than 3:1. For steeper slopes, increase berm size as directed by the Engineer.

Place berm in uncompacted windrow perpendicular to the slope at locations specified in the contract documents.

Filter sock diameter as specified in the contract documents.

(1) Filter berm size (standard or compact) as specified in the contract documents.

TYPICAL PLACEMENT OF BERM OR SOCK

FIGURE 9040.102

SHEET 1 OF 1

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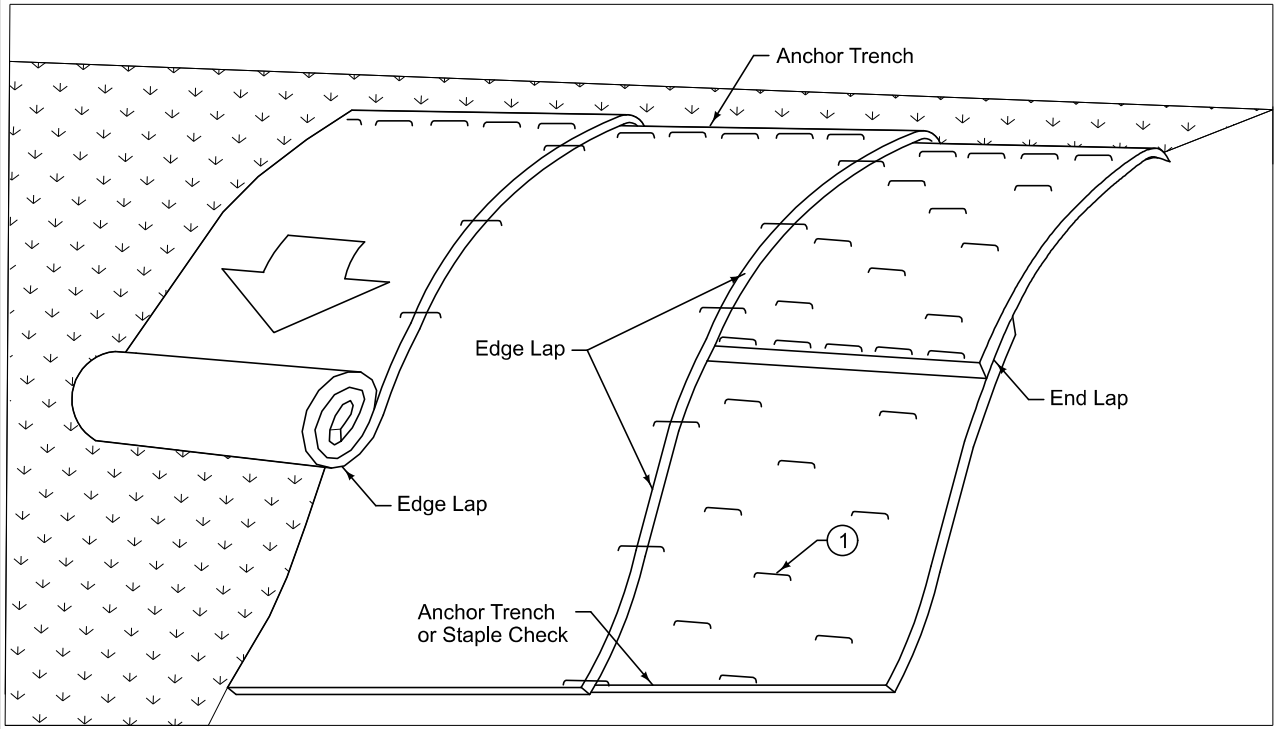
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9040.102

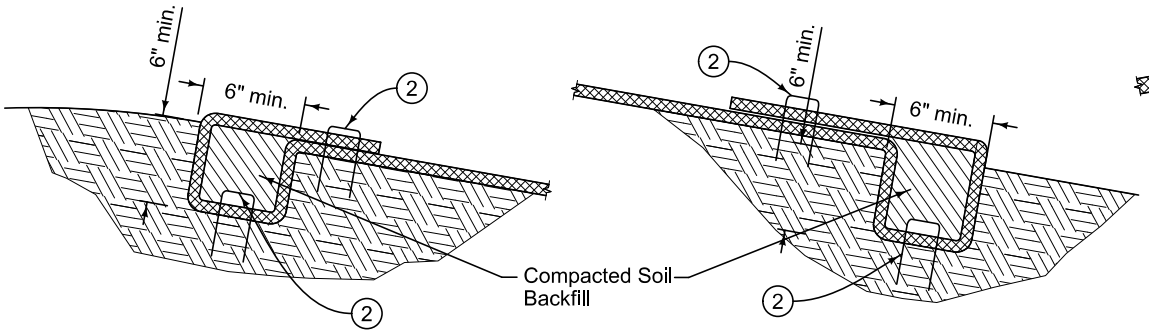
SHEET 1 of 1

SUDAS Standard Specifications

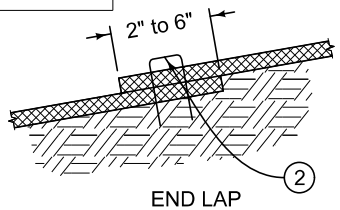
FILTER BERM AND FILTER SOCK



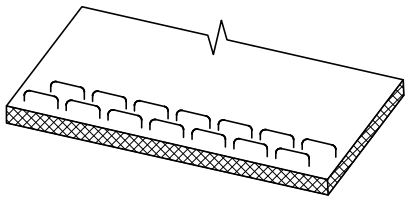
1. Secure blanket to ground according to manufacturer's recommended anchoring pattern and anchor density (minimum 1.3 anchors per square yard).
2. Install staples at 1 foot on center.



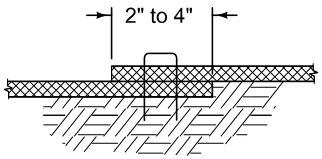
UPSLOPE AND TERMINAL END ANCHOR TRENCH



END LAP



STAPLE CHECK
(Two rows of staples at 4" on center and staggered 4" apart)



EDGE LAP
(4'-0" min. anchor spacing)

FIGURE 9040.103

SHEET 1 OF 1

SUDAS

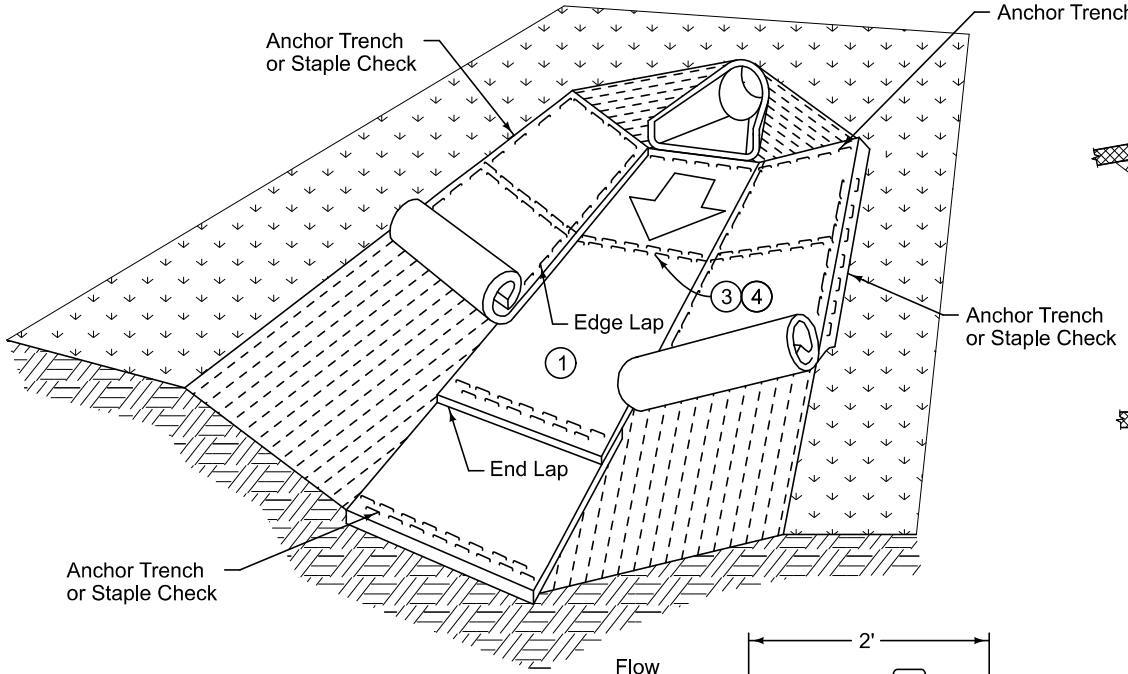
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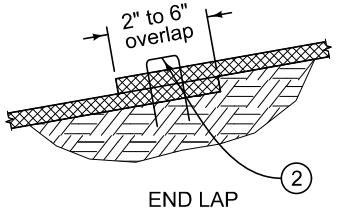
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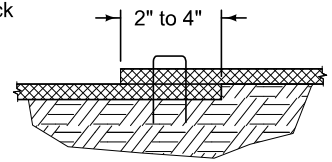
SUDAS Standard Specifications

ROLLED EROSION CONTROL PRODUCT (RECP) INSTALLATION ON SLOPES

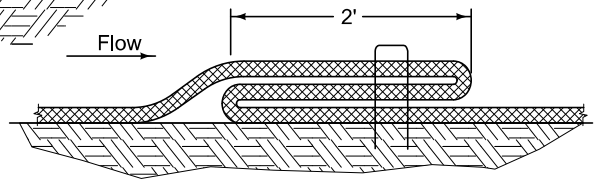




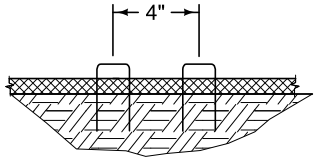
END LAP



EDGE LAP
(4'-0" min. anchor spacing)

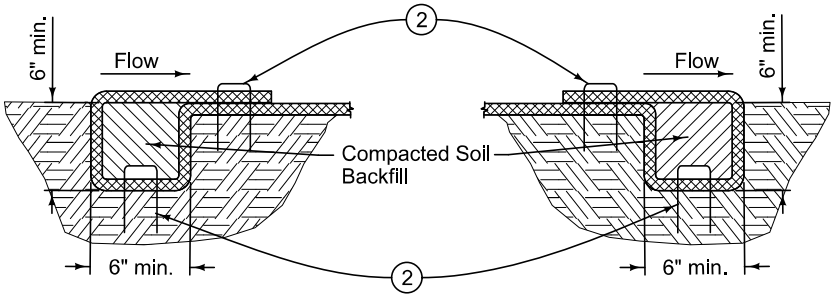


BLANKET CHECK
(Install a single row of staples at a 12" spacing)

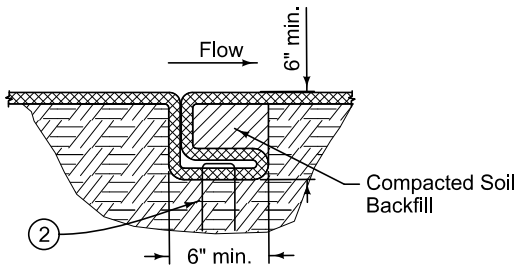


STAPLE CHECK
(Two rows of staples at 4" on
center and staggered 4" apart)

1. Secure blanket to ground according to manufacturer's recommended anchoring pattern and anchor density (minimum 1.7 anchors per square yard).
2. Install staples at 1 foot on center.
3. Install staple checks at 100 foot intervals for channel slopes less than 2.5%.
4. Install blanket checks for the following slopes:
   2.5% - 3% 100 ft. intervals
   3% - 5% 50 ft. intervals
   5% - 7% 25 ft. intervals



UPSTREAM AND DOWNSTREAM ANCHOR TRENCH



INTERMEDIATE ANCHOR TRENCH

FIGURE 9040.104 | SHEET 1 OF 1

SUDAS

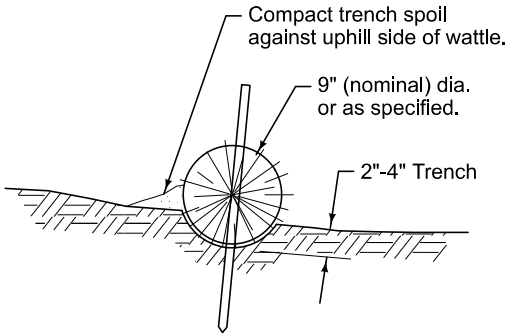
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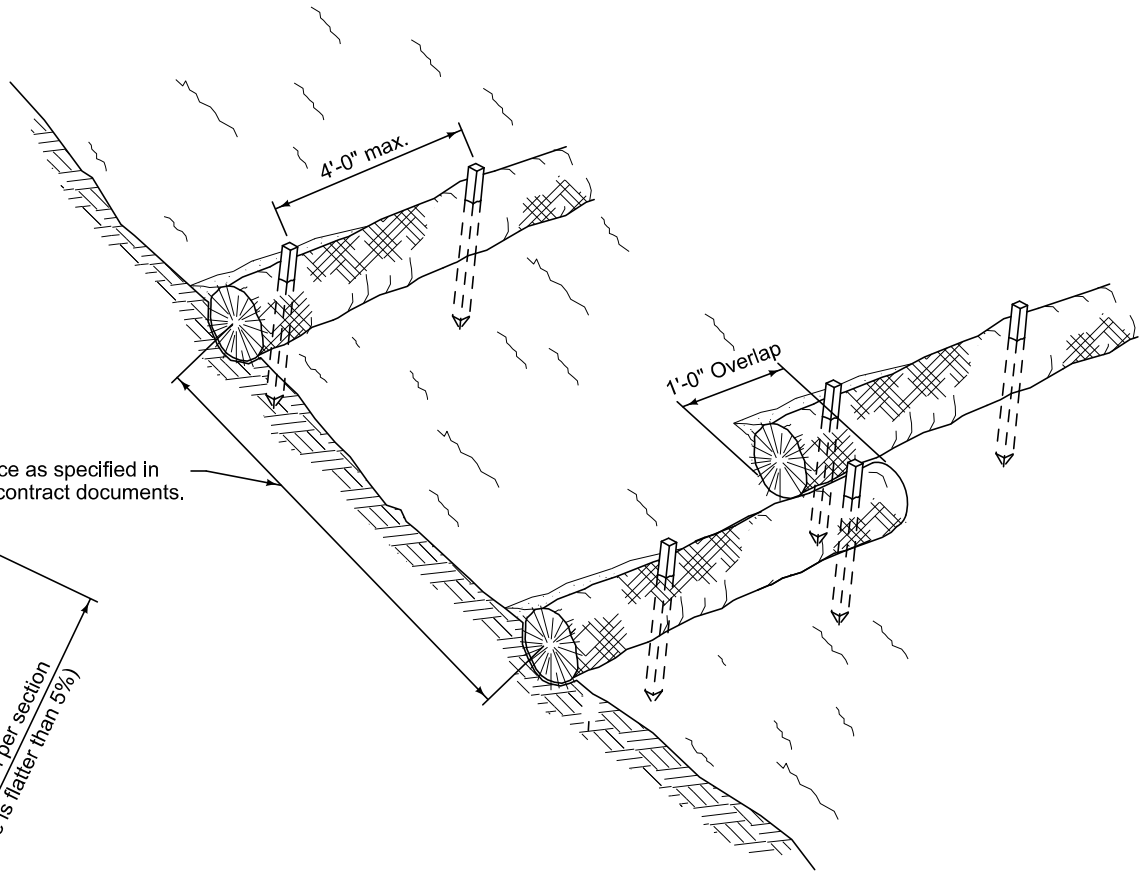
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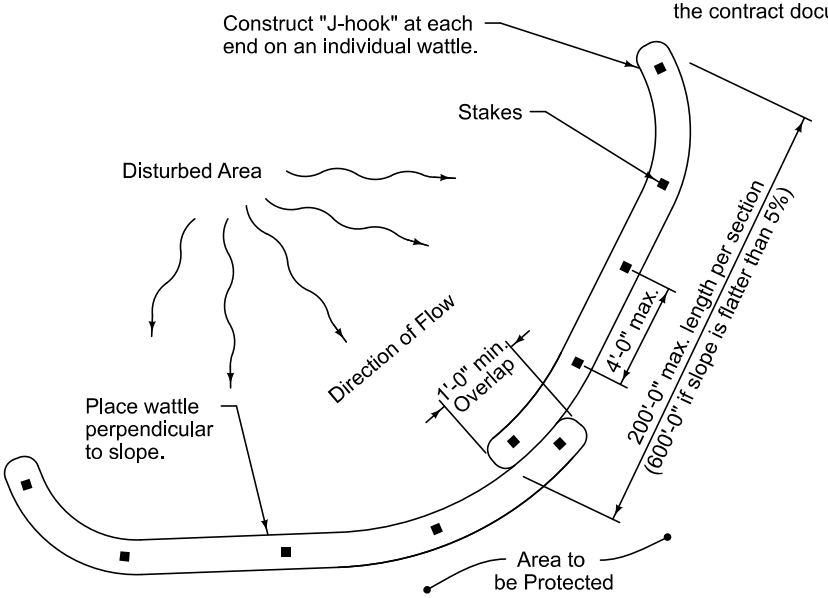
SHEET 1 of 1

SUDAS Standard Specifications

ROLLED EROSION CONTROL PRODUCT (RECP) INSTALLATION IN CHANNELS







PLAN VIEW OF SLOPE
(for sediment and slope control)

FIGURE 9040.105

SHEET 1 OF 1

SUDAS

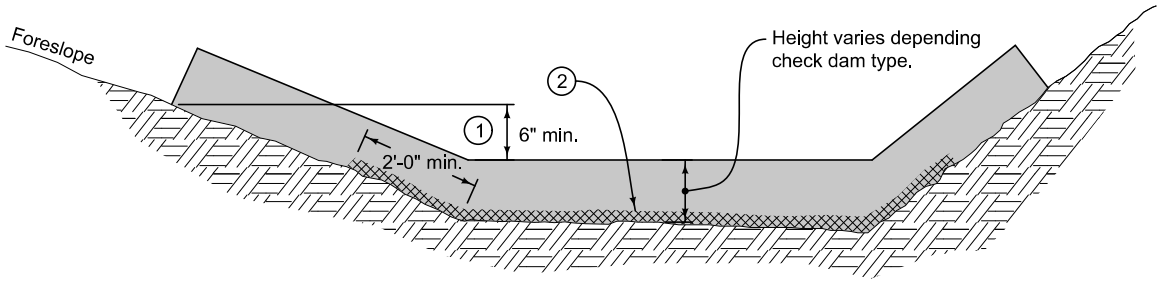
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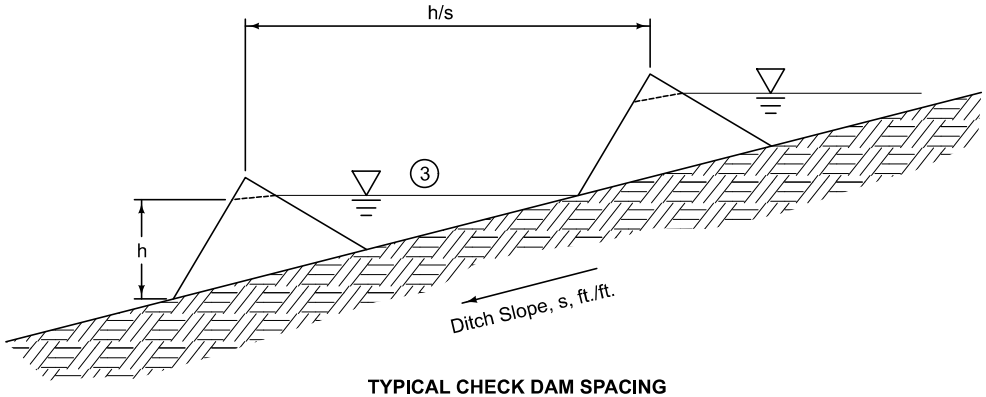
SHEET 1 of 1

SUDAS Standard Specifications

WATTLE



TYPICAL CHECK DAM SECTION
(Applies to silt fence, fiber log, and manufactured check dam devices)



TYPICAL CHECK DAM SPACING

1. Extend check dam up sides of slope so the bottom of the check dam is at least 6 inches higher than the check dam crest.
2. When specified, install an 8 foot wide strip of RECP under the check dam. Extend RECP up the slopes a minimum of 2 feet from the toe of the channel.
3. Space check dams so crest of downstream check dam is level with the base of the upstream check dam.

FIGURE 9040.106 | SHEET 1 OF 2

SUDAS

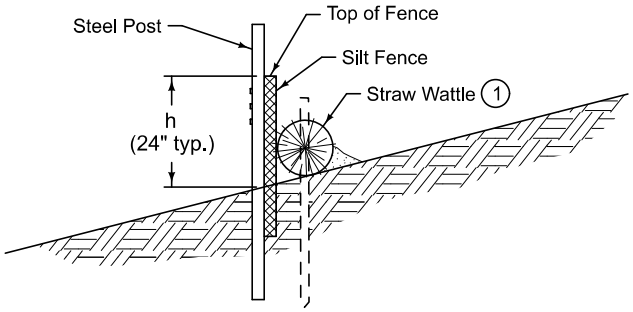
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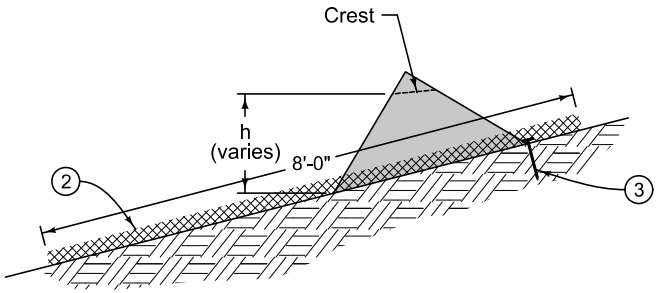
SHEET 1 of 2

SUDAS Standard Specifications

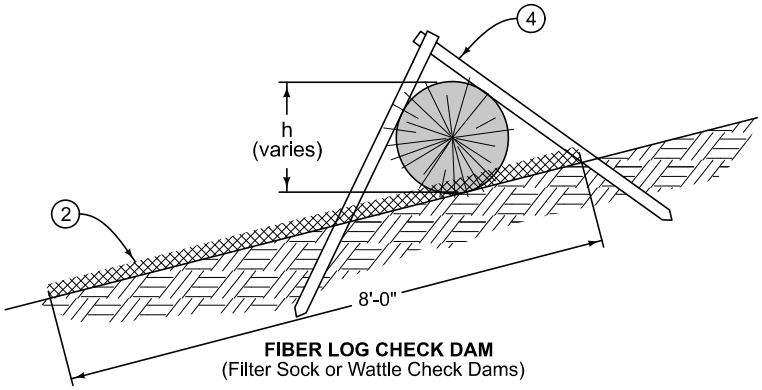
CHECK DAMS



SILT FENCE CHECK DAM
(See Figure 9040.119 for installation of Silt Fence Check Dams)



MANUFACTURED CHECK DAM
(Synthetic Permeable and Triangular Foam Check Dams)



FIBER LOG CHECK DAM
(Filter Sock or Wattle Check Dams)

1. When specified, place a straw wattle against the upstream face of silt fence check dams. Secure wattle in place with wood stakes.
2. When specified, install an 8 foot wide strip of RECP under the check dam. Extend RECP up the slopes a minimum of 2 feet from the toe of the channel.
3. Anchor manufactured check dam according to the manufacturer's recommendations.
4. Install two stakes at a 45 degree angle to the surface. Space stakes at 1 foot intervals.

FIGURE 9040.106 | SHEET 2 OF 2

SUDAS

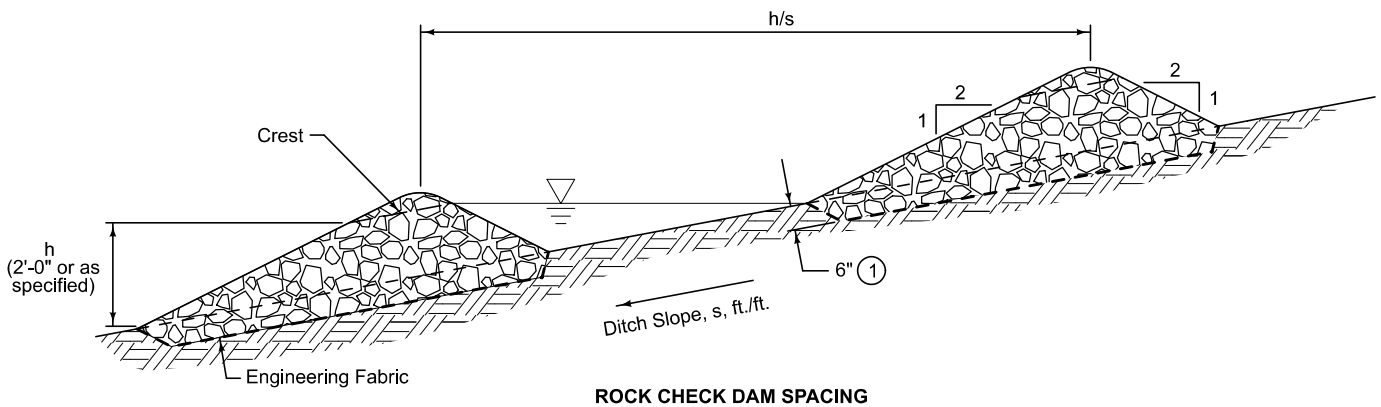
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9040.106

SHEET 2 of 2

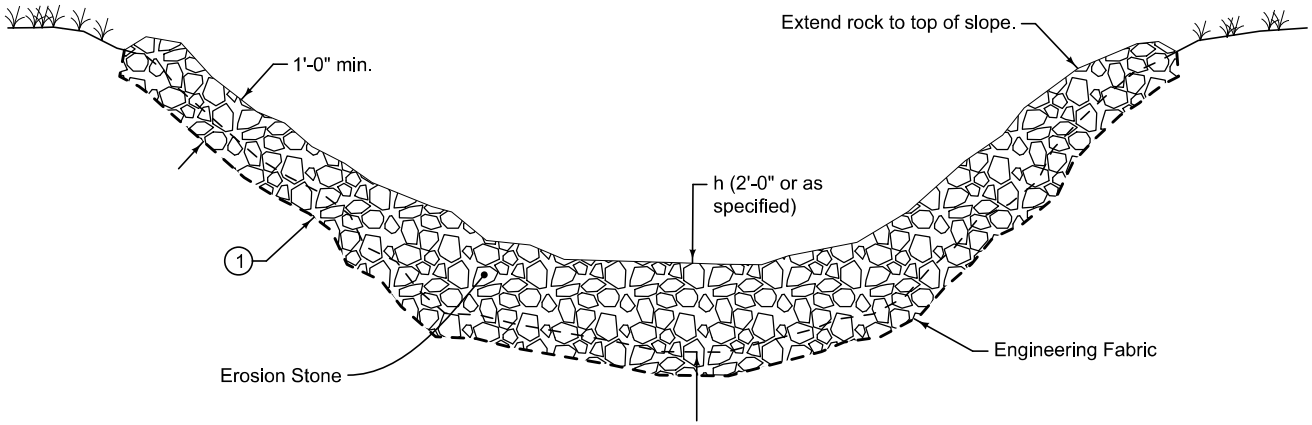
SUDAS Standard Specifications

CHECK DAMS



ROCK CHECK DAM SPACING

(1) Key rock check dam into bottom and sides of the channel a minimum of 6 inches.



ROCK CHECK DAM SECTION

FIGURE 9040.107

SHEET 1 OF 1

SUDAS

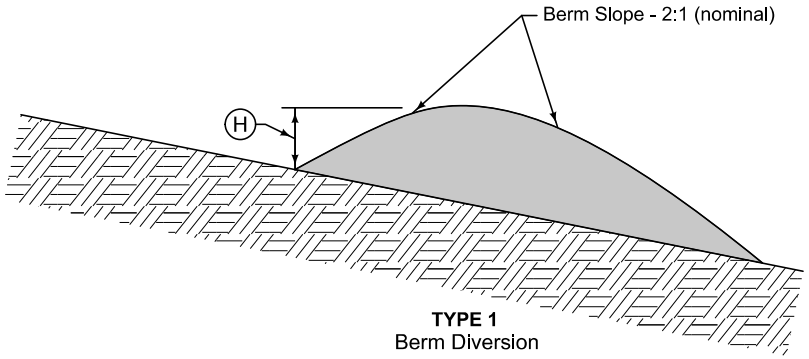
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9040.107

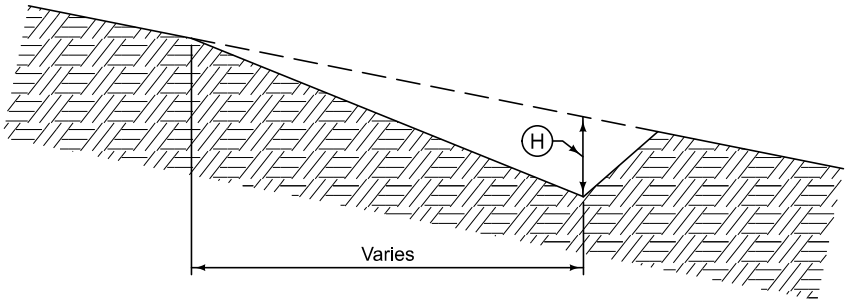
SHEET 1 of 1

SUDAS Standard Specifications

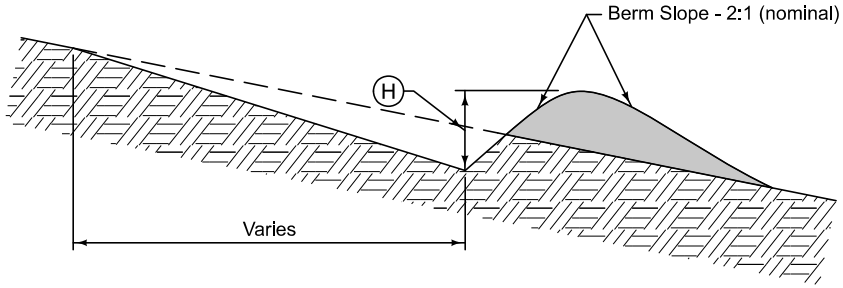
ROCK CHECK DAM



TYPE 1
Berm Diversion



TYPE 2
'V' Ditch Diversion



TYPE 3
Ditch/Berm Diversion

Diversion Types 1, 2, and 3 may be used interchangably unless otherwise specified in the contract documents.

Alternate configurations may be used upon approval from the Engineer.

(H) Total height of diversion (swale and berm): 18 inch minimum or as specified.

FIGURE 9040.108

SHEET 1 OF 1

SUDAS

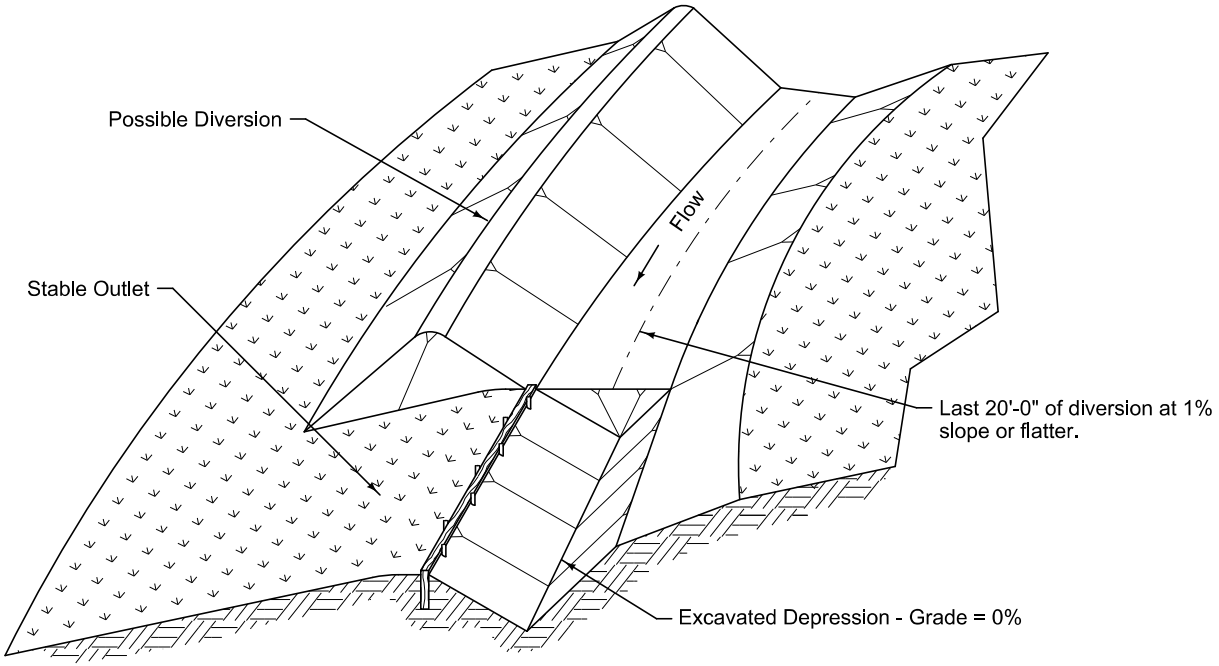
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9040.108

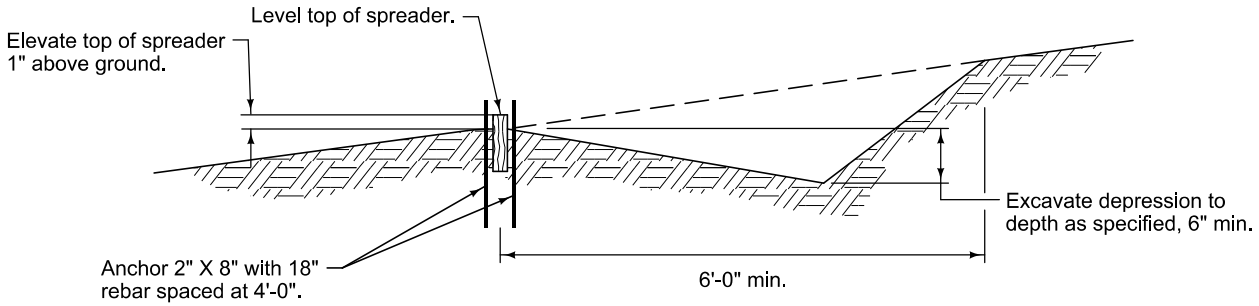
SHEET 1 of 1

SUDAS Standard Specifications

TEMPORARY EARTH DIVERSION BERMS



PERSPECTIVE VIEW



CROSS-SECTION

FIGURE 9040.109

SHEET 1 OF 1

SUDAS

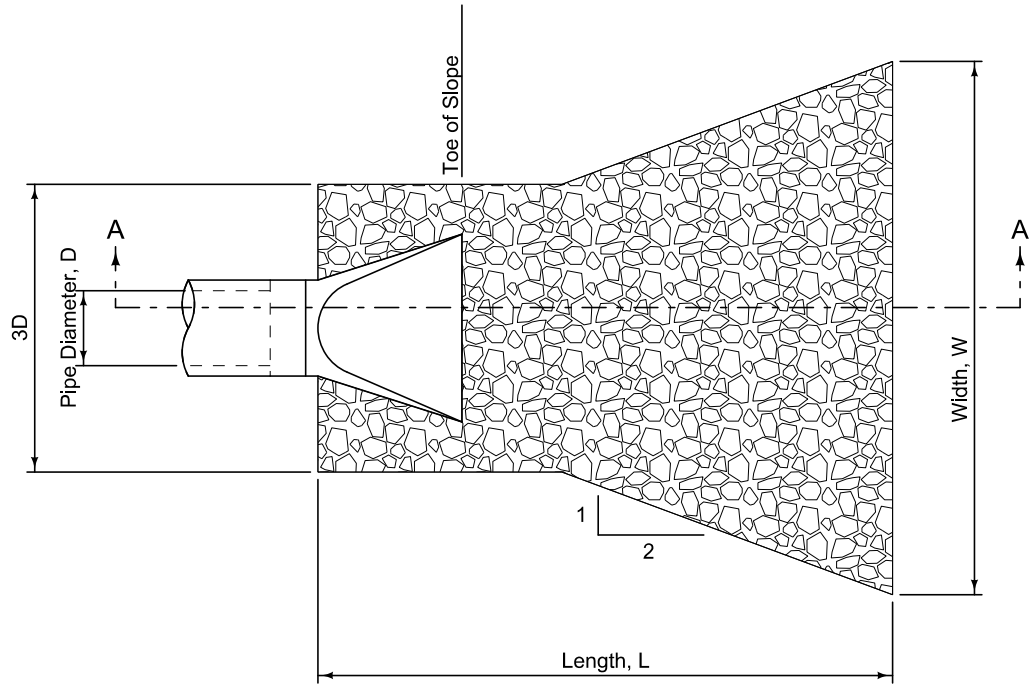
REVISION 2 10-21-14

9040.109

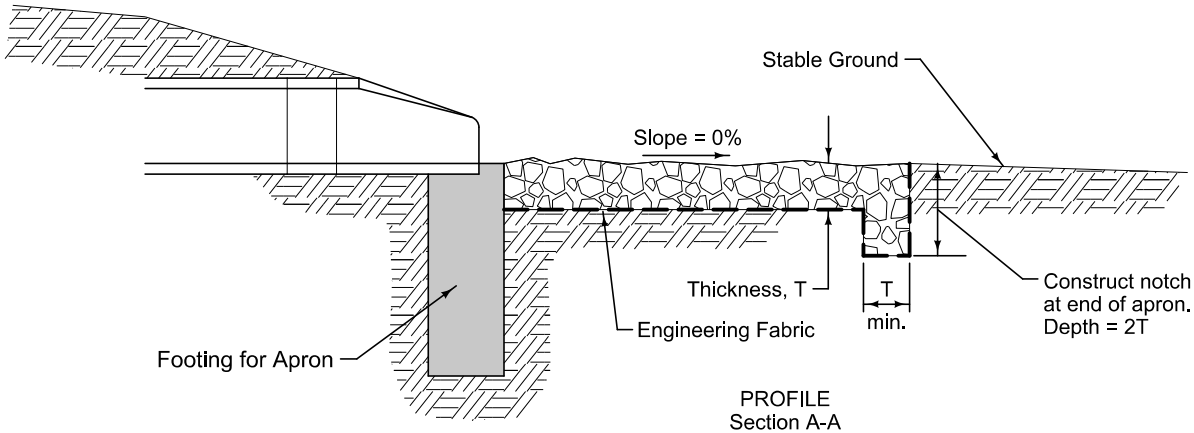
SHEET 1 of 1

SUDAS Standard Specifications

LEVEL SPREADER



PLAN



PROFILE
Section A-A

FIGURE 9040.110 | SHEET 1 OF 1

SUDAS

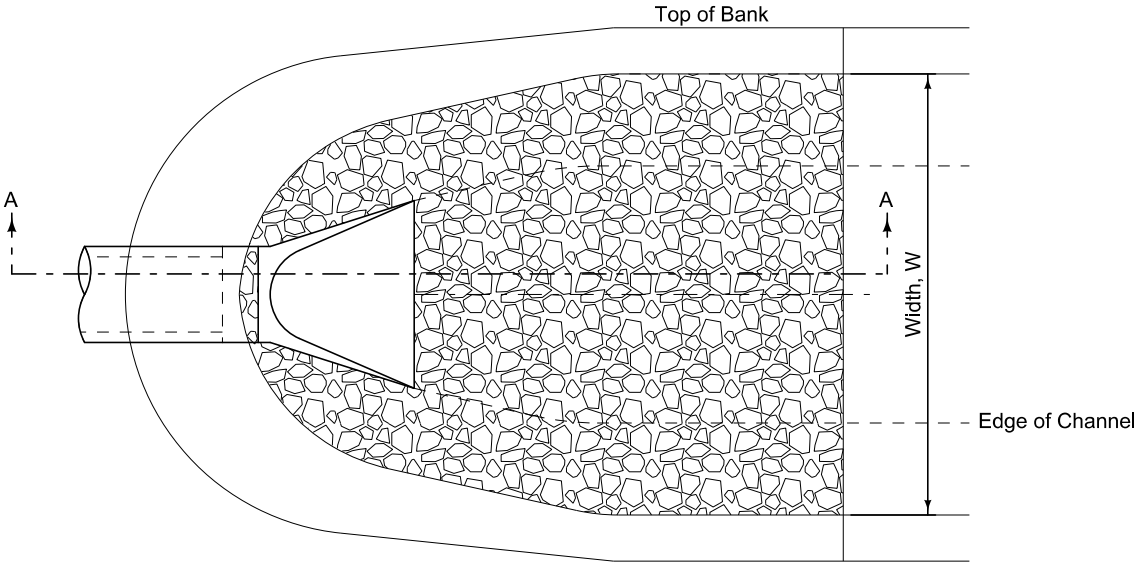
REVISION	
3	10-21-14

9040.110

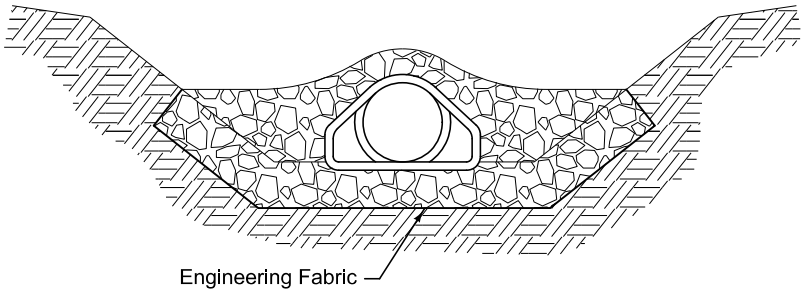
SHEET 1 of 1

SUDAS Standard Specifications

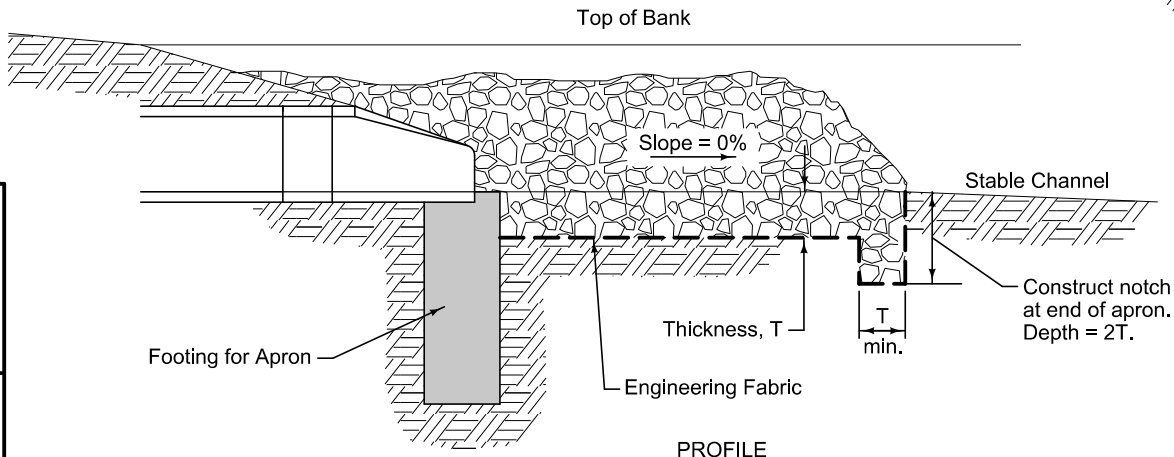
RIP RAP FOR PIPE OUTLET
ONTO FLAT GROUND



PLAN



CROSS-SECTION



PROFILE
Section A-A

FIGURE 9040.111 | SHEET 1 OF 1

SUDAS

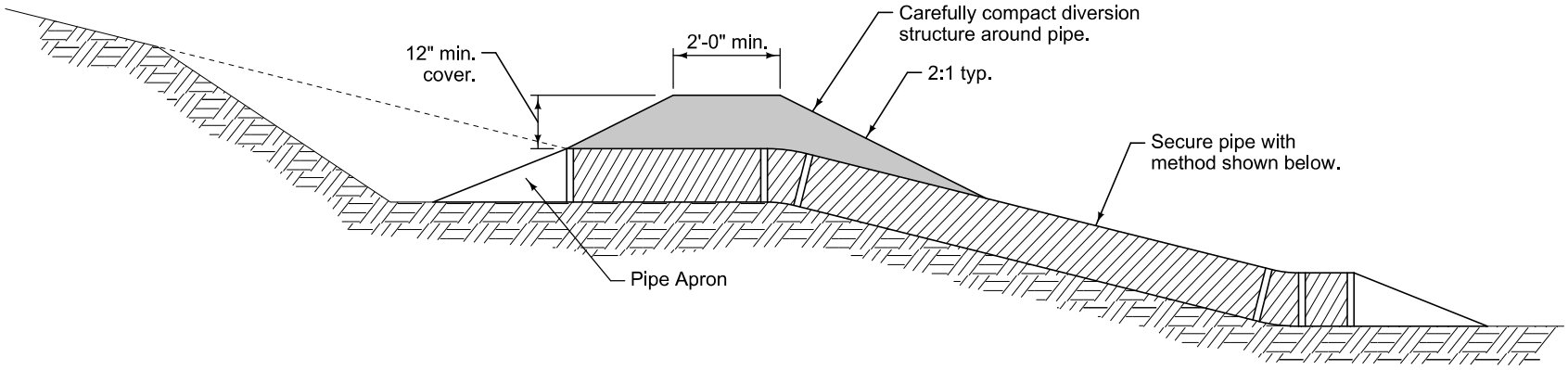
REVISION
3 | 10-21-14

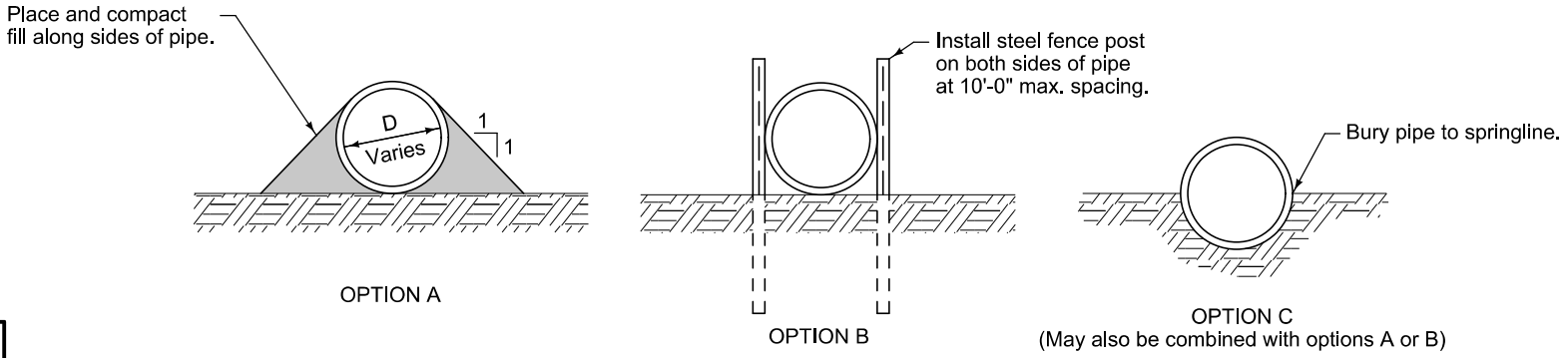
9040.111

SHEET 1 of 1

SUDAS Standard Specifications

RIP RAP APRON FOR PIPE
OUTLET INTO CHANNEL





OPTION A

OPTION B

OPTION C
(May also be combined with options A or B)

SLOPE DRAIN ANCHORING OPTIONS
(Options A, B, and C are interchangable unless otherwise specified in the contract documents)

FIGURE 9040.112

SHEET 1 OF 1

SUDAS

REVISION
2 10-21-14

9040.112

SHEET 1 of 1

SUDAS Standard Specifications

TEMPORARY PIPE SLOPE DRAIN

1. Barrel length and diameter as specified in the contract documents.
2. Riser pipe and base/dewatering device: See Figure 9040.115.
3. Anti-vortex device: See Figure 9040.116.

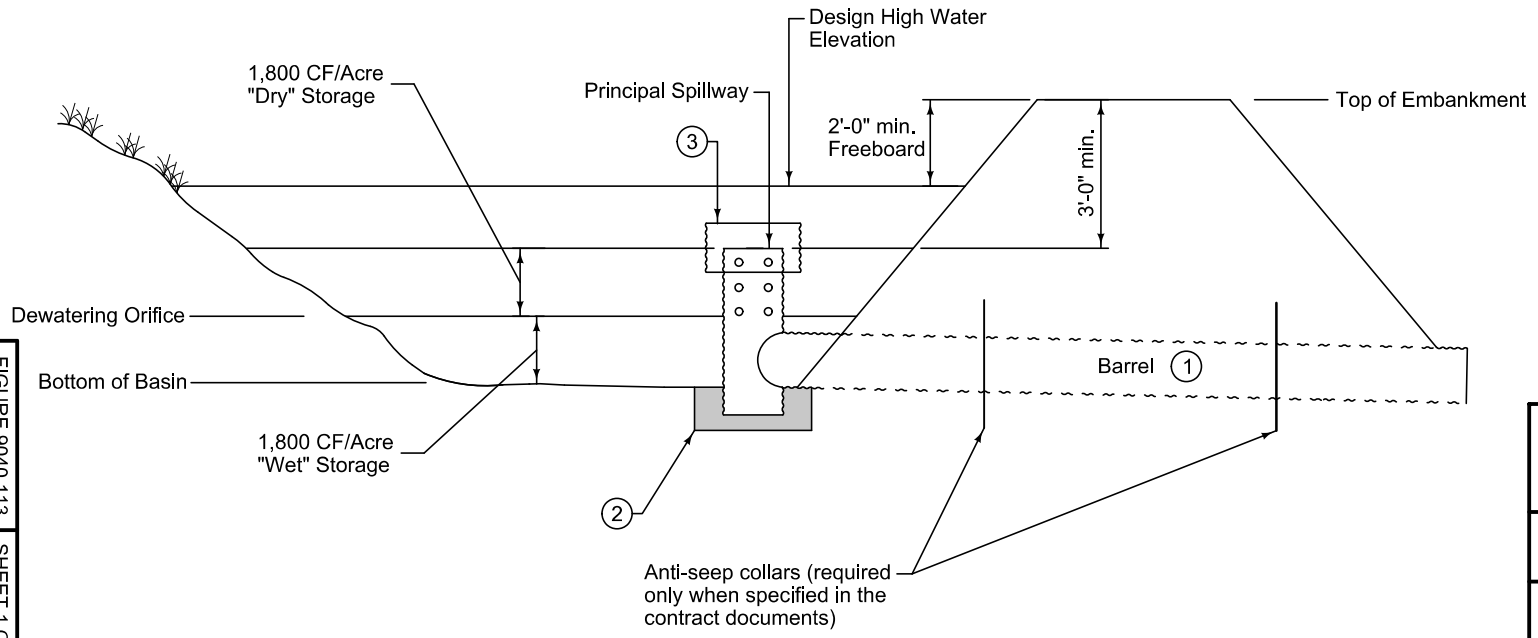


FIGURE 9040.113

SHEET 1 OF 1

SUDAS

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2 10-21-14

9040.113

SHEET 1 of 1

SUDAS Standard Specifications

SEDIMENT BASIN WITHOUT EMERGENCY SPILLWAY

(1) Barrel length and diameter as specified in the contract documents.

(2) Riser pipe and base/dewatering device: See Figure 9040.115.

(3) Anti-vortex device: See Figure 9040.116.

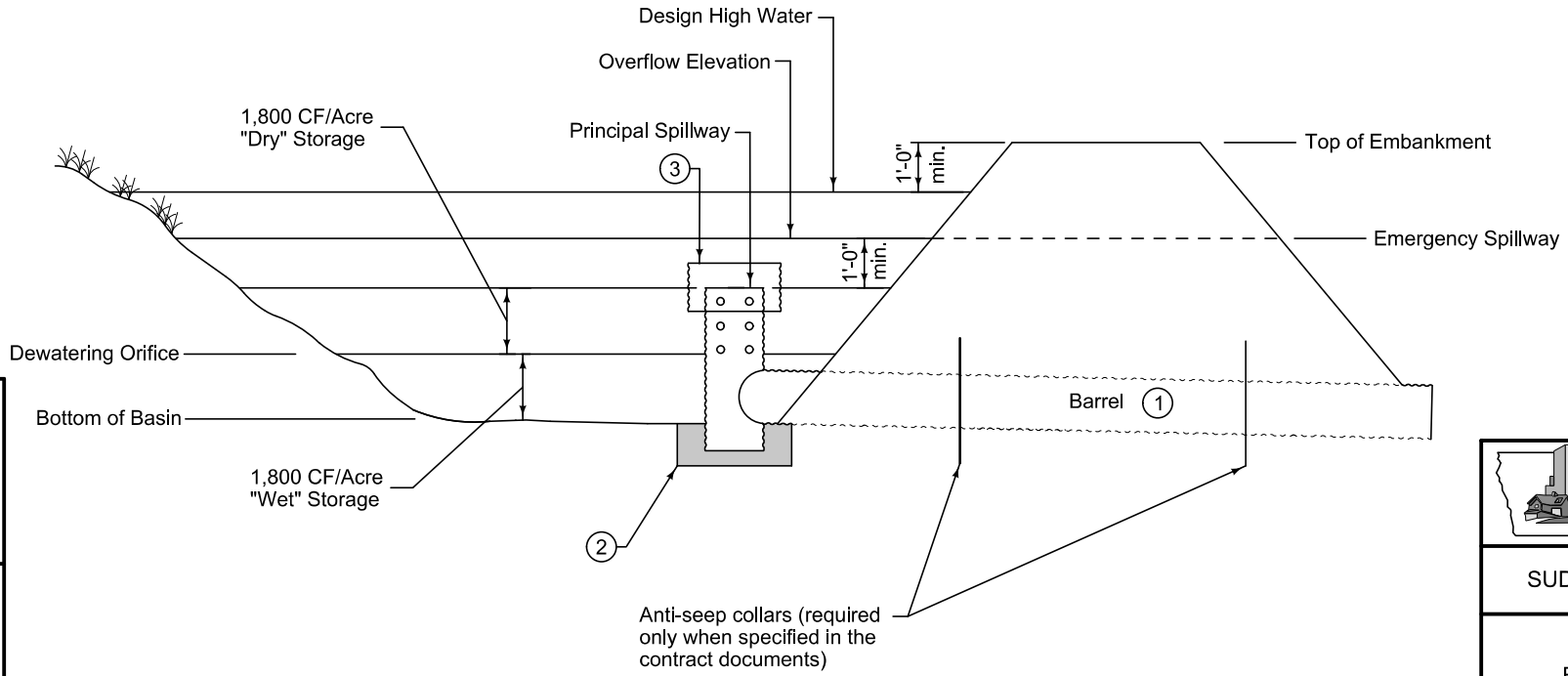


FIGURE 9040.114

SHEET 1 OF 1

SUDAS

REVISION
2 10-21-14

9040.114

SHEET 1 of 1

SUDAS Standard Specifications

SEDIMENT BASIN WITH EMERGENCY SPILLWAY

Elevations and dimensions not given are as specified in the contract documents.

(1) Drill four, 5/8 inch diameter holes, 3 inches from bottom of riser pipe and insert two, #4 bars in an "X" configuration.
Length of bars = D+16 inches

(2) Provide perforation configuration as specified in the contract documents.

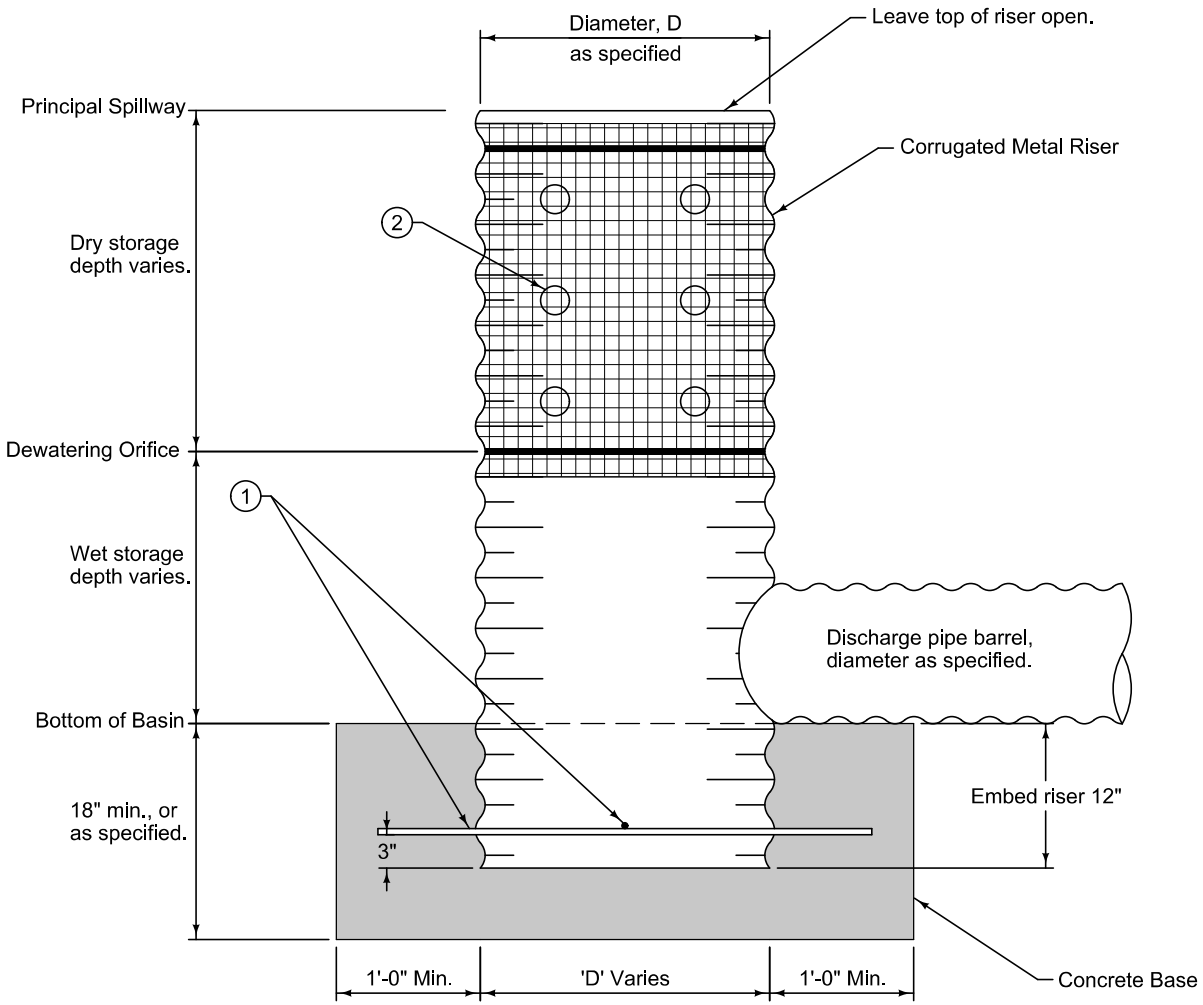


FIGURE 9040.115

SHEET 1 OF 1

SUDAS

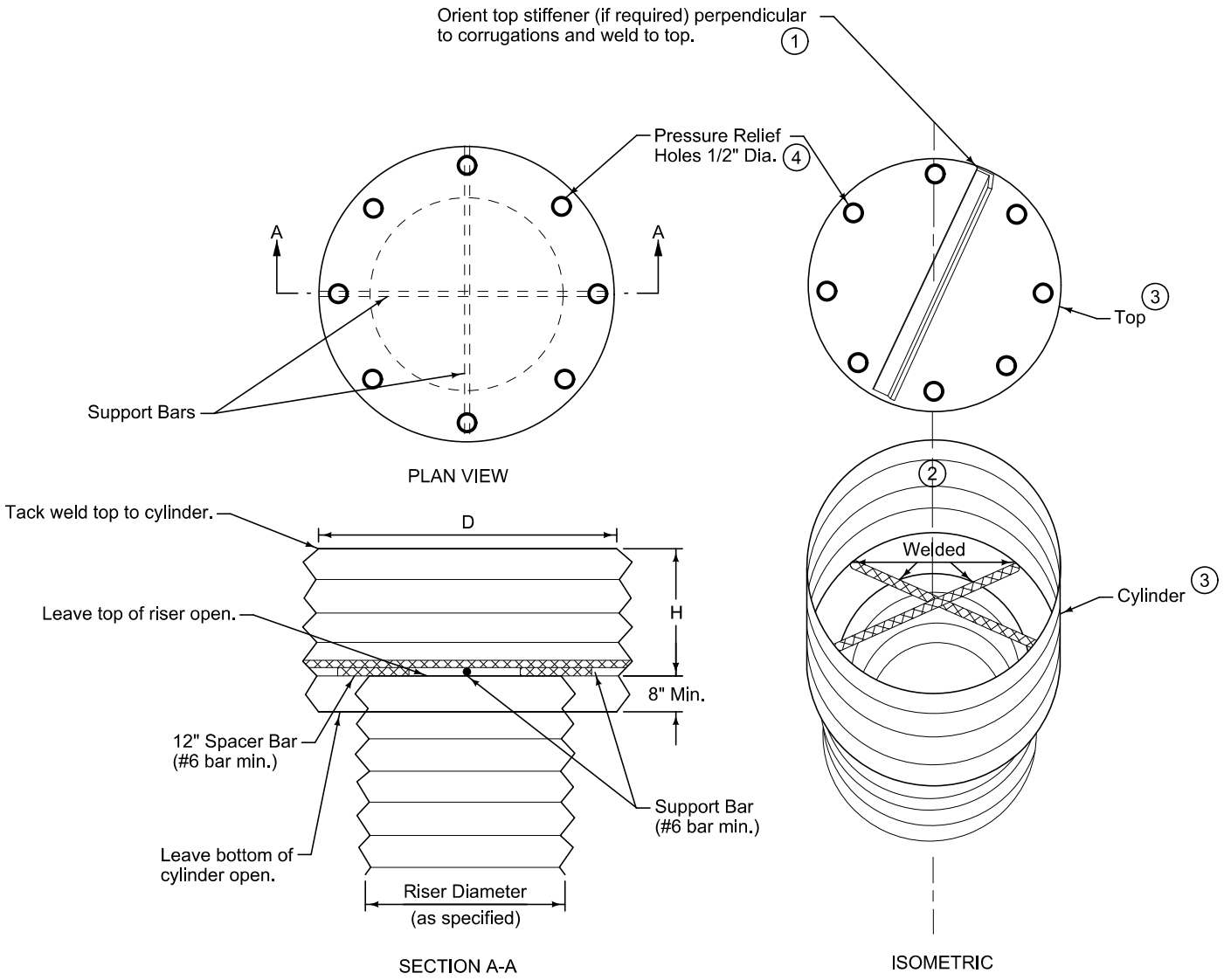
REVISION 2 10-21-14

9040.115

SHEET 1 of 1

SUDAS Standard Specifications

SEDIMENT BASIN
DEWATERING DEVICE
(PERFORATED RISER)



Alternate anti-vortex device configurations may be utilized upon approval of the Engineer.

1. See sheet 2 for dimensions of cylinder support bars, top plate, and top stiffener.
2. Firmly attach the anti-vortex cylinder to the top of the riser by welding or other means.
3. Corrugated metal or 1/8 inch steel plate cylinder and top.
4. Pressure relief holes may be omitted if ends of corrugations are left fully open when the top is attached.

FIGURE 9040.116

SHEET 1 OF 2

SUDAS

REVISION	
2	10-21-14

9040.116

SHEET 1 of 2

SUDAS Standard Specifications

ANTI-VORTEX DEVICE

RISER	CYLINDER				MINIMUM TOP	
Diameter (in.)	Diameter (in.)	Thickness (gage)	Height (H) (in.)	Minimum Size Support Bar	Thickness	Stiffener
12	18	16	6	#6 rebar or 1 1/2" X 3/16" angle	16 ga F & C	----
15	21	16	7	#6 rebar or 1 1/2" X 3/16" angle	16 ga F & C	----
18	27	16	8	#6 rebar or 1 1/2" X 3/16" angle	16 ga F & C	----
21	30	16	11	#6 rebar or 1 1/2" X 3/16" angle	16 ga (C), 14 ga (F)	----
24	36	16	13	#6 rebar or 1 1/2" X 3/16" angle	16 ga (C), 14 ga (F)	----
27	42	16	15	#6 rebar or 1 1/2" X 3/16" angle	16 ga (C), 14 ga (F)	----
36	54	16	17	#8 rebar	14 ga (C), 12 ga (F)	----
42	60	16	19	#8 rebar	14 ga (C), 12 ga (F)	----
48	72	16	21	1 1/4" pipe or 1 1/4" X 1 1/4" X 1/4" angle	14 ga (C), 10 ga (F)	----
54	78	16	25	1 1/4" pipe or 1 1/4" X 1 1/4" X 1/4" angle	14 ga (C), 10 ga (F)	----
60	90	14	29	1 1/2" pipe or 1 1/2" X 1 1/2" X 1/4" angle	12 ga (C), 8 ga (F)	----
66	96	14	33	2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2" X 2" X 1/4" angle
72	102	14	36	2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2 1/2" X 2 1/2" X 1/4" angle
78	114	14	39	2 1/2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2 1/2" X 2 1/2" X 1/4" angle
84	120	12	42	2 1/2" pipe or 2" X 2" X 1/4" angle	12 ga (C), 8 ga (F)	2 1/2" X 2 1/2" X 5/16" angle

Notes:

1. The criterion for sizing the cylinder is that the area between the inside of the cylinder and the outside of the riser is equal to or greater than the area inside the riser. Therefore, the above table is invalid for use with concrete pipe risers.

2. C - Corrugated F - Flat.

FIGURE 9040.116 | SHEET 2 OF 2

SUDAS

REVISION 2 10-21-14

9040.116

SHEET 2 of 2

SUDAS Standard Specifications

ANTI-VORTEX DEVICE

Sediment baffles improve sediment capture by increasing the length that flow must travel through a sediment basin or sediment trap.

1. Construct sediment baffle by installing rows of silt fence across the bottom of the sediment basin or sediment trap leaving an opening equal to 25% of the bottom width on alternating sides.

2. Install the number of baffles specified in the contract documents. Space baffles evenly between the inlet and outlet of the basin or trap.

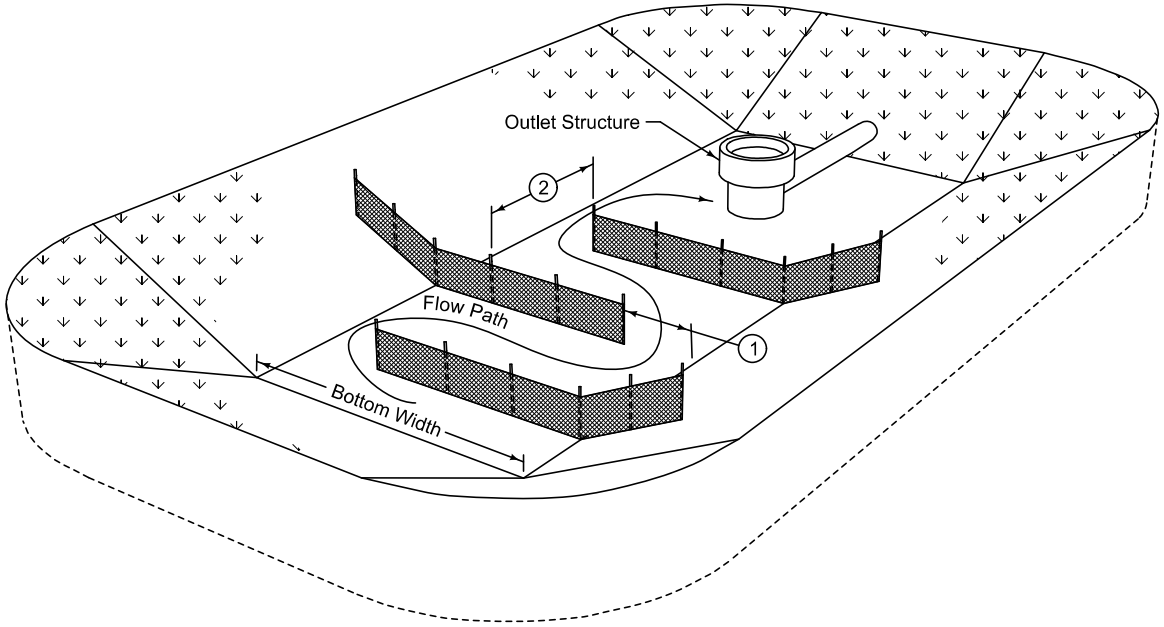


FIGURE 9040.117

SHEET 1 OF 1

SUDAS

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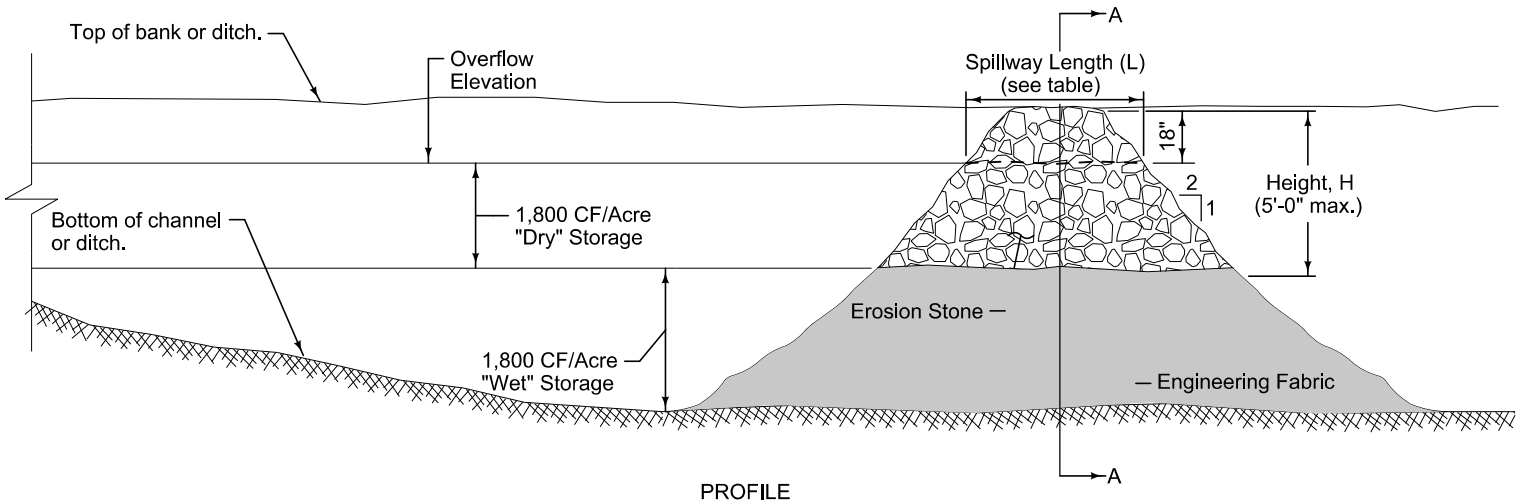
9040.117

SHEET 1 of 1

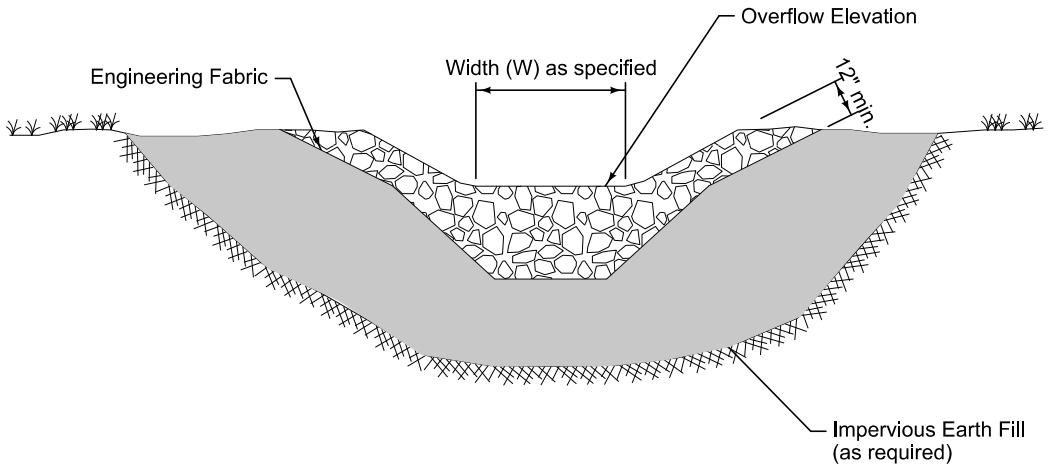
SUDAS Standard Specifications

SEDIMENT BAFFLE

Remove accumulated sediment when level reaches one-half the height of the wet storage.



PROFILE



SECTION A-A

Spillway Length

H (ft.)	L (ft.)
1.5	2.0
2.0	2.0
2.5	2.5
3.0	2.5
3.5	3.0
4.0	3.0
4.5	4.0
5.0	4.5

FIGURE 9040.118

SHEET 1 OF 1

SUDAS

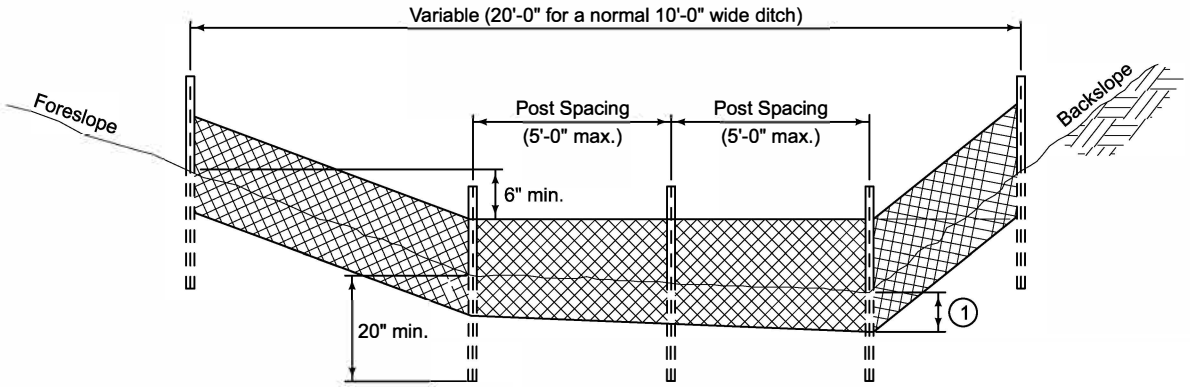
REVISION 2 10-21-14

9040.118

SHEET 1 of 1

SUDAS Standard Specifications

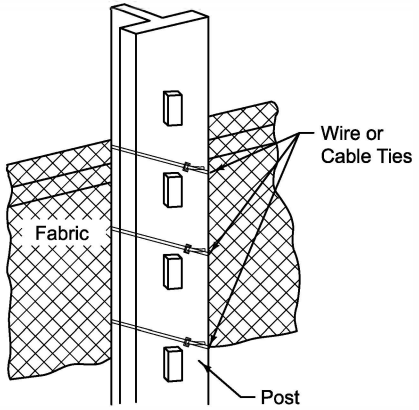
SEDIMENT TRAP



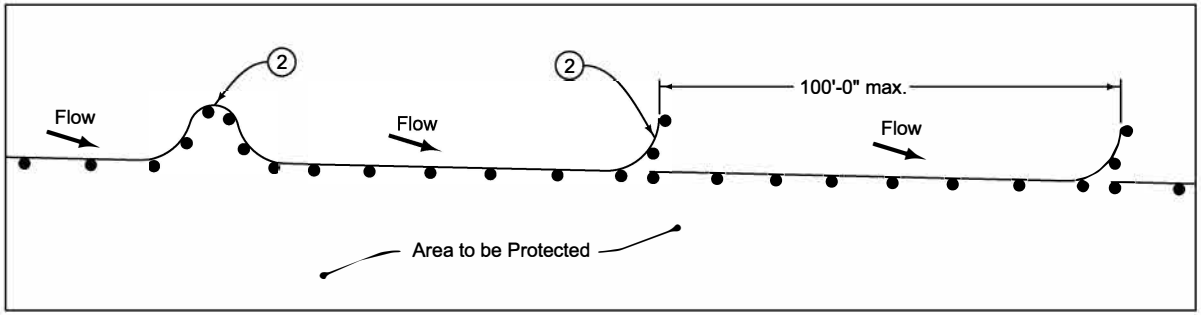
TYPICAL SILT FENCE DITCH CHECK

1. Insert 12 inches of fabric a minimum of 6 inches deep (fabric may be folded below the ground line).

2. Install silt fence for perimiter control with a maximum run length of 100 feet. At the downstream end of each run, turn the silt fence up the slope for 20 feet as shown to construct a 'J-Hook' to contain runoff. At the contractor's option, the silt fence may terminate and restart at the J-hook or may be installed continuously through the J-hook.



ATTACHMENT TO POST



TYPICAL SILT FENCE INSTALLATION FOR PERIMITER CONTROL

FIGURE 9040.119

SHEET 1 OF 2

SUDAS

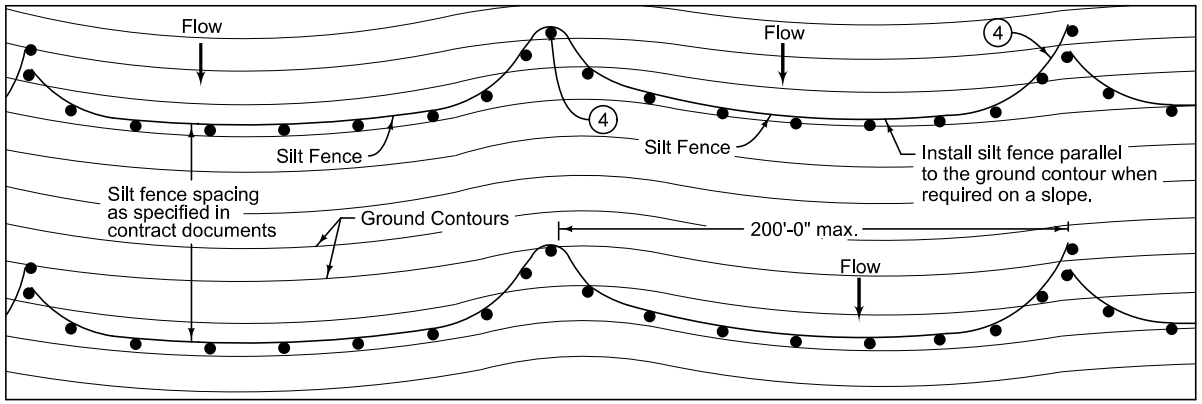
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9040.119

SHEET 1 of 2

SUDAS Standard Specifications

SILT FENCE

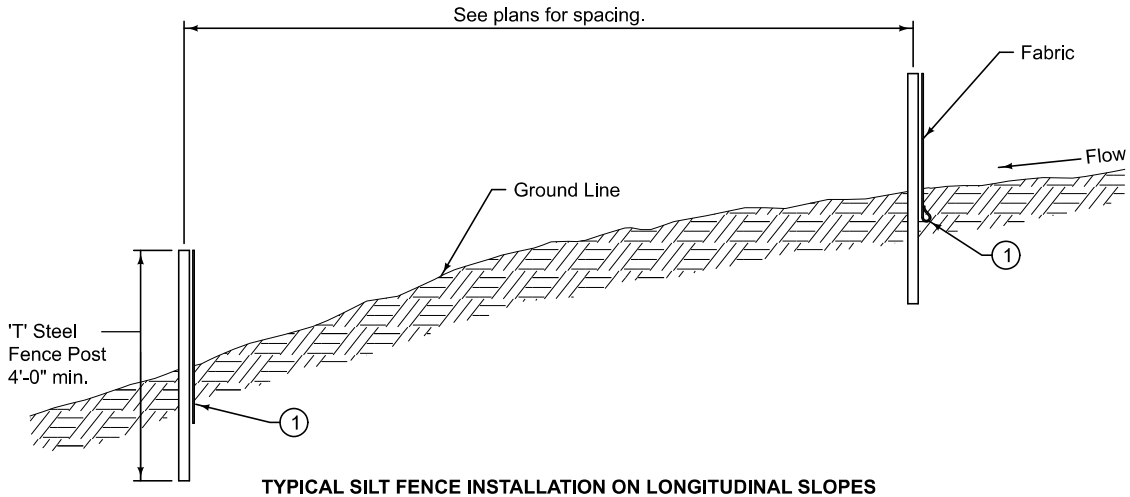


TYPICAL SILT FENCE INSTALLATION ON LONGITUDINAL SLOPES
(Plan View)

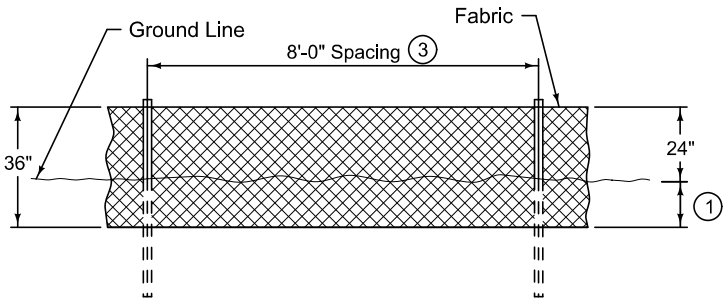
(1) Insert 12 inches of fabric a minimum of 6 inches deep (fabric may be folded below the ground line).

(3) Reduce post spacing to 5 feet at water concentration areas, or as required to adequately support fence.

(4) Place silt fence continuously along a constant elevation for a maximum run of 200 feet. At the end of each run, construct a 'J-Hook' to contain runoff by turning the silt fence up the slope for a length of 20 feet as shown. At the contractor's option, the silt fence may terminate and restart at the J-hook or may be installed continuously through the J-hook.



TYPICAL SILT FENCE INSTALLATION ON LONGITUDINAL SLOPES
(Profile View)



DETAILS OF SILT FENCE ON LONGITUDINAL SLOPES

FIGURE 9040.119 | SHEET 2 OF 2

SUDAS

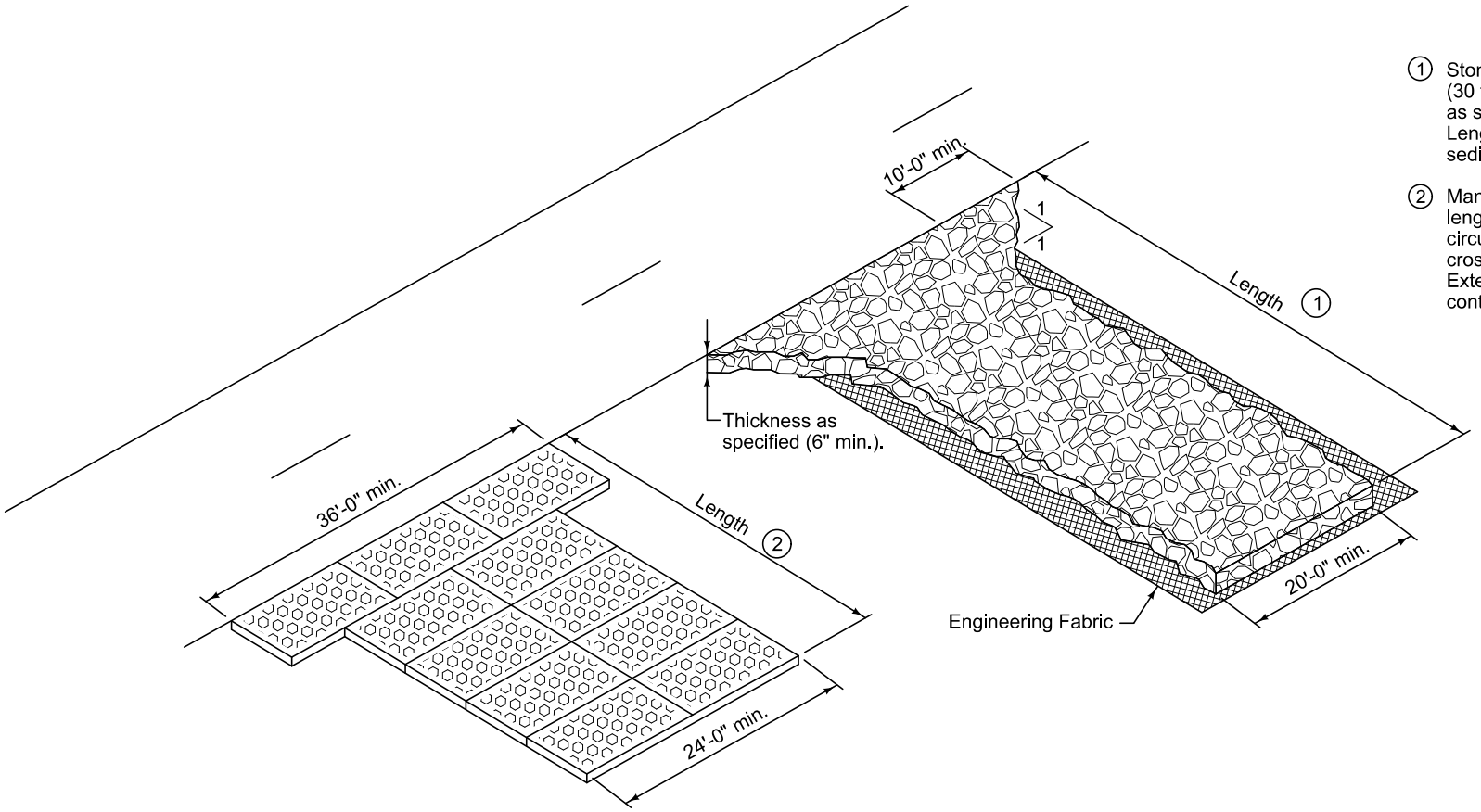
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9040.119

SHEET 2 of 2

SUDAS Standard Specifications

SILT FENCE



(1) Stone Exit: 50 foot minimum length (30 foot for single family residential), or as specified in the contract documents. Length of exit may be increased if sediment track-out occurs.

(2) Manufactured Track-Out Pad: Minimum length of 35 feet or 3 times the circumference of the largest tire that will cross its path (whichever is larger). Extend length if adequate track out control is not acheived.

FIGURE 9040.120 | SHEET 1 OF 1

SUDAS

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9040.120

SHEET 1 of 1

SUDAS Standard Specifications

STABILIZED CONSTRUCTION EXIT

GABIONS AND REVET MATTRESSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Gabions

B. Revet Mattresses (Gabion Mattresses)

1.02 DESCRIPTION OF WORK

A. Assembly and installation of gabions.

B. Assembly and installation of revet mattresses.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Upon request, submit certification that products supplied comply with identified specifications.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Gabions:

1. **Measurement:** Measurement will be the plan quantity in cubic yards for the total volume of each type of gabion installed.

2. **Payment:** Payment will be at the unit price per cubic yard for each type of gabion installed.

3. **Includes:** Unit price includes, but is not limited to, furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing gabion stone, engineering fabric, and anchor stakes.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Revet Mattresses:

1. **Measurement:** Measurement will be the plan quantity in cubic yards for the total volume of each type of revet mattress installed.

2. **Payment:** Payment will be at the unit price per cubic yard for each type of revet mattress installed.

3. **Includes:** Unit price includes, but is not limited to, furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing mattress stone, engineering fabric, and anchor stakes.

C. Excavation: Comply with Section 2010, 1.08, E.

PART 2 - PRODUCTS

2.01 DOUBLE TWISTED WIRE BASKETS

Utilitize double twisted wire baskets unless otherwise specified in the contract documents.

A. General: Fabricate baskets according to ASTM A 975.

B. Wire:

1. **Galvanized:** Comply with ASTM A 975, Style 1 for mesh, selvedge, and lacing wire.

2. **PVC Coated:** Comply with ASTM A 975, Style 3 for mesh, selvedge, and lacing wire.

3. **Tensile Strength:** Minimum tensile strength of 60,000 psi. Maximum tensile strength as specified in ASTM A 975.

C. Connections:

1. **Galvanized Gabion and Revet Mattresses:** Provide metallic coated steel lacing wire or ring fasteners complying with ASTM A 975.

2. **PVC Coated Gabions and Revet Mattresses:** Provide only stainless steel ring fasteners complying with ASTM A 975.

2.02 WELDED WIRE BASKETS

Utilize welded wire baskets only when specified in the contract documents.

A. General: Fabricate baskets according to ASTM A 974.

B. Welded Wire:

1. **Galvanized:** Comply with ASTM A 974, Style 2 for wire, selvedge, and lacing wire.

2. **PVC Coated:**
   a. Provide Style 2, galvanized wire fabric with a minimum nominal wire diameter of 0.120 inches for gabion baskets and 0.087 inches for revet mattresses.
   b. Coat wire with PVC. Comply with ASTM A 974, Style 5.

3. **Tensile Strength:** Minimum tensile strength of 80,000 psi. Maximum tensile strength as specified in ASTM A 974.

C. Connections:

1. **Galvanized Gabions and Revet Mattresses:** Provide metallic-coated lacing wire with a nominal diameter of 0.120 inches. Comply with the requirements of ASTM A 764 as follows:
   a. Tensile Strength: Class I (Finish 1 or 2).
   b. Coating: Class 3, Type B or C.

2. **PVC Coated Gabions and Revet Mattresses:** Provide stainless steel lacing wire with a nominal diameter of 0.120 inches complying with ASTM A 313, Type 302, Class 1.

2.03 GABION AND MATTRESS STONE

Comply with Iowa DOT Section 4130.

2.04 ENGINEERING FABRIC

Comply with Iowa DOT Article 4196.01, B for embankment erosion control.

2.05 ANCHOR STAKES

When anchor stakes are specified in the contract documents provide 2 inch galvanized standard weight pipe complying with ASTM A 53. Provide stakes with length as specified in the contract documents.

2.06 GRANULAR SUBBASE

Comply with Iowa DOT Section 4123 for modified subbase.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION AND BEDDING

A. When applicable, cut and reshape the area behind a proposed gabion wall as specified in the contract documents to allow for placement of the wall.

B. Excavate the subgrade area to the required elevation and smooth as necessary for proper placement of the gabions or mattresses.

C. Prepare a firm unyielding subgrade foundation. In fill areas, construct and compact subgrade to no less than 95% of maximum Standard Proctor Density according to ASTM D 698.

D. If unsuitable foundation materials exist, remove and replace with suitable materials and compact to no less than 95% of maximum Standard Proctor Density according to ASTM D 698.

E. If specified in the contract documents, place and compact granular subbase materials to the dimensions specified in the contract documents.

3.02 ENGINEERING FABRIC

A. Install engineering fabric under the proposed gabion or mattress installation.

B. Extend fabric behind gabion walls to the top of the wall.

C. Overlap adjacent sections of engineering fabric a minimum of 3 inches, with the upstream strip on top.

3.03 CONNECTIONS

Make all connections with lacing wire or approved fasteners.

A. Lacing Wire:

1. Loop or twist lacing wire to secure it to the wire mesh or fabric.

2. Proceed to lace with alternating double and single loops through every mesh or fabric opening, approximately every 3 to 4 inches, pulling each loop tight.

3. Secure end of lacing wire to the wire mesh or fabric by twisting or looping.

B. Fasteners: Install fasteners according to manufacturer's specified spacing.

3.04 GABION ASSEMBLY AND INSTALLATION

A. Refer to the contract documents for special details of gabion wall installation including height, slope of wall, gabion setback, special backfill materials, and tieback requirements. Construct these features as specified in the contract documents.

B. Unfold baskets and flatten all kinks and bends. Erect the sides, ends, and diaphragms, ensuring all panels are in the correct position and the tops of all sides are aligned.

C. Connect the four corners of the gabion first, followed by connecting the diaphragms to the outside walls.

3.04 GABION ASSEMBLY AND INSTALLATION (Continued)

D. Install and secure gabion baskets together.

1. After initial assembly, move baskets into their final position.

2. Join empty baskets together along the vertical and top edges.

E. Fill gabion baskets with gabion stone.

1. When PVC coated baskets are specified, take care not to damage PVC coating during stone placement.

2. Fill baskets in lifts not exceeding 1 foot each.

3. Manually orient stones after placement of each lift.

4. Machine placement of stone will be allowed. However, considerable handwork is required to provide maximum density without bulges, a compact and dense exposed face, and maximum aggregate contact with the lid and other baskets to be placed in the structure.

5. For gabions 3 feet high, install internal connecting wires after placement of each lift. Internal connecting wires are not required on gabions with a height of 18 inches or less.
   a. Connect each exposed cell face to the opposite face or diaphragm with internal connecting wires.
   b. Install two connecting wires on each exposed face, in each cell, in between each lift.
   c. Locate wires with equal horizontal spacing approximately 1 foot apart.
   d. Install wires by looping each end around two mesh or fabric openings, then wrapping wire tightly around itself for at least four full turns, locking the end of the wire in place by lacing it under the previous lap.
   e. A 3 foot high cell with one exposed face requires four connecting wires. A 3 foot high end cell with two exposed faces requires eight connecting wires.

6. Fill adjacent cells consecutively. Do not allow stone fill in one cell to be more than 1 foot higher than an adjacent cell.

7. Overfill gabions 1 to 2 inches to allow for settlement.

F. Attach gabion lids.

1. Pull edges of lids tight until lid meets the perimeter edge of the gabion.

2. Install lacing wire or fasteners at edges and diaphragms to connect lid.

G. Place and compact backfill behind gabion walls to the same level as the filled gabions as gabions are installed.

H. If structure requires more than one layer, connect the upper empty baskets to the top of the completed lower gabions along the front and back edges of the baskets.

3.05 REVET MATTRESS ASSEMBLY AND INSTALLATION

A. Assemble revet mattresses in their final location. Unroll mattress and flatten all kinks and bends.

B. Erect the sides, ends, and diaphragms, ensuring that all panels are in the correct position and the tops of all sides are aligned.

3.05 REVET MATTRESS ASSEMBLY AND INSTALLATION (Continued)

C. Connect the four corners of the mattress first followed by connecting the diaphragms to the outside walls.

D. Join adjacent empty mattresses together along the vertical and top edges.

E. If anchor stakes are specified in the contract documents, install stakes at required spacing. Drive stakes into ground so the top of the stake is flush with the top of the mattress. Tie anchor stakes to baskets at the top and base of the mattress.

F. Fill revet mattresses with mattress stone.

1. When PVC coated baskets are specified, take care not to damage PVC coating during stone placement.

2. Machine placement of stone will be allowed. However, handwork is required to provide maximum density without bulges or voids.

3. Fill mattresses in stages as required to prevent bulges between adjacent cells.

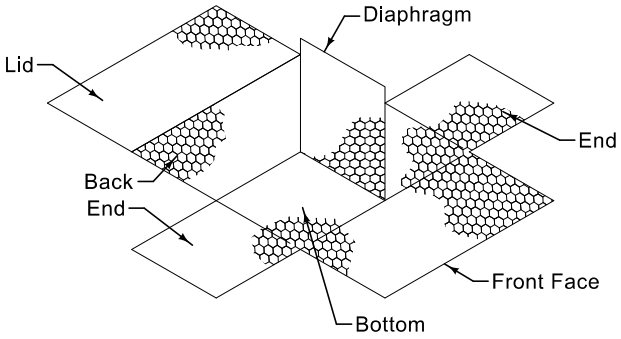
4. Overfill mattresses 1 to 2 inches to allow for natural settlement of stone.

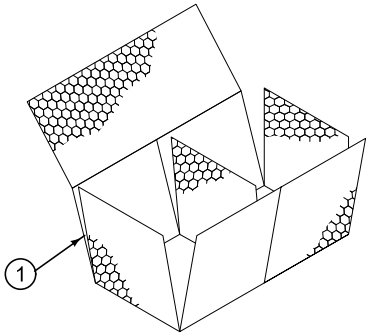
G. Attach mattress lids.

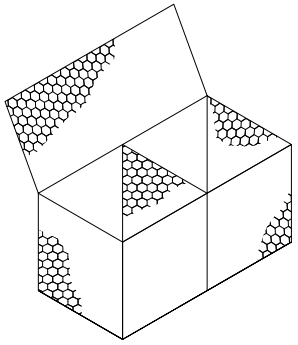
1. Pull edges of lids tight until lid meets the perimeter edge of the mattress.

2. Install lacing wire or fasteners at edges and diaphragms to connect lid.

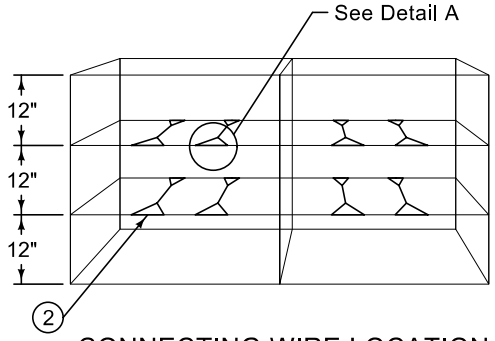
END OF SECTION



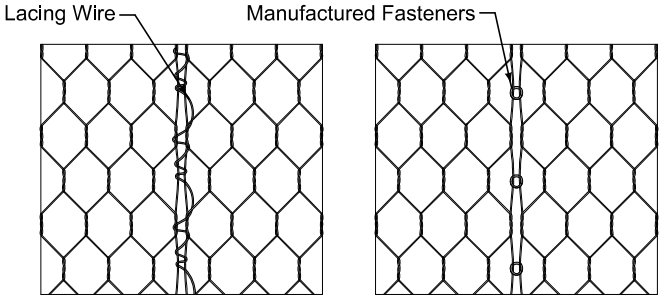




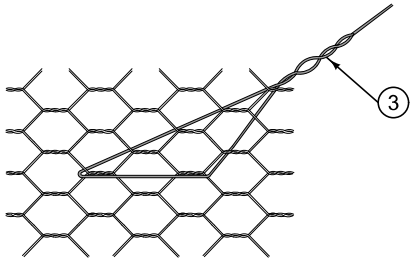
GABION ASSEMBLY



CONNECTING WIRE LOCATION



EDGE CONNECTIONS



DETAIL A

1. Connect edges of basket with lacing wire or fasteners.
2. Install connecting wires on exposed gabion faces.
3. Twist wire a minimum of four turns.

FIGURE 9050.101

SHEET 1 OF 1

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SHEET 1 of 1

SUDAS Standard Specifications

GABION ASSEMBLY

CHAIN LINK FENCE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Chain Link Fence

B. Removal and Reinstallation of Existing Fence

C. Temporary Fence

1.02 DESCRIPTION OF WORK

A. Installation of chain link fence.

B. Removal and reinstallation of existing fences.

C. Installation and removal of temporary fence.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Materials and color samples for vinyl-coated fence fabric.

B. Upon request, submit certification that products supplied comply with identified specifications.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Provide chain link fencing and gates as completed units, constructed by a single source, including necessary erection accessories, fittings, and fastenings.

1.08 MEASUREMENT AND PAYMENT

A. Chain Link Fence:

1. **Residential:**
   - **a. Measurement:** Measurement will be in linear feet for each type and height of fence, measured along the bottom of the fence fabric, excluding the length of gates.
   - **b. Payment:** Payment will be at the unit price per linear foot for each type and height of fence installed.
   - **c. Includes:** Unit price includes, but is not limited to, posts, fabric, rails, fittings, ties, PVC coating (if specified in the contract documents), excavation of post holes, and concrete encasement of posts.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Commercial:

a. Measurement: Measurement will be in linear feet for each type and height of fence, measured along the bottom of the fence fabric, excluding the length of gates.

b. Payment: Payment will be at the unit price per linear foot for each type and height of fence installed.

c. Includes: Unit price includes, but is not limited to, posts, fabric, rails, braces, truss rods, ties, tension wire, tension bands, tension bars, grounds, fittings, PVC coating (if specified in the contract documents), excavation of post holes, and concrete encasement of posts.

B. Gates:

1. Measurement: Each type, height, and span of gate will be counted.

2. Payment: Payment will be at the unit price for each type, height, and span of gate.

3. Includes: Unit price includes, but is not limited to, gate rails, fabric, stretcher bars, braces, vertical stay, hinges, latches, keepers, drop bar lock, center gate stop, and barbed wire (if specified in the contract documents).

C. Barbed Wire:

1. Measurement: Measurement will be in linear feet for the length of fence to which barbed wire is applied, measured along the top of fence.

2. Payment: Payment will be at the unit price per linear foot of barbed wire.

3. Includes: Unit price includes, but is not limited to, furnishing and installing all necessary strands of barbed wire, anchors, and barbed wire supporting arms.

D. Removal and Reinstallation of Existing Fence:

1. Measurement: Measurement will be in linear feet for each type and size of fence removed and reinstalled, measured along the bottom of the fence fabric, including length of gates.

2. Payment: Payment will be at the unit price per linear foot for each size and type of fence removed and reinstalled.

3. Includes: Unit price includes, but is not limited to, removing vegetation; removing all fence fabric, appurtenances, posts, and gates; removal of concrete encasement from posts; storage of the removed fencing materials to prevent damage; reinstallation of the posts, gates, and fabric, including all appurtenances; and replacement of any fence parts that are not able to be salvaged and reinstalled. Replace items damaged from Contractor's operations with new materials, at no additional cost to the Contracting Authority.

E. Removal of Fence:

1. Measurement: Measurement will be in linear feet of fence removed, measured along the bottom of fence fabric, including length of gates.

2. Payment: Payment will be at the unit price per linear foot of fence removed.

3. Includes: Unit price includes, but is not limited to, off-site disposal of fence (including posts, concrete encasement of posts, gates, grounds, and barbed wire) and placing and compacting backfill material in post holes.

1.08 MEASUREMENT AND PAYMENT (Continued)

F. Temporary Fence:

1. **Measurement:** Measurement will be in linear feet for each type and height of temporary fence, measured along the bottom of the fence fabric, excluding the length of gates.

2. **Payment:** Payment will be at the unit price per linear foot for each type and height of temporary fence.

3. **Includes:** Unit price includes, but is not limited to, furnishing, installing, and removing posts, fabric, ties, and fittings.

PART 2 - PRODUCTS

2.01 FABRIC

A. General: Provide fence fabric manufactured from wire meeting the requirements of ASTM A 817. Use No. 9 gauge wire woven in a 2 inch mesh. Construct knuckled selvedge at the top and bottom of the fabric.

B. Zinc-coated Fabric: Comply with ASTM A 392.

1. Wire Coated Prior to Weaving: Use Type II, Class 5 zinc coating per ASTM A 817.

2. Fabric Coated After Weaving: Use Class 2 coating per ASTM A 392.

C Aluminum-coated Fabric: Meet the requirements of ASTM A 491. Coat wire prior to weaving fabric per ASTM A 817, Type I coating.

D. PVC-coated Fabric: Comply with ASTM F 668, Class 2b.

1. Apply PVC coating to zinc or aluminum-coated wire prior to weaving fabric.

2. PVC coating color as specified in the contract documents, complying with ASTM F 934.

2.02 POSTS, RAILS, AND BRACES

A. Standard weight (Schedule 40) pipe complying with ASTM F 1083.

1. Galvanize pipe inside and out.

2. Unless otherwise specified in the contract documents, provide the following nominal sizes for the respective uses:

Post Use	**Fence Height**		
	48” and under (nominal diameter)	48” to 96” (nominal diameter)	Greater than 96” (nominal diameter)
Line Post	2”	2 1/2"	3”
Terminal Post*	2 1/2"	3”	4”
Top/intermediate Rail Braces	1 1/4"	1 1/4"	1 1/4"
Gate Post	Refer to contract documents and ASTM F 900		
*Includes corner, angle, end, and pull posts.			

B. Pipe meeting the requirements of ASTM F 1043, Group 1A (Type A coating) or Group 1C (Type B coating). Use nominal sizes specified in ASTM F 1043.

C. When PVC-coated fence is specified in the contract documents, coat all posts, rails, and braces with a PVC-coated finish according to ASTM F 1043.

1. Zinc-coated post per ASTM F 1083 prior to application of PVC coating.

2. Color as specified in the contract documents, complying with ASTM F 934.

D. Ensure all posts, rails, and braces provided for a given section of fence have similar coatings and shapes.

E. Provide caps for all posts. Comply with ASTM F 626.

2.03 FITTINGS

A. Comply with ASTM F 626.

B. Provide attachments to connect braces to posts by fittings that will hold both post and brace rigidly.

C. Provide 3/8 inch diameter round steel diagonal tension rods with an appropriate commercial means for tightening. Provide a locknut or other device to hold the tightening device in place.

D. Provide a suitable sleeve or coupling device, recommended by the manufacturer, to connect sections of top rail and provide for expansion and contraction.

E. Use stretcher (tension) bars of the size specified in ASTM F 626 with suitable bands for attaching fabric to corner, end, or gate posts.

2.04 TIE WIRE AND TENSION WIRE

A. Tie Wire: Provide tie wires for chain link fence that are the size and type the manufacturer recommends, but no smaller than No. 9 diameter for post ties or No. 12 diameter for rail and brace ties. Comply with ASTM F 626.

B. Tension Wire: Comply with ASTM A 824, with Type I or Type II (Class 3) coating per ASTM A 817.

2.05 BARBED WIRE SUPPORTING ARMS

A. Comply with ASTM F 626 for type of arm configuration specified in the contract documents, as listed below:
   1. Type I: Single slanted arm for three barbed wire strands.
   2. Type II: Single vertical arm for three barbed wire strands.
   3. Type III: V-shaped arm for six barbed wire strands.
   4. Type IV: A-shaped arm for five barbed wire strands.

B. Anchor arms to line, end, corner, and pull posts

2.06 BARBED WIRE

Comply with ASTM A 121, design number 12-4-5-14R, Type A or Type Z (Class 3) coating.

2.07 GATES

A. Provide the type, height, and width of gates as specified in the contract documents.

B. Comply with ASTM F 900.

C. Provide coating on gate, gate posts, and fabric as required for adjacent fence.

2.08 CONCRETE

Provide concrete materials complying with Section 6010.

2.09 ELECTRICAL GROUND

A. Ground Rod: 5/8 inch diameter, 8 foot long copper-clad rod.

B. Ground Wire: No. 6 AWG bare copper wire.

PART 3 - EXECUTION

3.01 CHAIN LINK FENCE INSTALLATION

A. General: Comply with ASTM F 567, except as modified herein. Construct fence at the location and height specified in the contract documents.

B. Posts:

1. Post Location:
a. Place posts in the line of the fence with equal spacing not to exceed 10 feet on center.
b. Set terminal (end, corner, and gate) posts at the beginning and end of each continuous length of fence and at abrupt changes in vertical and horizontal alignments. Place pull posts so that no more than 300 linear feet of fence is constructed with only line posts.

2. Post Setting:
a. Dig or drill post holes to the dimensions specified in the contract documents.
b. Set posts in concrete. Ensure all posts are set plumb in a vertical position.
c. Form top of concrete footing so it extends 1 inch above grade and is sloped to direct water away from the post. To prevent frost heave, ensure footing is a uniform size to full depth without flare at the top of grade.
d. Install posts no less than 24 hours prior to installation of fabric.
e. Set terminal, corner, angle, pull, and gate posts with the required brace-post assembly as specified in the contract documents.

C. Rails:

1. Top Rail: Pass the top rail through the base of the line post caps to form a continuous brace from end to end of each stretch of fence. Join rail sections with sleeve, swedge end, or coupling device to allow for expansion and contraction. Securely fasten the top rail to the terminal posts with pressed steel connectors.

2. Intermediate Rail: Securely fasten the intermediate rail between all line posts and terminal posts with pressed steel fasteners. Intermediate rail is required only on fences 8 feet tall and taller.

D. Braces:

1. Securely fasten braces to the post by means of malleable iron or pressed steel connections; then truss from the line post back to the end, gate, or corner post.

2. Tighten the diagonal tension rod (truss rod) to produce proper tension.

E. Fabric:

1. Install fabric on the outside of the posts from the area being fenced or on the roadway side of the posts.

2. Secure one end of the fabric by a stretcher bar inserted in the final link of the fabric. Pull fabric taut with bottom selvedge, 2 inches above grade, before making attachment elsewhere.

3. Tighten and secure each end of each run of chain link fabric by a stretcher bar inserted in the final link of the fabric. Secure stretcher bar to the end post by tension bands equally spaced no more than 15 inches apart.

4. Attach fence fabric securely to the braces, top rail, tension wire, and all intermediate posts with wire ties or bands at intervals of no more than 12 inches.

3.01 CHAIN LINK FENCE INSTALLATION (Continued)

F. Bottom Tension Wire:

1. Install bottom tension wire on fence 5 feet high and taller.

2. Stretch bottom tension wire taut from terminal post to terminal post and securely fasten to each intermediate post within the bottom 6 inches of fabric.

G. Barbed Wire (When Specified):

1. Install 3 parallel wires on each barbed wire supporting arm on the outside of the area being secured, unless otherwise specified in the contract documents.

2. Pull wires taut, without kinks or twists, for tension.

H. Gates: Install gates as specified in the contract documents.

I. Electrical Grounds:

1. Install electrical grounds as specified in the contract documents at the following locations:
   a) Where a primary electrical transmission line (not a secondary feeder line for individual service) passes over the fence. Also install the ground on the fence at a distance of 25 to 50 feet in each direction from the crossing.
   b) Where the fence is adjacent to and within 50 feet of a primary electrical transmission line, install the ground at 500 foot maximum intervals.
   c) In at least one location on each applicable straight section of fence.

2. Drive ground rod vertically until the top is 6 inches below the ground surface.

3. Clamp ground wire to the rod and to the fence in such a manner that each element of the fence is grounded.

3.02 REMOVAL OF EXISTING FENCE

Remove all fences, including posts and footings, within work areas unless otherwise specified in the contract documents. Remove fence to first line post beyond construction limits. Replace items damaged from Contractor's operations with new materials, at no additional cost to the Contracting Authority.

3.03 TEMPORARY FENCE

A. Furnish and install chain link fence fabric, posts, ties, and other materials for the height specified in the contract documents.

B. Install according to permanent fence installation specifications, with the following exceptions:

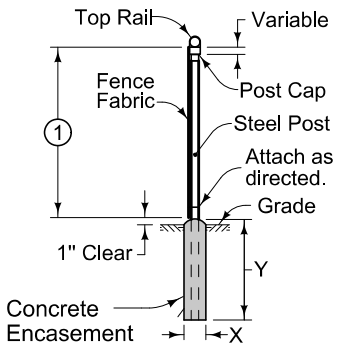
1. Drive posts into the ground. Do not set posts in concrete except at corner or temporary gate posts.

2. Top rail, tension wire, and bracing will not be required.

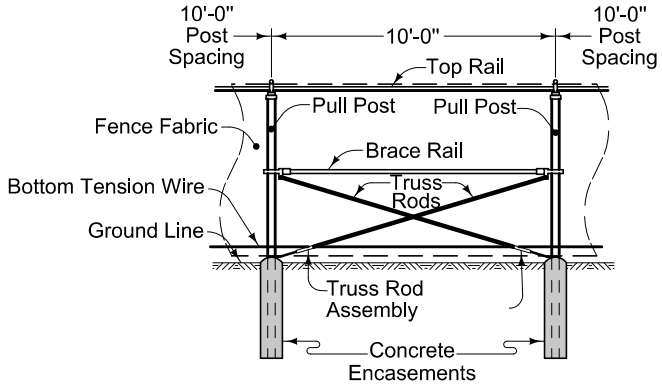
C. Remove temporary fence and materials when no longer necessary. Place suitable backfill material in post holes. Fence materials will remain the property of the Contractor and removed from the site.

END OF SECTION

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POST INSTALLATION



PULL POST INSTALLATION

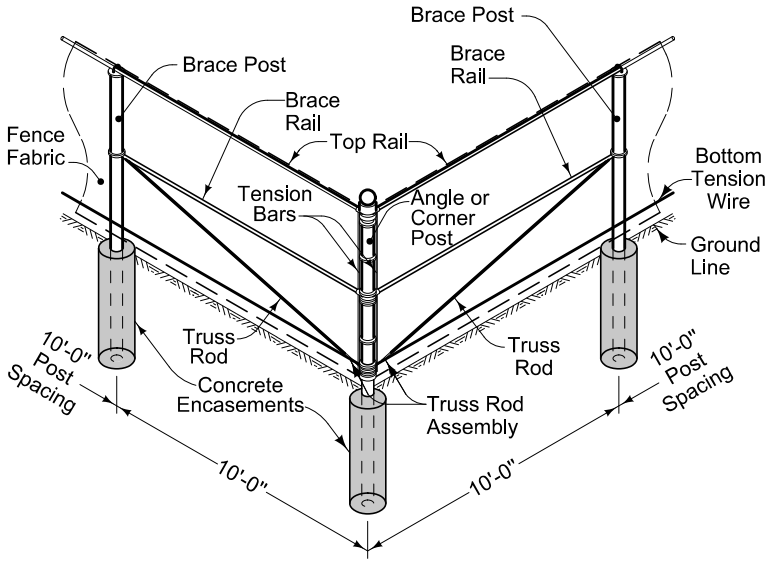
Place fence fabric on roadway side of post. For certain curves, stream crossings, or other locations, the Contractor has the option to place fabric on the side of the post away from the roadway.

Residential chain link fence does not include braces, truss rod assembly, tension wire, tension bar, tension band, or grounds

(1) Fabric width as specified in the contract documents.

(2) For fence heights greater than 8 feet, the depth of the fence post footing is 3 feet plus 3 inches for each 1 foot in height over 8 feet.

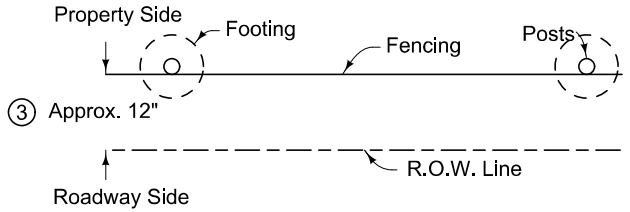
(3) Install the fence on the roadway side of the right-of-way when specified in the contract documents.



ANGLE OR CORNER POST INSTALLATION

FENCE POST FOOTING DEPTH AND DIAMETER

USE IN FENCE	FENCE HEIGHT					
	4'-0" and less		Over 4'-0" to 8'-0"		Over 8'-0"	
	X	Y	X	Y	X	Y
Line and Brace Posts	0'-8"	3'-0"	0'-10"	3'-0"	1'-0"	(2)
Terminal Post*	0'-10"	3'-0"	1'-0"	3'-0"	1'-4"	(2)
*Includes corner, angle, end, and pull posts.						



PLAN OF FENCE

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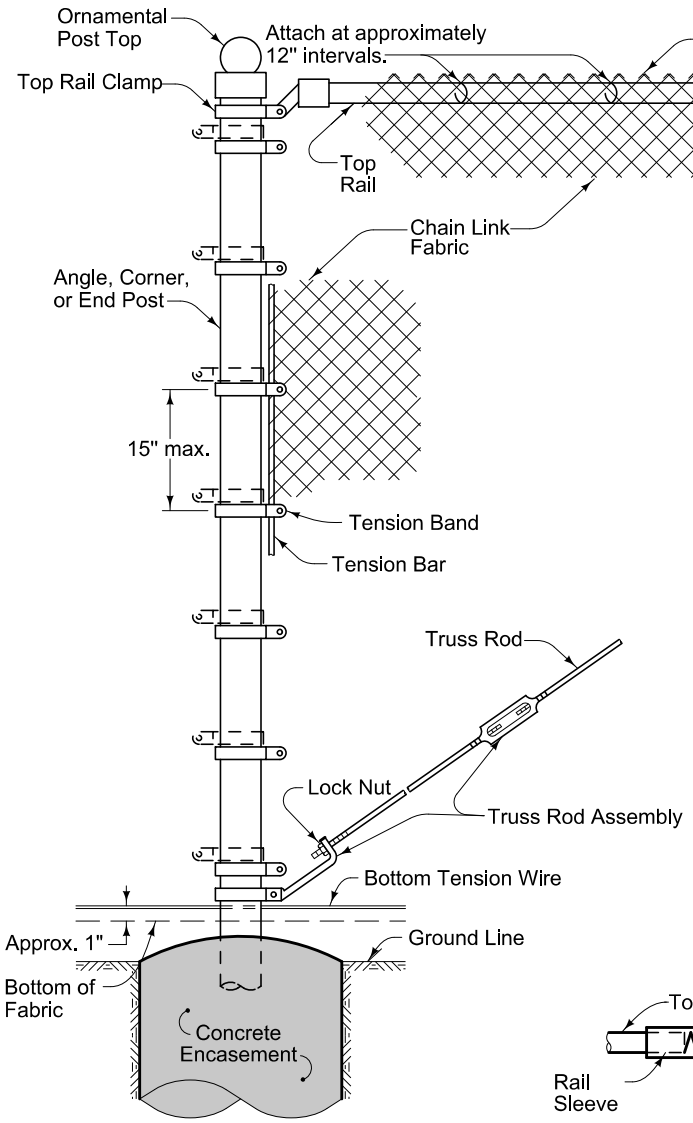
SHEET 1 of 2

SUDAS Standard Specifications

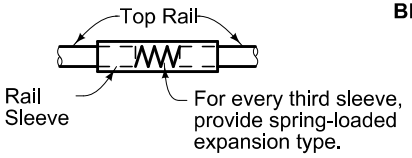
CHAIN LINK FENCE

FIGURE 9060.101

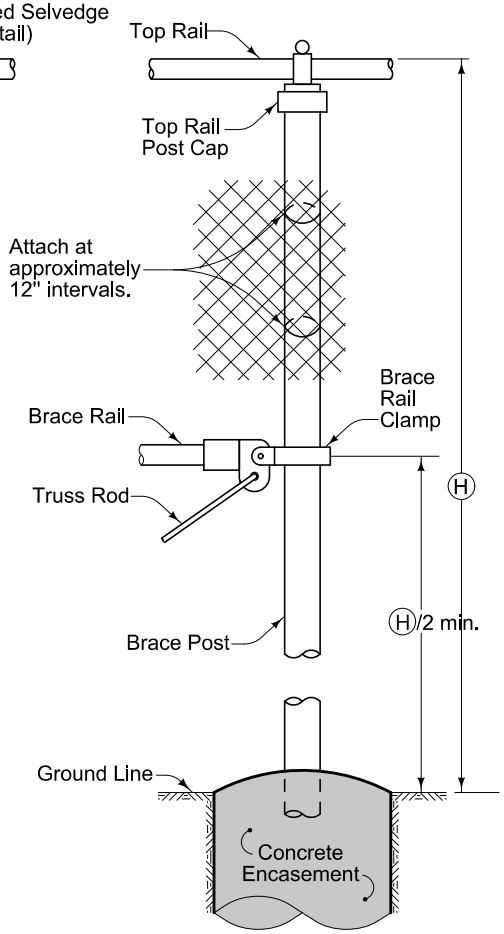
SHEET 1 OF 2



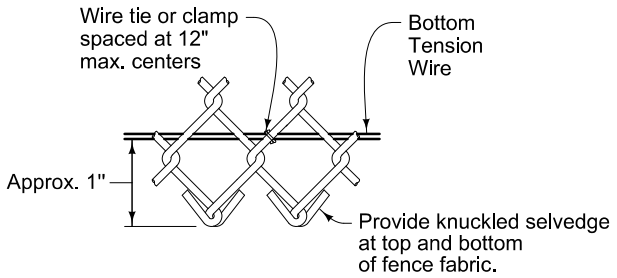
ANGLE, CORNER, OR END POST ASSEMBLY



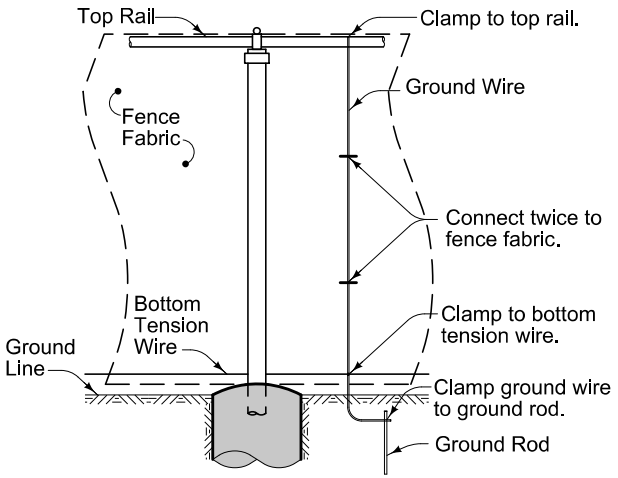
RAIL SLEEVE



BRACE POST ASSEMBLY



BOTTOM TENSION WIRE AND KNUCKLED SELVEDGE



GROUND ROD INSTALLATION

FIGURE 9060.101

SHEET 2 OF 2

SUDAS

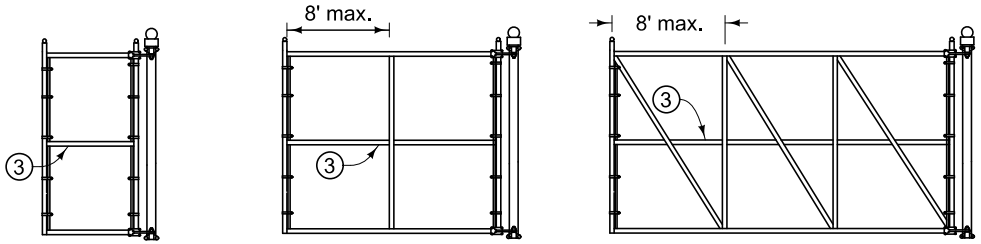
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SUDAS Standard Specifications

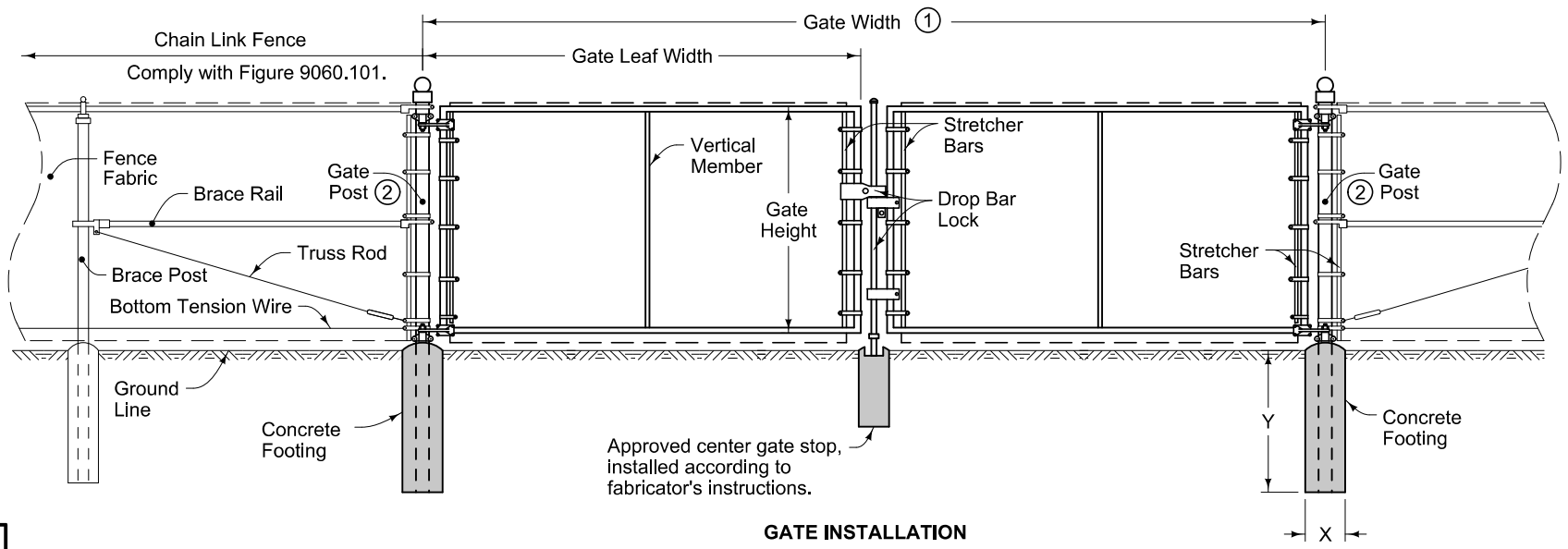
CHAIN LINK FENCE



8' AND LESS | OVER 8' UP TO 16' | OVER 16' UP TO 18'

FRAME PATTERNS FOR VARIOUS GATE OPENINGS

1. Double swing gate is required only for widths greater than 16 feet. Exact details of gate design are subject to approval of the Engineer. Furnish gate with approved stop, latch, and means for locking. Install as recommended by the manufacturer.
2. End post used to terminate run of fence if no gate is proposed.
3. Horizontal members are required only if the fabric height is 8 feet or greater.



GATE INSTALLATION

GATE POST FOOTING DEPTH AND DIAMETER

GATE HEIGHT	GATE LEAF WIDTH	X	Y
6'-0" or less	4'-0" or less	0'-10"	3'-0"
6'-0" or less	over 4'-0" to 10'-0"	0'-12"	3'-0"
6'-0" or less	over 10'-0" to 18'-0"	1'-2"	3'-0"
over 6'-0"	6'-0" or less	0'-10"	3'-0"
over 6'-0"	over 6'-0" to 12'-0"	1'-0"	3'-0"
over 6'-0"	over 12'-0" to 18'-0"	1'-4"	3'-6"
over 6'-0"	over 18'-0" to 24'-0"	1'-6"	4'-0"

FIGURE 9060.102 | SHEET 1 OF 1

SUDAS

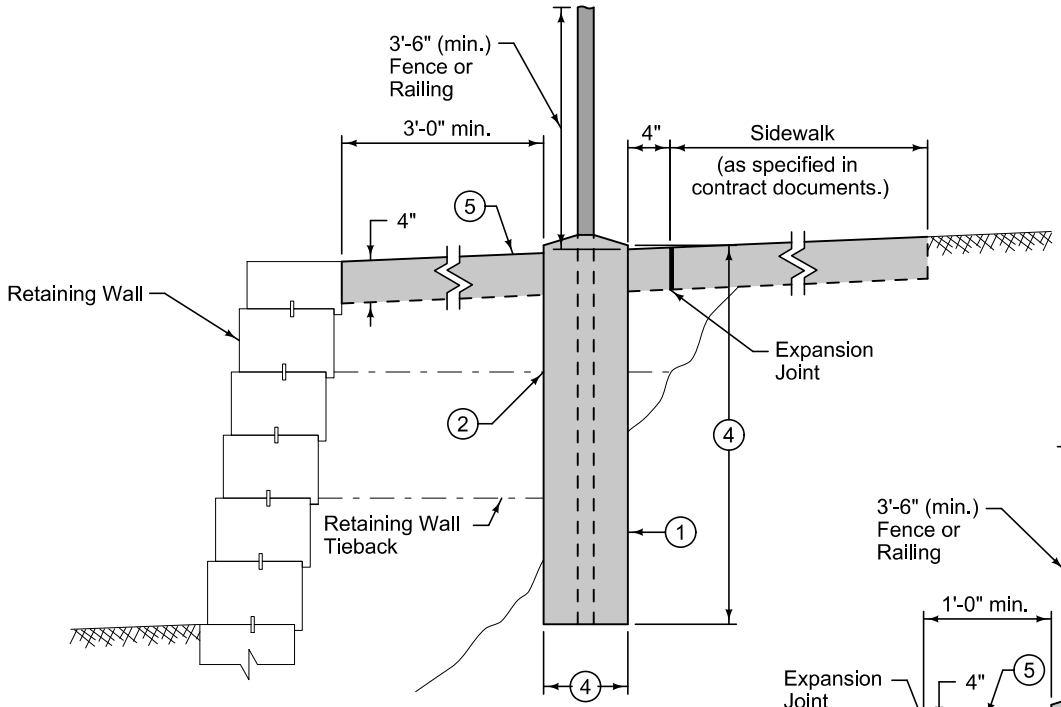
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9060.102

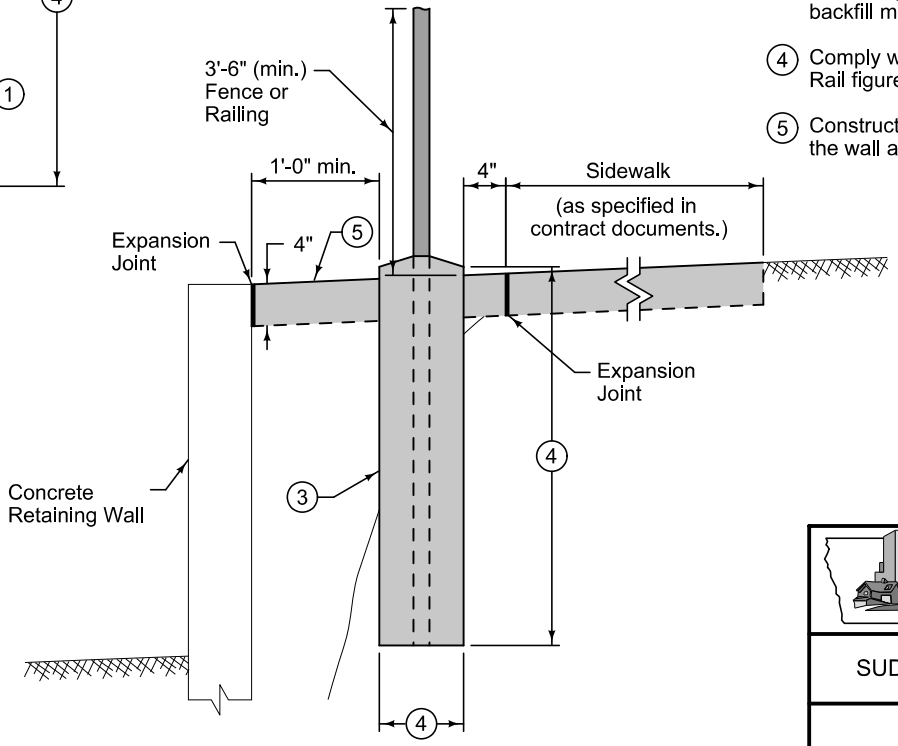
SHEET 1 of 1

SUDAS Standard Specifications

CHAIN LINK GATE



RETAINING WALL



CONCRETE RETAINING WALL

1. For modular block retaining walls, install column tube or PVC pipe as backfill material is placed. When fence is installed after backfill material is placed, utilize hand excavation of post hole footings to avoid damaging engineering fabric tiebacks.

   For landscape timber walls, locate fence posts to avoid timber tiebacks.

2. Cut or displace engineering fabric tiebacks (if present) around column tube or PVC pipe.

3. Column tubes or PVC pipes may installed behind PCC retaining walls during placement of backfill material or post holes may be excavated upon completion of backfill material placement.

4. Comply with Chain Link Fence or Safety Rail figures for post footing dimensions.

5. Construct a PCC cap between the back of the wall and the fence or rail.

FIGURE 9060.103 | SHEET 1 OF 1

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9060.103

SHEET 1 of 1

SUDAS Standard Specifications

POST INSTALLATION
ADJACENT TO RETAINING WALLS

LANDSCAPE RETAINING WALLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Modular Block Retaining Walls

B. Limestone Retaining Walls

C. Landscape Timber Retaining Walls

1.02 DESCRIPTION OF WORK

A. Construction of modular block retaining walls.

B. Construction of limestone retaining walls.

C. Construction of landscape timber retaining walls.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Upon request, submit certification that products supplied comply with identified specifications.

B. Test results on modular blocks, if required.

C. Catalog cuts for modular retaining wall blocks and cap stones indicating the size, type, and color proposed for installation.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Modular Block Retaining Wall:

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall, including coping or cap stones.

2. **Payment:** Payment will be at the unit price per square foot of retaining wall.

3. **Includes:** Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing wall units, geogrid (if necessary), leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, granular backfill material, suitable backfill material, and shoring as necessary.

B. Limestone Retaining Wall:

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall.

2. **Payment:** Payment will be at the unit price per square foot of retaining wall.

3. **Includes:** Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing leveling pad, limestone, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

C. Landscape Timbers:

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall.

2. **Payment:** Payment will be at the unit price per square foot of retaining wall.

3. **Includes:** Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing leveling pad, landscape timbers, spikes, reinforcing bar, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

D. Excavation and Suitable Backfill Material: If bid separately, excavation for wall construction and placement of suitable backfill material will be measured and paid according to Section 2010, 1.08.

E. Fence: Comply with Section 9060, 1.08, A.

F. Safety Rail: Comply with Section 9080, 1.08, C.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Modular Block Walls:

1. Dry-cast Concrete Wall Units:
a. Comply with ASTM C 1372 and Iowa DOT Section 2430. Test units and provide samples according to ASTM C 140.
b. Provide certification that the blocks comply with the freeze-thaw durability requirements of ASTM C 1262 and Iowa DOT Materials I.M. 445.04.
c. Furnish from an approved supplier listed in Iowa DOT Materials I.M. 445.04, Appendix A (MAPLE).
d. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
1) Iowa DOT Materials I.M. 445.04, Appendix B (MAPLE) lists approved systems.
2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.04.
3) Submit results of test data to the Engineer.

2. Wet-cast Concrete Wall Units: Comply with Iowa Section 2430.
a. Furnish from an approved supplier listed in Iowa DOT Materials I.M. 445.05, Appendix A (MAPLE).
b. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
1) Iowa DOT Materials I.M. 445.05, Appendix B (MAPLE) lists approved systems.
2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.05.
3) Submit results of test data to the Engineer.

B. Limestone: Furnish limestone slabs with a flat bottom and top and a clean face. Provide slabs with a minimum depth of 8 inches, or as specified in the contract documents, to ensure stability of the wall.

C. Landscape Timbers:

1. Minimum 6 inch by 6 inch (nominal) pressure-treated landscape timbers rated for ground contact. Ensure timbers are straight, solid, have at least three good sides, and are free of visible dry rot, with only a minor amount of splitting or cracking. Ensure all timbers used in a wall have the same cross-sectional area.

2. Provide 3/8 inch diameter galvanized spikes, 10 to 12 inches long.

D. Leveling Pad: Provide material recommended by the wall manufacturer or supplier.

1. Granular Material: Comply with Iowa DOT Section 4132.

2. Concrete: Comply with Section 6010. Provide Class C Concrete.

E. Subdrain: Comply with Section 4040, 2.02. Minimum 4 inch diameter pipe.

F. Porous Backfill Material (for Subdrain): Comply with Section 4040, 2.04.

G. Engineering Fabric: Provide fabric complying with Iowa DOT Article 4196.01 for subsurface drainage.

H. Unit Fill Material: Comply with Iowa DOT Section 4131.

2.01 MATERIALS (Continued)

I. Backfill Material:

1. Granular Backfill Material: Comply with Iowa DOT Section 4133 when granular backfill material is necessary according to the manufacturer's requirements. Crushed stone meeting the requirements of Iowa DOT Section 4131 maybe substituted for granular backfill.

2. Suitable Backfill Material: Comply with Section 2010.

J. Fence: If the contract documents require a fence, comply with Section 9060.

K. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

PART 3 - EXECUTION

3.01 EXCAVATION AND EMBANKMENT

A. Prior to beginning wall construction, compact proposed embankment behind the wall according to the field quality control requirements of Section 2010 with the following exception: compact to a minimum of 90% of maximum Standard Proctor Density.

B. Excavate to the line and grade specified in the contract documents. Minimize over-excavation. Install sheeting, shoring, or other retention systems as required to ensure the stability of the excavation.

3.02 INSTALLATION

A. General:

1. Height: Overall wall height is limited to 4 feet.

2. Foundation Soil Preparation: Excavate and compact 12 inches of native soil beneath the leveling pad to 95% of maximum Standard Proctor Density.

3. Leveling Pad:
a. Construct a minimum 6 inch thick leveling pad of granular material, at a depth such that the entire first course will be completely below the finished grade at the base of the wall.
b. Compact granular material with a minimum of three passes of a vibratory plate compactor.

4. Subdrain:
a. Install subdrain behind the first course of retaining wall. Place porous backfill material around the subdrain to a minimum cover of 3 inches, and ensure a trench width of at least 8 inches.
b. Wrap porous backfill material with engineering fabric.
c. Ensure positive drainage on subdrain, and outlet subdrains into a storm sewer or along a slope at an elevation lower than the lowest point in the pipe behind the wall.

5. Fence: If the contract documents require a fence, comply with Section 9060.

6. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

B. Modular Block Retaining Wall:

1. Unit Installation:
a. Place units side by side for the full length of wall alignment. Establish alignment by means of a string line or offset from the base line.
b. Ensure units are in full contact with the leveling pad.
c. Install connecting pins. Fill open cells of blocks with unit fill material; tamp the fill.
d. Sweep all excess material from top of units and install the next course. Ensure each course is completely filled prior to proceeding to the successive course.
e. Place each course so that pins protrude into adjoining courses a minimum of 1 inch or to tolerances recommended by the supplier/manufacturer. Two pins are required per unit. Repeat the above procedure for each course to the top of wall height.
f. At the end of each course, where the wall changes elevation, turn the units into the backfill material. Place units to create the minimum radius possible. Install a minimum of three units into the grade. Ensure only the front face of the units is visible from the side of the wall.

3.02 INSTALLATION (Continued)

2. Backfill Material Placement:

a. Place each lift of granular backfill material following the erection of each lift of wall. Where reinforcement material is present, roughly level the backfill material before placing and connecting the reinforcement. If necessary, decrease the lift thickness to obtain the specified density.

b. At the end of each day's operations, shape the last level of backfill material to allow runoff of rain water away from the wall face.

c. Compact granular backfill material according to the field quality control requirements of Section 2010 with the following exception: ensure the moisture content falls within a range from 3% under optimum moisture to no more than the optimum moisture content.

d. Place and compact backfill material without disturbing or distorting the tieback reinforcement (if present) or the wall. Do not use tamping type rollers or other rollers that may damage the reinforcing. Use light mechanical tampers to achieve the required compaction in a strip 3 feet wide adjacent to the backside of the wall; compaction density testing will not be required within 3 feet of the back of the wall.

3. Tieback Reinforcement Installation: Install tieback reinforcement according to the manufacturer's requirements.

C. Limestone Retaining Wall:

1. Place limestone slabs. Ensure adjacent slabs are in full contact without gaps.

2. Stagger vertical joints so no joint is located closer than 2 feet to a joint in the course below it.

3. After each course is laid, place backfill material behind the wall and compact with hand tools to a density equal to or greater than the existing soil behind the wall.

D. Landscape Timbers:

1. Lay first course of timbers horizontally, ensuring timbers are level. Set back each succeeding course 1/2 inch.

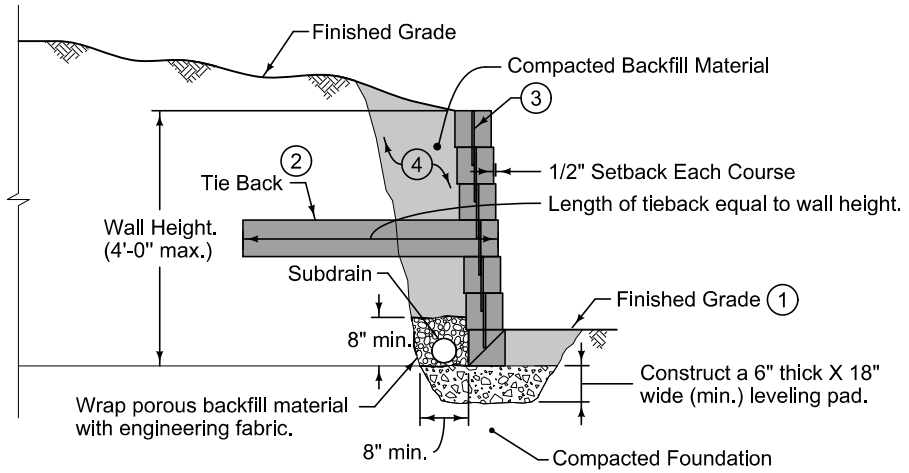
2. Secure each course to the course below it using spikes placed 2 feet from each joint and spaced at no more than 4 feet. Drill pilot holes in timbers to facilitate installation of spikes.

3. Stagger vertical joints so no joint is located closer than 2 feet to a joint in the course below it.

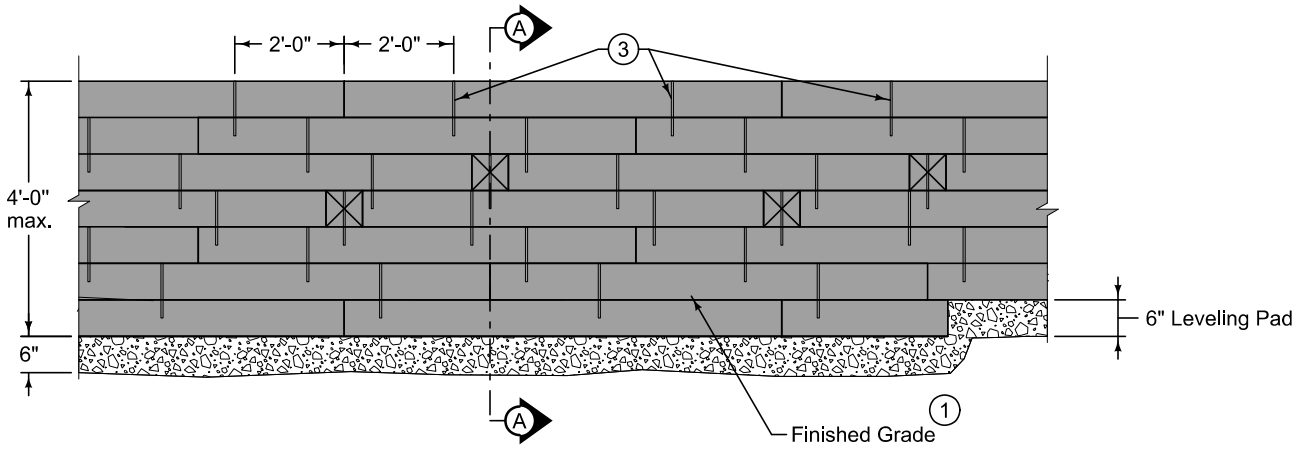
4. Install tiebacks with length equal to the wall height, perpendicular to the wall face, spaced at 8 feet. Stagger location of tieback on each course. Do not install tiebacks in bottom three courses or upper two courses of timbers. Ensure the end of the tieback is flush with the front of the retaining wall. Attach tieback to course below it using a spike.

5. After each course is laid, place backfill material behind the wall and compact with hand tools to a density equal to or greater than the existing soil behind the wall.

END OF SECTION



SECTION A-A



ELEVATION

1. Construct entire first course of timbers beneath finished grade.
2. No tie backs in upper two courses or lower three courses of timbers. Stagger tie back location.
3. Secure each course with spikes.
4. Excavate and place backfill material. Use suitable soil or granular material.

FIGURE 9070.101 | SHEET 1 OF 1

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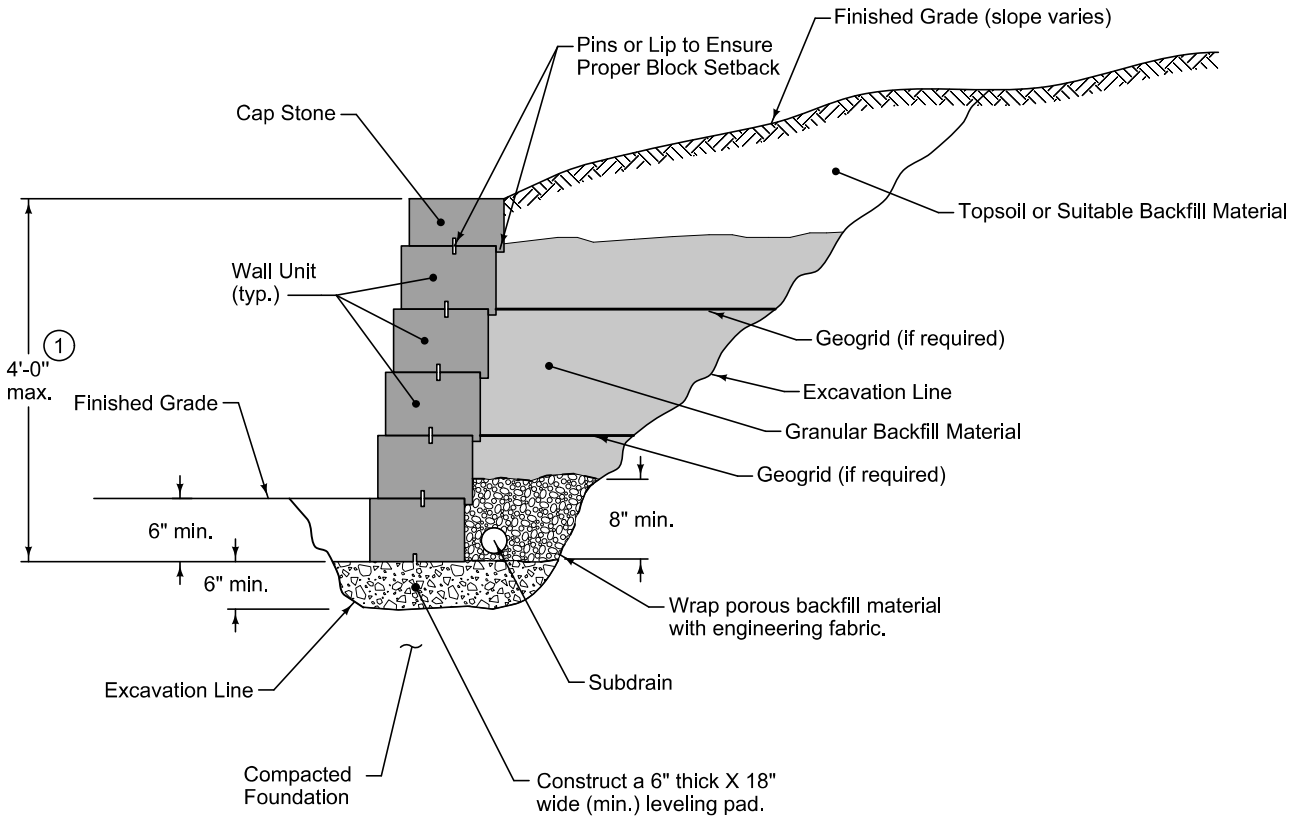
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SUDAS Standard Specifications

LANDSCAPE TIMBER RETAINING WALL

Exact dimensions, wall batter, backfill limits, reinforcement, and leveling pad materials and dimensions will be specified by the wall manufacturer.

(1) For walls higher than 4 feet, use segmental block retaining wall.



TYPICAL SECTION

FIGURE 9070.102

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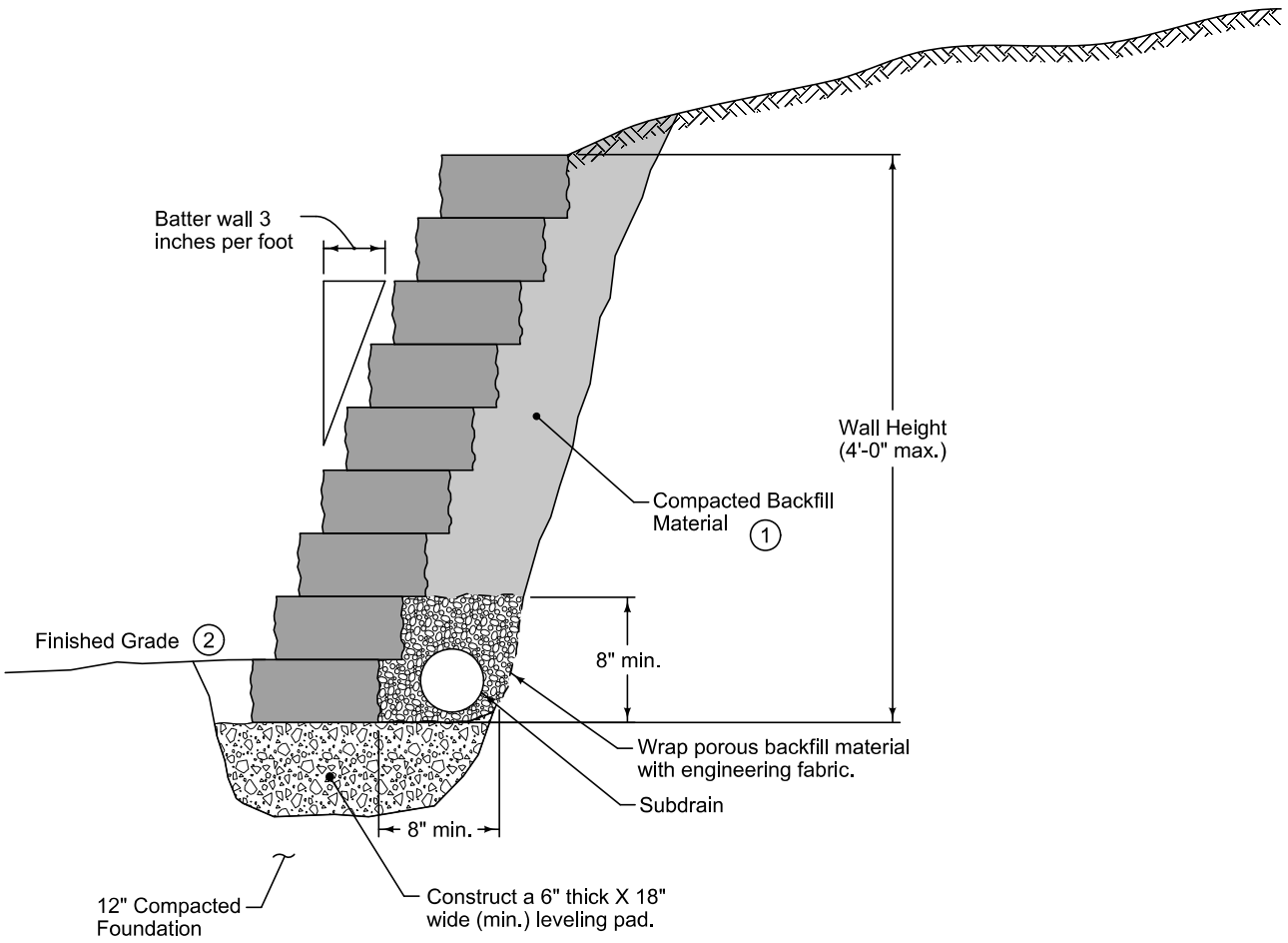
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SUDAS Standard Specifications

MODULAR BLOCK RETAINING WALL

(1) Compact backfill material as wall construction progresses.

(2) Construct entire first course of limestone below finished grade.



TYPICAL SECTION

FIGURE 9070.103

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SUDAS Standard Specifications

LIMESTONE RETAINING WALL

SEGMENTAL BLOCK RETAINING WALLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

Segmental Block Retaining Walls

1.02 DESCRIPTION OF WORK

Constructing segmental block retaining walls.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Upon request, submit certification that products supplied comply with identified specifications.

B. Detailed design calculations (including soil bearing pressure), construction drawings, and shop drawings for all segmental block retaining walls, prepared by a licensed Professional Engineer in the State of Iowa.

C. A detailed explanation of the design properties of geogrid reinforcement and quality control tests limits.

D. Test results on segmental blocks, if required.

E. Catalog cuts of segmental retaining wall blocks and cap stones indicating the size, type, and color specified for installation.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. A licensed Professional Engineer in the State of Iowa must prepare, sign, and seal detailed design calculations, construction drawings, and shop drawings for all segmental block retaining walls.

B. Ensure design complies with the National Concrete Masonry Association (NCMA) “Design Manual for Segmental Retaining Walls.”

1.08 MEASUREMENT AND PAYMENT

A. Segmental Block Retaining Wall:

1. **Measurement:** Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall, including coping or cap stones.

2. **Payment:** Payment will be at the unit price per square foot of retaining wall.

3. **Includes:** Unit price includes, but is not limited to, design by a Licensed Professional Engineer in the State of Iowa, excavation, foundation preparation, furnishing and placing wall units, geogrid, leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

B. Excavation and Suitable Backfill Material: If bid separately, excavation for wall construction and placement of suitable backfill material will be measured and paid according to Section 2010, 1.08.

C. Granular Backfill Material:

1. **Measurement:** Measurement will be in tons for material used in connection with segmental block retaining walls.

2. **Payment:** Payment will be at the unit price per ton of granular backfill material.

3. **Includes:** Unit price includes, but is not limited to, furnishing, transporting, placing, and compacting material.

D. Fence: Comply with Section 9060, 1.08, A.

E. Safety Rail: Comply with Section 9080, 1.08, C.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Segmental Block Walls:

1. Dry-cast Concrete Wall Units:
a. Comply with ASTM C 1372 and Iowa DOT Section 2431. Test and provide samples according to ASTM C 140.
b. Provide certification that the blocks comply with the freeze-thaw durability requirements of ASTM C 1262 and the additional requirements for concrete units of Iowa DOT Materials I.M. 445.04.
c. Furnish from an approved supplier.
1) Iowa DOT Materials I.M. 445.04, Appendix A (MAPLE) lists approved suppliers.
2) Provide written certification that blocks comply with ASTM C 1372 and the additional materials requirements of Iowa DOT Materials I.M. 445.04, Appendix A (MAPLE).
d. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
1) Iowa DOT Materials I.M. 445.04, Appendix B (MAPLE) lists approved systems.
2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.04.
3) Submit results of test data to the Engineer.

2. Wet-cast Concrete Wall Units: Comply with the materials and compressive strength requirements of Iowa DOT Section 2431 and Materials I.M. 445.05.
a. Furnish from an approved supplier.
1) Iowa DOT Materials I.M. 445.05, Appendix A (MAPLE) lists approved suppliers.
2) Provide written certification that blocks comply with Iowa DOT Materials I.M. 445.05.
b. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
1) Iowa DOT Materials I.M. 445.05, Appendix B (MAPLE) lists approved systems.
2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.05.
3) Submit results of test data to the Engineer.

3. Geogrid: Provide geogrid as specified in the retaining wall design.

B. Leveling Pad: Provide material recommended by the wall manufacturer or supplier.

1. Granular Material: Comply with Iowa DOT Section 4132.

2. Concrete: Comply with Section 6010. Use Class C Concrete.

C. Subdrain: Comply with Section 4040, 2.02. Minimum 4 inch diameter pipe.

D. Porous Backfill Material (for Subdrain): Comply with Section 4040, 2.04.

E. Engineering Fabric: Provide fabric complying with Iowa DOT Article 4196.01 for subsurface drainage.

F. Unit Fill Material: Comply with Iowa DOT Section 4131.

2.01 MATERIALS (Continued)

G. Backfill Material:

1. Granular Backfill Material: Comply with Iowa DOT Section 4133 within the reinforced earth zone of segmental block retaining walls. Crushed stone meeting the requirements of Iowa DOT Section 4131 may be substituted for granular backfill.

2. Suitable Backfill Material: Comply with Section 2010.

H. Fence: If the contract documents require a fence, comply with Section 9060.

I. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

PART 3 - EXECUTION

3.01 EXCAVATION AND EMBANKMENT

A. Prior to beginning wall construction, compact proposed embankment behind the wall according to the field quality control requirements of Section 2010 with the following exception: compact to a minimum of 90% of maximum Standard Proctor Density.

B. Excavate to the line and grade specified in the contract documents. Minimize over-excavation. Install sheeting, shoring, or other retention systems as required to ensure the stability of the excavation.

3.02 INSTALLATION

A. Foundation Soil Preparation: Excavate and compact 12 inches of native soil beneath the leveling pad to 95% of maximum Standard Proctor Density.

B. Leveling Pad: Construct a minimum 6 inch thick leveling pad of material as specified in the contract documents.

C. Unit Installation: Install materials at the proper elevation and orientation specified in the contract documents. Install the concrete segmental units and geogrid reinforcement according to the approved submittals.

D. Subdrains:

1. Install subdrains as specified in the contract documents to maintain gravity flow of water to the outside of the reinforced earth zone. Outlet subdrains into a storm sewer or along a slope at an elevation lower than the lowest point of the pipe within the reinforced earth zone.

2. Place porous backfill material around the subdrain to a minimum cover of 3 inches.

3. Wrap porous backfill material with engineering fabric.

E. Backfill Material Placement:

1. Place the backfill material in maximum 8 inch lifts, spread, and compact in such a manner that eliminates the development of wrinkles and/or movement of the geogrid reinforcement.

2. Compact granular backfill material according to the field quality control requirements of Section 2010 with the following exception: ensure the moisture content falls within a range from 3% under optimum moisture to no more than the optimum moisture content.

3. Use only hand-operated compaction equipment within 3 feet of the front of the wall face.

4. Do not operate tracked construction equipment directly on the geogrid reinforcement. A minimum thickness of 6 inches of backfill material is required over the geogrid reinforcement prior to operation of tracked vehicles. Minimize turning of tracked vehicles to prevent tracks from displacing the fill and damaging the geogrid reinforcement.

5. Rubber-tired equipment may pass over the geogrid reinforcement, if done according to the manufacturer's recommendations. Avoid sudden braking and sharp turning.

3.02 INSTALLATION (Continued)

F. Geogrid Installation:

1. Do not overlap the geogrid in the design strength direction; use one continuous piece of material. The design strength direction is perpendicular to the wall face. Butt adjacent sections of geogrid in a manner to ensure 100% coverage after placement.

2. Install the geogrid reinforcement under tension. Apply a nominal tension to the reinforcement and maintain it by staples, stakes, or hand tensioning. The tension applied may be released after the geogrid reinforcement has been covered and held in place with soil fill.

G. Fence: If the contract documents require a fence, comply with Section 9060.

H. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

END OF SECTION

COMBINED CONCRETE SIDEWALK AND RETAINING WALL

PART 1 - GENERAL

1.01 SECTION INCLUDES

Combined Concrete Sidewalk and Retaining Wall

1.02 DESCRIPTION OF WORK

Constructing combined concrete sidewalk and retaining wall.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Upon request, submit certification that products supplied comply with identified specifications.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Combined Concrete Sidewalk and Retaining Wall:

1. **Measurement:** Measurement will be in cubic yards for the volume of combined sidewalk and retaining wall.

2. **Payment:** Payment will be at the unit price per cubic yard of combined sidewalk and retaining wall.

3. **Includes:** Unit price includes, but is not limited to, excavation; foundation preparation; furnishing and placing concrete and reinforcing steel; joint material; subdrain; porous backfill material; suitable backfill material; finishing disturbed areas; and shoring as necessary.

B. Fence: Comply with Section 9060, 1.08, A.

C. Safety Rail: Comply with Section 9080, 1.08, C.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Combined Concrete Sidewalk and Retaining Wall:

1. **Portland Cement Concrete:** Comply with Section 6010, 2.03.

2. **Reinforcing Steel:** Comply with Iowa DOT Section 4151.

3. **Expansion Joint:** Comply with Iowa DOT Article 4136.02. Use resilient filler when the type is not specified.

B. Subdrain: Comply with Section 4040, 2.02. Minimum 4 inch diameter.

C. Porous Backfill Material (for Subdrain): Comply with Section 4040, 2.04.

D. Suitable Backfill Material: Comply with Section 2010.

E. Rodent-proof Hardware Cloth: Comply with Iowa DOT Materials I.M. 443.01.

F. Fence: If the contract documents require a fence, comply with Section 9060.

G. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

PART 3 - EXECUTION

3.01 EXCAVATION AND EMBANKMENT

A. Prior to beginning wall construction, compact proposed embankment behind the wall according to the field quality control requirements of Section 2010 with the following exception: compact to a minimum of 90% of maximum Standard Proctor Density.

B. Excavate to the line and grade specified in the contract documents. Minimize over-excavation. Install sheeting, shoring, or other retention systems as required to ensure the stability of the excavation.

3.02 INSTALLATION

A. General:

1. Comply with Section 6010.

2. Forming the back of the wall is not required. Where the back of the walls is not formed and sloughing occurs, remove the loose material, and replace with concrete at no additional cost to the Contracting Authority.

3. Install 3 inch diameter weep holes at 8 foot intervals. Form weep holes with an approved rustproof device backed with rodent-proof hardware cloth.

4. Install 8 inch wide trench of porous backfill behind the wall. Install subdrain within porous backfill trench. Ensure positive drainage on subdrain.

B. Backfill Material Placement:

1. Place the backfill material in maximum 8 inch lifts, spread, and compact.

2. Compact granular backfill material according to the field quality control requirements of Section 2010 with the following exception: ensure the moisture content falls within a range from 3% under optimum moisture to no more than the optimum moisture content.

3. Use only hand-operated compaction equipment within 3 feet of the front of the wall face.

C. Fence: If the contract documents require a fence, comply with Section 9060.

D. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

3.03 JOINTS

A. Form ED joints in the wall at no more than 60 foot spacing. Affix expansion material to retaining wall.

B. Form C joints in the wall at no more than 20 foot spacing.

C. Form E joints in the sidewalk to coincide with ED joints in the wall. Form C joints in the sidewalk at spacing equal to the sidewalk width.

D. Form a longitudinal joint in the sidewalk when the sidewalk width is greater than 8 feet.

3.04 RUSTICATION

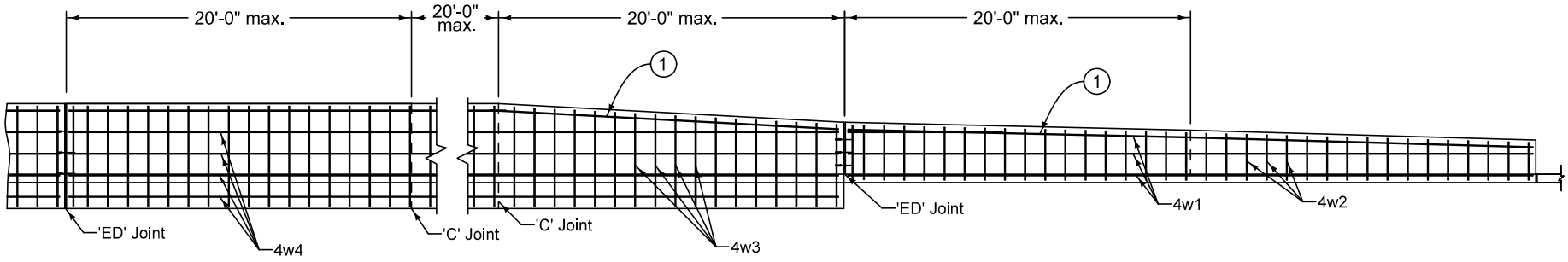
Decorative form liners or inserts may be used when forming the face of the wall with the approval of the Engineer. Form rustications as specified in the contract documents.

END OF SECTION

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Provide a minimum concrete cover to near reinforcement of 1 1/2 inches. Provide 3 inches minimum cover at the ends of bars.

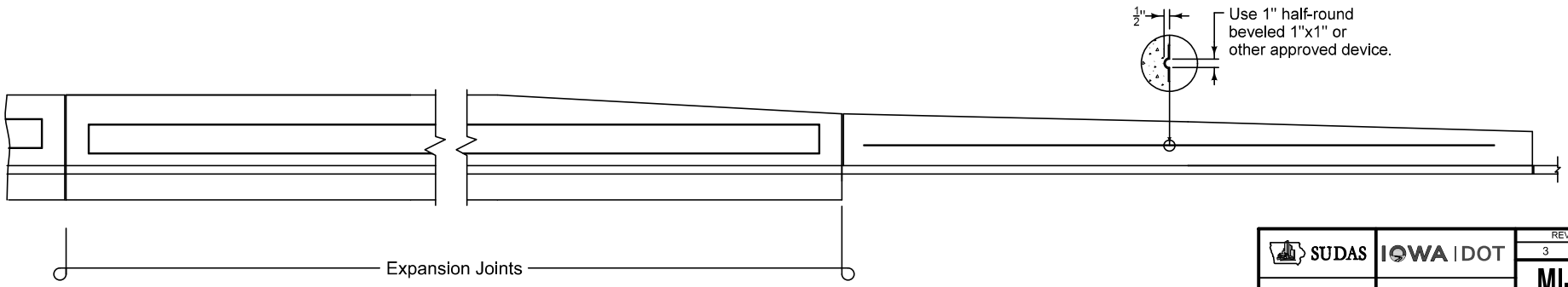
(1) Top bar parallel to top of wall. Lap 6 inch minimum as necessary. Tie securely.



TYPE B WALL

TYPE A WALL

TYPICAL LONGITUDINAL SECTION OF RETAINING WALL



TYPICAL RUSTICATION DETAIL

FIGURE 9072.221 | SHEET 1 OF 2

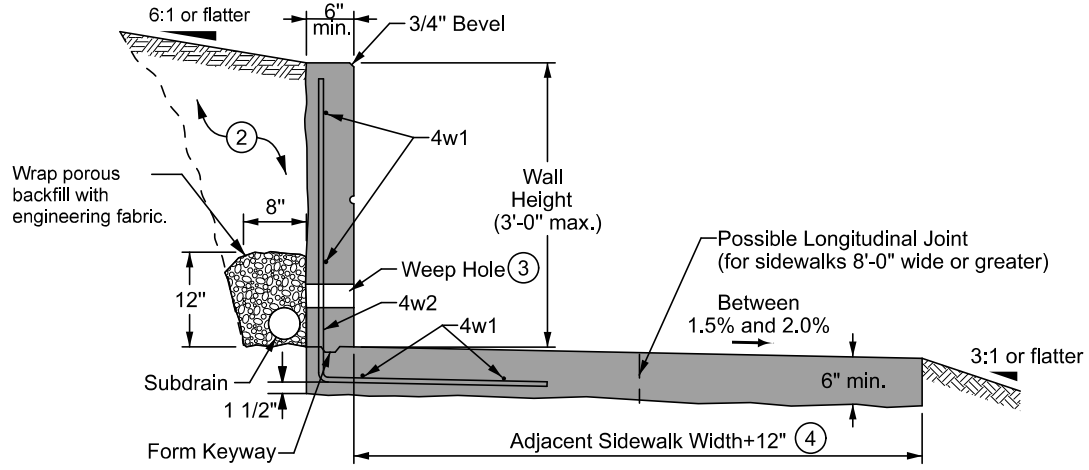
SUDAS	IOWA | DOT	REVISION 3 04-15-25
FIGURE 9072.221	STANDARD ROAD PLAN	MI-221
		SHEET 1 of 2

REVISIONS: Added 1.5 inch clearance dimension on type "A" wall, "L" bar.

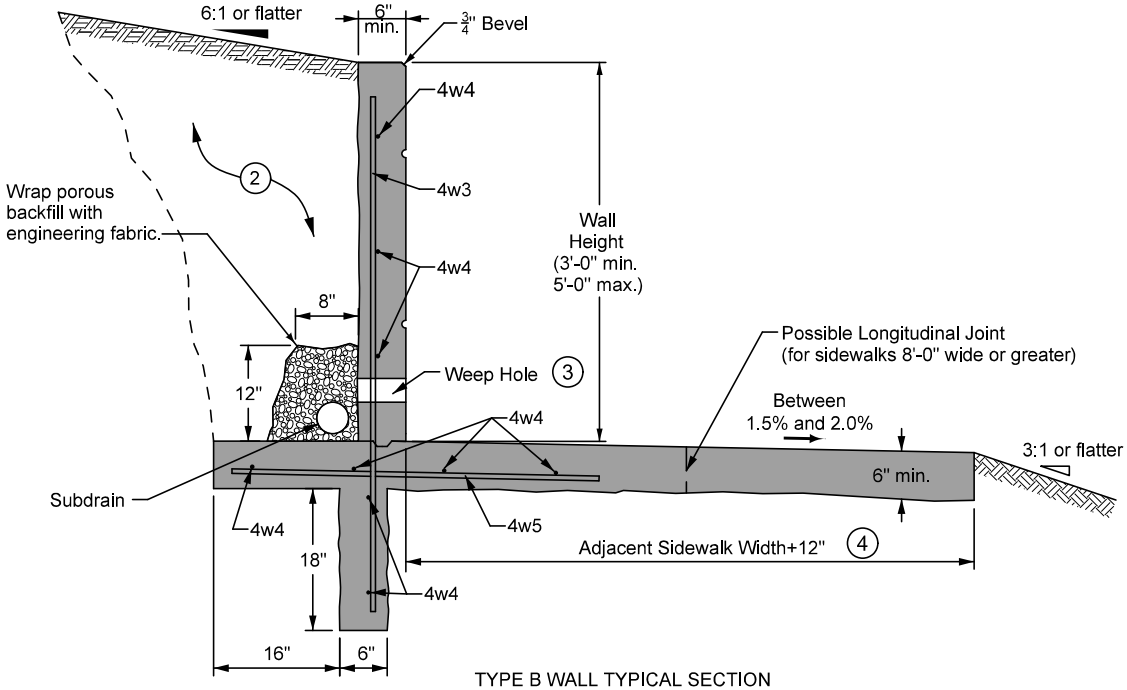
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

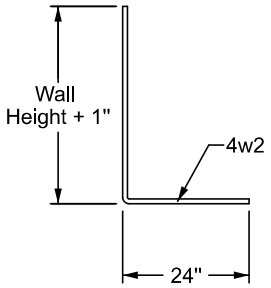
COMBINED RETAINING WALL - SIDEWALK



TYPE A WALL TYPICAL SECTION



TYPE B WALL TYPICAL SECTION



BENT BARS

Provide a minimum concrete cover to near reinforcement of 1 1/2 inches. Provide 3 inches minimum cover at the ends of bars.

(2) Excavate and place backfill material as necessary.

(3) Provide 3 inch diameter weep holes at 8 foot intervals. Install rodent guards in weep holes. Align bottom of weep hole with top of subdrain.

(4) Additional 12 inch width is adjacent to wall.

REINFORCING BAR LIST					
Wall Type	Mark	Size	Shape	Length	Spacing
Type A	4w1	4	———	Variable	15"
	4w2	4	L	Variable	14"
Type B	4w3	4	—	Wall Height + 18"	14"
	4w4	4	—	Variable	15"
	4w5	4	—	3'-10"	14"

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REVISION 3 04-15-25

FIGURE 9072.221 | STANDARD ROAD PLAN

MI-221

SHEET 1 of 2

REVISIONS: Added 1.5 inch clearance dimension on type "A" wall, "L" bar.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

COMBINED RETAINING WALL - SIDEWALK

FIGURE 9072.221 | SHEET 2 OF 2

CONCRETE STEPS, HANDRAILS, AND SAFETY RAIL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete Steps

B. Handrails

C. Safety Rail

1.02 DESCRIPTION OF WORK

A. Construction of concrete steps.

B. Furnishing and installation of handrails.

C. Furnishing and installation of safety rail.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Submit color samples and product literature for primer, paint, and powder coating to be used on handrails and safety rail.

B. Submit shop drawings for handrails and safety rail.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. Provide 1 gallon of color matched exterior grade polyurethane paint for each color specified, for the Contracting Authority’s maintenance use.

B. Label each container with the manufacturer’s name, product number, and color number.

1.08 MEASUREMENT AND PAYMENT

A. Concrete Steps:

1. **Measurement:** Measurement will be the area of concrete steps in square feet for each type of concrete step. The length will be the horizontal length between expansion joints, and the width will include curbs.

2. **Payment:** Payment will be at the unit price per square foot of concrete steps.

3. **Includes:** Unit price includes, but is not limited to, reinforcement, expansion joint material, and preparation of subgrade.

B. Handrail:

1. **Measurement:** Measurement will be in linear feet for each type of handrail, measured along the top of the handrail from end of rail to end of rail.

2. **Payment:** Payment will be at the unit price per linear foot for each type of handrail.

3. **Includes:** Unit price includes, but is not limited to, posts, mounting hardware or concrete grout, and finishing (painted, galvanized, or powder coated).

C. Safety Rail:

1. **Measurement:** Measurement will be in linear feet for safety rail, measured along the top of the safety rail from end post to end post.

2. **Payment:** Payment will be at the unit price per linear foot of safety rail.

3. **Includes:** Unit price includes, but is not limited to, posts, concrete for ground mounting, pickets, mounting hardware, epoxy grout, and finishing (painted, galvanized, or powder coated).

PART 2 - PRODUCTS

2.01 STEPS

A. Concrete: Class C concrete complying with Section 6010, 2.03.

B. Reinforcing Steel: Comply with Iowa DOT Section 4151 for epoxy coated reinforcement. Comply with ACI-318 for dowel bar substitutes.

C. Expansion Joint: Comply with Iowa DOT Section 4136.03, A.

D. Forms: Comply with Iowa DOT Section 2403.

2.02 HANDRAIL

1 1/4 to 2 inches in diameter; ensure post diameter matches handrail diameter.

A. Steel: Welded or seamless black steel pipe and posts complying with ASTM A 53, Grade A or B.

B. Aluminum: Aluminum-alloy extruded structural pipe complying with ASTM B 429, alloy 6061-T6 or 6063-T6, schedule 40 (if specified; for use with grouted connection only).

C. Bends: Provide manufactured pipe bends and connections for handrail. Do not field bend pipe.

2.03 SAFETY RAIL

A. Rails and Posts: Provide 2 1/2 inch by 2 1/2 inch tubular high strength steel with 1/4 inch minimum wall thickness. Comply with ASTM A 500, Grade B.

B. Pickets: Provide 1 inch by 1 inch tubular high strength steel with 1/8 inch minimum wall thickness. Comply with ASTM A 500, Grade B.

2.04 FINISH

A. Painted: Provide factory-mixed paint / primer.

1. Primer: Provide single component, water-based rust and corrosion resistant primer specifically designed for use on steel surfaces.

2. Paint: Provide water-based, abrasion-resistant paint specifically designed for use on steel surfaces.

B. Galvanized: When specified in the contract documents, galvanize handrail and safety rail.

1. Provide zinc coating complying with ASTM A 123.

2. Hot-dip galvanize components after fabrication.

3. For hot-dip galvanized components that will be powder coated, utilize the dry-kettle (pre-fluxing) process. Air cool galvanized components. Do not quench in water or chromate.

C. Powder Coated: Apply powder coat to steel, galvanized steel, or aluminum handrail and safety rail when specified in the contract documents. Comply with the manufacturer's recommendations for surface preparation, application of primer, and application of the powder coating, in addition to the following minimum requirements.

2.04 FINISH (Continued)

1. **Surface Preparation:**
   a. **Steel Substrate:**
      1) Remove oils and surface contamination by solvent cleaning. Comply with the requirements of SSPC-SP 1. Rinse thoroughly with hot water or water pressure and dry completely.
      2) Remove loose rust, loose mill scale, and other foreign substances by hand or power tool cleaning. Comply with SSPC-SP 2 or 3.
      3) Remove all dirt, grease, rust scale, mill scale, paint, slag, and other foreign substances by blast cleaning. Comply with SSPC-SP 6.
      4) Remove all blast cleaning products by means of vacuuming or compressed air.
      5) Chemically clean surface to remove residual contamination, apply conversion coating, and apply sealing agent to prepare the surface for powder coating.
      6) Begin powder coating as soon as possible after surface preparation to prevent the development of iron oxide on the surface of the steel.
   b. **Galvanized Steel Substrate:**
      1) Remove all tears, spikes, high spots, or other surface defects caused by the galvanizing process using hand or power tools.
      2) Apply an alkaline solution, with a pH between 11 and 12, to remove traces of oil, grease, and dirt.
      3) Remove residual zinc oxide by spraying surface with a mild acidic solution (pH of 3.5 to 4.5).
      4) Apply conversion coating to the surface and apply sealing agent to prepare the surface for powder coating.
   c. **Aluminum Substrate:**
      1) Clean surface by power washing to remove contaminants.
      2) Clean surface with an aqueous alkaline solution by immersion or scrubbing with a soft brush. Do not scrub with a steel bristle brush. Dry completely after cleaning.
      3) Remove oils and surface contamination by solvent cleaning. Comply with the requirements of SSPC-SP 1.
      4) Remove light deposits of aluminum reaction by-products by hand or power tool cleaning. Comply with SSPC-SP 2 or 3.
      5) Remove aluminum oxide by sweep blasting or chemical treatment:
         a) Sweep Blasting:
            i) Utilize oil-free compressed air to prevent contamination of cleaned surface.
            ii) Utilize blast media with a MOH hardness of 5 or less, or utilize organic media such as corn cobs or walnut shells. Do not roughen surface.
            iii) Powder coat surface within 60 minutes of sweep blasting to prevent re-formation of aluminum oxide.
         b) Chemical Treatment: Comply with ASTM D 1730 for Type B treatment.
      6) Chemically clean surface to remove residual contamination, apply conversion coating, and apply sealing agent to prepare the surface for powder coating.

2. **Priming:** Apply as recommended by coating manufacturer for specific substrate to all surfaces, unless specifically not required by coating manufacturer.

3. **Coating:**
   a. **General:**
      1) Provide complete multi-coat systems formulated and recommended by the manufacturer for the application indicated.
      2) Provide urethane, TGIC polyester, polyester wrinkle, or non-TGIC polyester based powder coatings as recommended by the powder coating manufacturer to provide long term exterior durability.

2.04 FINISH (Continued)

b. Application:

1) Apply coating to the thickness specified by the coating manufacturer. Comply with coating manufacturer's recommendations for application of powder coating.
2) Apply coating in uniform thickness coats without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

4. Curing: Cure the powder coating at the temperature and for the time recommended by the powder coating manufacturer.

2.05 ATTACHMENT

A. Bolted Connection:

1. Anchor plate: 1/4 inch thick, 6 inch by 6 inch steel anchor plate with a 46,000 psi yield strength. Paint or galvanize anchor plate to match handrail or safety rail.

2. Bolts: Provide 3/8 inch galvanized anchor bolts or threaded rod with length as required to provide a 3 inch embedment. Comply with ASTM A 36.

3. Adhesive Anchoring Material:

a. Epoxy complying with ASTM C 881, Type IV. Provide appropriate epoxy class based upon concrete temperature at time of installation.
b. Grout on approved products list in Iowa DOT Materials I.M. 491.11, Appendix C.

B. Grouted Connection:

1. Polymer Grout: Comply with Iowa DOT Materials I.M. 491.11.

2. Non-shrink Grout: Comply with Iowa DOT Materials I.M. 491.13.

PART 3 - EXECUTION

3.01 INSTALLATION OF STEPS

A. Prepare Subgrade: In fill areas, construct and compact subgrade to 95% of maximum Standard Proctor Density.

B. Forming: Comply with Iowa DOT Article 2403.03, B.

C. Concrete: Comply with Section 6010, 3.02. Deposit concrete for the full depth of the steps in one operation.

D. Reinforcing Steel: Comply with Iowa DOT Section 2404. Provide a minimum 2 inches of cover on all reinforcing steel.

3.02 INSTALLATION OF RAIL

A. General:

1. Install rail continuously with no gaps or breaks along the length specified in the contract documents.

2. Use welded connections between rail components. Grind connections to remove sharp or abrasive edges and to remove other irregularities.

B. Handrail: Install the top rail between 34 inches and 38 inches above the nose of the step tread. Maintain a consistent height above the step treads. Install the bottom rail midway between the nose of the step and the top rail.

C. Safety Rail:

1. **Rails:** Install the top rail a minimum of 42 inches above the finished grade. Install the bottom rail a maximum of 4 inches above finished grade.
2. **Pickets:** Locate pickets in the center of the top and bottom rails and space evenly between posts. Provide a maximum clear opening between pickets of 4 inches.

D. Posts: Install posts at a maximum spacing of 8 feet. Attach handrail posts in one of following two ways.

1. **Bolted Connection:**
   a. Weld anchor plate to the bottom of the handrail posts.
   b. Layout location and drill four 7/16 inch holes for anchor bolts at each post attachment point. Drill holes with a carbide drill bit; do not core drill anchor bolt holes.
   c. Apply adhesive anchoring material according to manufacturer's published recommendations and install threaded rod or anchor bolts.

2. **Grouted Connection:**
   a. Form a 6 inch deep hole in the concrete curb 1 inch larger than the outside diameter of the post. Alternatively, hole may be core drilled in hardened concrete.
   b. After the concrete hardens, set handrail posts into holes and temporarily secure.
   c. Fill the void between the post and holes with non-shrink or polymer grout.

3.03 PAINTING

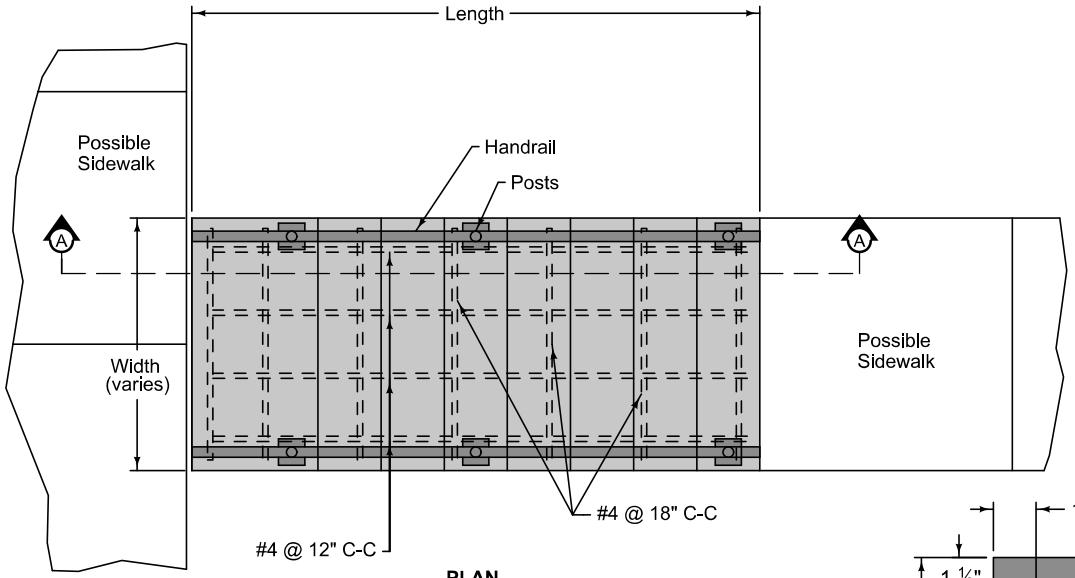
Do not paint hot dipped galvanized or aluminum handrail or safety rail.

A. Mix paint and/or primer to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to paint unless such procedure is specifically described in manufacturer's product instructions.

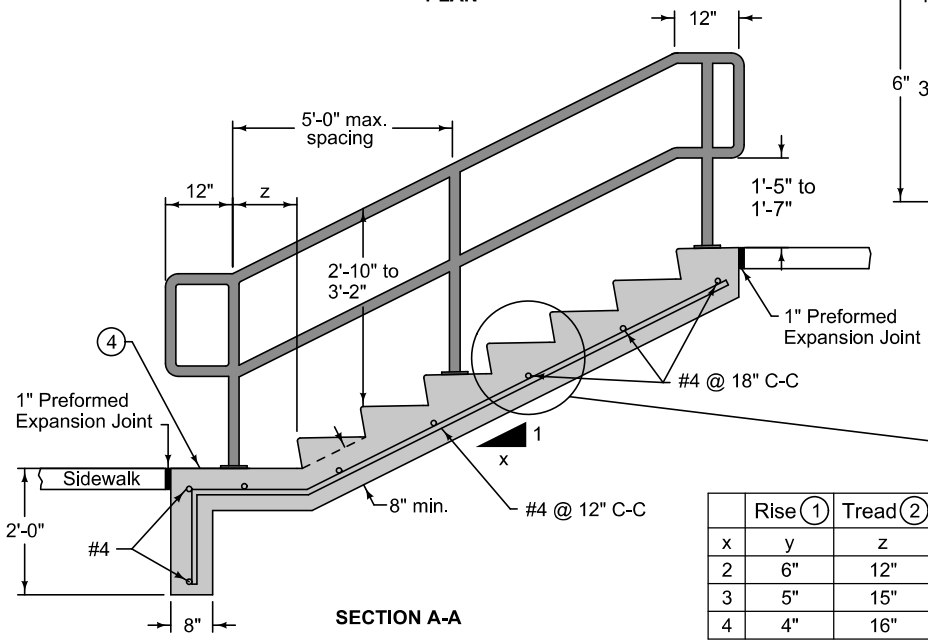
B. Shop coat handrail, safety rail, posts, pickets, and anchor plates with primer following fabrication.

C. Apply two field coats of paint upon completion of installation.

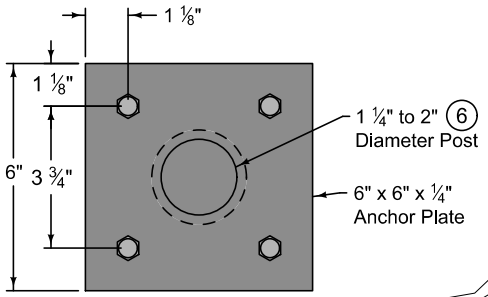
END OF SECTION



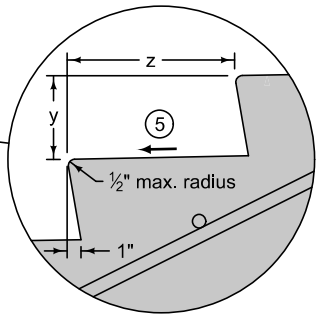
PLAN



SECTION A-A



ANCHOR PLATE DETAIL



	Rise (1)	Tread (2)
x	y	z
2	6"	12"
3	5"	15"
4	4"	16"

Provide a minimum of 2 inches of cover for all reinforcing.

Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

(1) Minimum riser height is 4 inches. Maximum riser height is 7 inches.

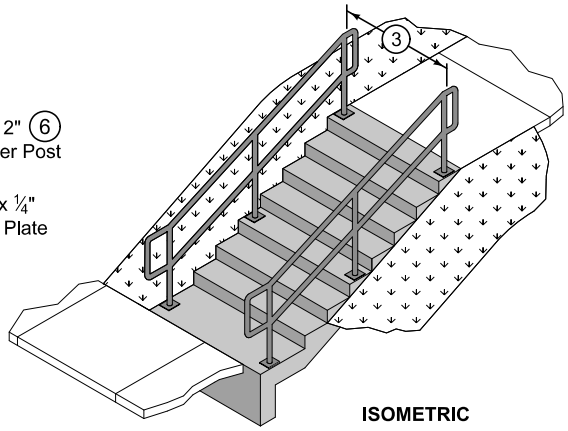
(2) Minimum tread depth is 11 inches.

(3) Match existing sidewalk width.

(4) Construct cross slope of landing to match adjacent sidewalk.

(5) Slope tread 1% minimum to 2% maximum in any direction.

(6) Weld post to anchor plate with 1/4 inch weld. Grind weld to provide smooth surface, free of burrs.



ISOMETRIC

FIGURE 9080.101

SHEET 1 OF 1

SUDAS

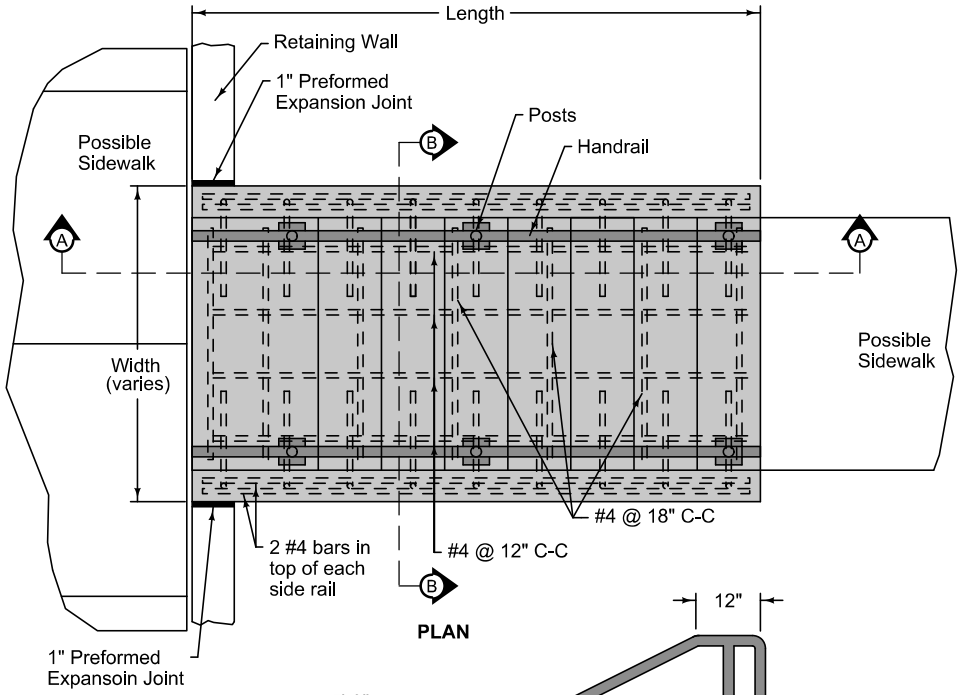
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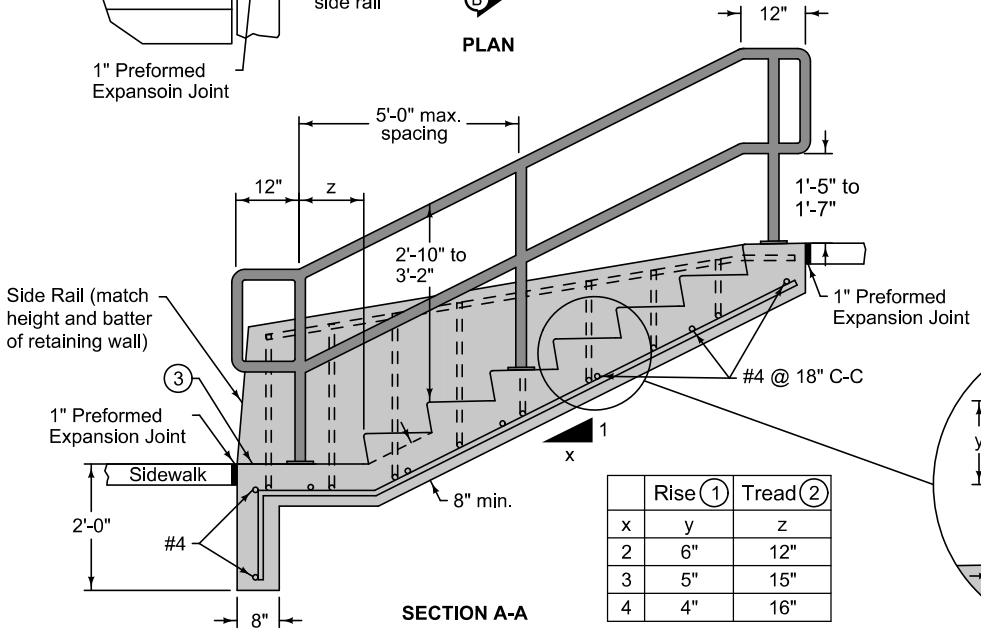
SHEET 1 of 1

SUDAS Standard Specifications

TYPE A CONCRETE STEPS WITH HANDRAIL

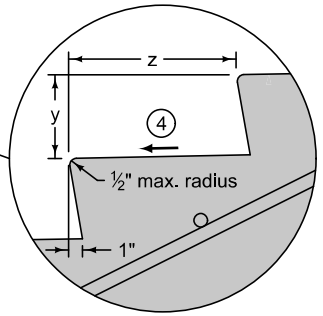


PLAN



SECTION A-A

	Rise (1)	Tread (2)
x	y	z
2	6"	12"
3	5"	15"
4	4"	16"



Provide a minimum of 2 inches of cover for all reinforcing.

Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

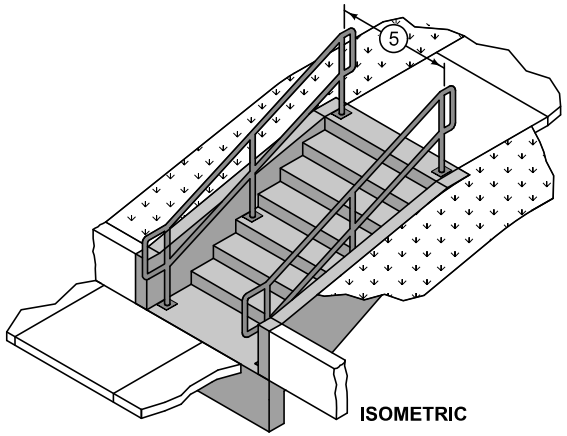
(1) Minimum riser height is 4 inches. Maximum riser height is 7 inches.

(2) Minimum tread depth is 11 inches.

(3) Construct cross slope of landing to match adjacent sidewalk.

(4) Slope tread 1% minimum to 2% maximum in any direction.

(5) Match existing sidewalk width.



ISOMETRIC

SUDAS

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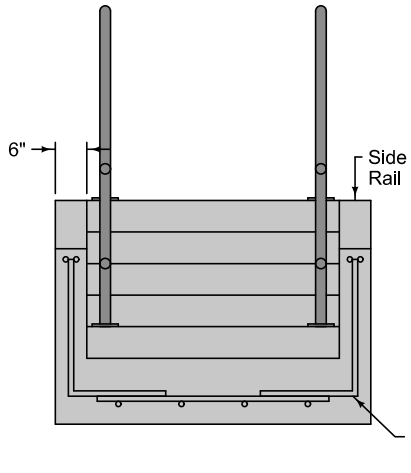
SHEET 1 of 2

SUDAS Standard Specifications

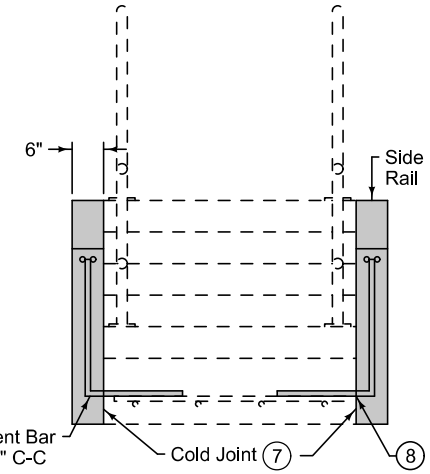
TYPE B CONCRETE STEPS WITH HANDRAIL

FIGURE 9080.102

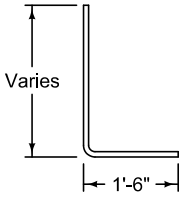
SHEET 1 OF 2



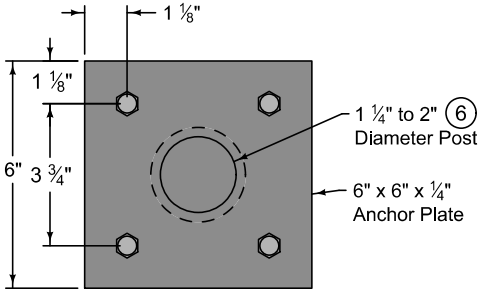
SECTION B-B
(Side Rails and Stairs Formed and Constructed Monolithically)



ALTERNATE SECTION B-B
(Side Rails and Stairs Formed and Constructed Separately)



BENT BAR



ANCHOR PLATE DETAIL

Provide a minimum of 2 inches of cover for all reinforcing.

Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

(6) Weld post to anchor plate with 1/4 inch weld. Grind weld to provide smooth surface, free of burrs.

(7) Upon approval of Engineer, side rails may be formed and constructed separately from the stairs. Seal the cold joint between the side rail and stairs according to Section 7010.

(8) If side rails and stairs are constructed separately, dowel bar substitutes may be used for the bent bars connections between the side rails and the stairs.

FIGURE 9080.102 | SHEET 2 OF 2

SUDAS

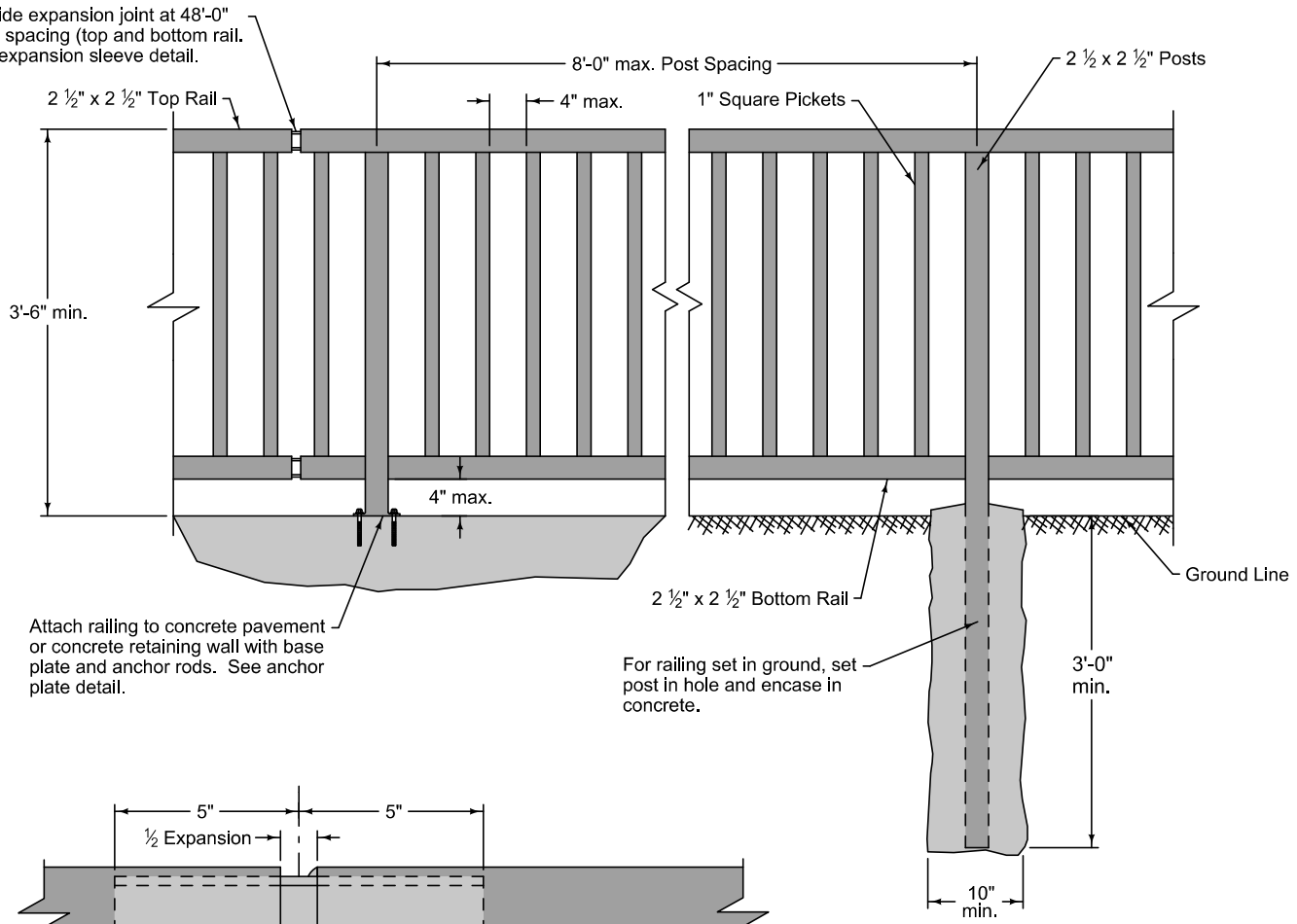
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SHEET 2 of 2

SUDAS Standard Specifications

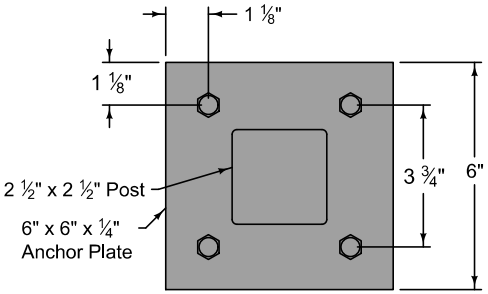
TYPE B CONCRETE STEPS WITH HANDRAIL



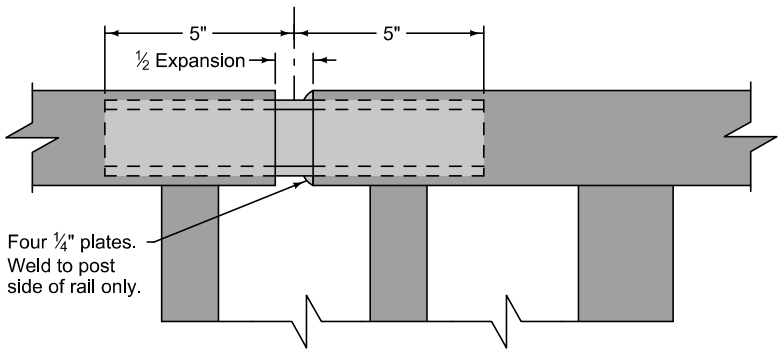
Weld all components with 1/4 inch fillet welds. Grind welds and connections as requried to provide a smooth surface, free of burrs.

Field paint safety rail after installation as specified in the contract documents.

(1) Detail shown is for top rail. Expansion joint for bottom rail is similar.



ANCHOR PLATE DETAIL



EXPANSION SLEEVE DETAIL (1)

FIGURE 9080.103

SHEET 1 OF 1

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9080.103

SHEET 1 of 1

SUDAS Standard Specifications

SAFETY RAIL

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DIVISION 10
Demolition

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Section 10,010 - Demolition of Building Structures (Continued)

Figure	Figure No.
Details for Plugging Water Wells	10010.101

DEMOLITION OF BUILDING STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Protection of Public and Private Facilities

B. Demolition of Building Structures

C. Removal and Disposal of all Site Elements

D. Site Backfill, Grading, Soil Restoration, and Clean Up

E. Establishment of Ground Cover

1.02 DESCRIPTION OF WORK

A. Properly disconnect all public and private utilities.

B. Comply with local, state, and federal regulations to remove and properly dispose of sidewalks, steps, driveways, and structures (including both above ground and below ground elements).

C. Comply with local, state, and federal regulations to remove fuel tanks, septic tanks, cisterns, and any other underground facilities; and to properly dispose of any liquids or products contained within these items.

D. Properly plug or abandon wells.

E. Place backfill material in holes and depressions, grade the site, and establish ground cover.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Seventy-two hours prior to initiating demolition at each site, submit a plan to control erosion and sediment from each site covered by the contract.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:

Ensure access to fire hydrants is maintained at all times.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Submit a schedule of work to the Engineer a minimum of 72 hours prior to commencing activities.

B. Coordinate with public and private utilities for timely disconnection of service prior to initiating demolition.

1.06 SCHEDULING AND CONFLICTS (Continued)

C. Submit a traffic control plan to the Engineer 48 hours in advance of any lane or road closures indicating the area of closure and the signs and traffic control devices to be used to set up the closure.

1.07 SPECIAL REQUIREMENTS

A. The use of explosives is not allowed unless specified in the contract documents.

B. Use of fire is prohibited.

C. Obtain all local, state, and federal permits required for execution of the work, including notification to the Iowa DNR according to 40 CFR 61.145. Pay all permit fees.

D. Property Ownership:

1. Title: The property address, legal description, and ownership will be included in the contract documents. Upon execution of the contract for the work of demolition and site clearance on all or any part of the demolition area, all rights, title, and interest of the Jurisdiction in and to buildings, structures, and other property to be demolished and/or removed by the Contractor on part or all of said project area as described in the contract documents and contract addenda thereto, is vested with the Contractor.

2. Land: No property rights, title, or interest of any kind whatsoever, in or to the land or premises upon which such buildings or structures stand, is created, assigned, conveyed, granted, or transferred to the Contractor or any other person or persons, except only the license and right of entry to remove such buildings and according to the contract documents. Do not use the land or premises, or allow any other party to use the land or premises, for any purpose other than activities in direct support of the demolition of the building.

1.08 MEASUREMENT AND PAYMENT

A. Demolition Work:

1. Measurement: Lump sum item; no measurement will be made.

2. Payment: Payment will be at the lump sum price.

3. Includes: Unit price includes, but is not limited to, removal of trees, brush, vegetation, buildings, building materials, contents of buildings, appliances, trash, rubbish, basement walls, foundations, sidewalks, steps, and driveways from the site; disconnection of utilities; furnishing and compaction of backfill material; furnishing and placing topsoil; finish grading of disturbed areas; placing and removing safety fencing; removal of fuel and septic tanks and cisterns; seeding; and payment of any permit or disposal fees.

B. Plug or Abandon Well:

1. Measurement: Each abandoned or plugged well will be counted.

2. Payment: Payment will be at the unit price for each plugged or abandoned well.

3. Includes: Unit price includes, but is not limited to, obtaining all permits; plug or abandon private wells according to local, state, and federal regulations.

PART 2 - PRODUCTS

2.01 BACKFILL MATERIAL

Meet the requirements of Section 3010, 2.03.

2.02 TOPSOIL

Meet the requirements of Section 2010, 2.01.

2.03 SEEDING

Meet the requirements of Section 9010.

2.04 WELL PLUGGING

A. Sealing Materials:

1. **Neat Cement:** Provide at a ratio of 14 pounds of cement per 1 gallon of water.
2. **Bentonite:** Graded bentonite, bentonite pellets, or bentonite grout.
3. **Sand Cement Grout:** Provide at a ratio of 1 sack of cement, equal volume of masonry sand, and not more than 6 gallons of water.
4. **Concrete:** Provide a Class A, Class B, or Class C mix meeting the requirements of Iowa DOT Materials I.M. 529.

B. Filling Materials: Provide filling materials free of foreign matter and any toxic residue.

1. Sand
2. Pea gravel
3. Class A, B, or C granular surfacing material
4. Agricultural lime

PART 3 - EXECUTION

3.01 GENERAL

A. Protect existing fire hydrants, street lights, traffic signals, utility poles, fire alarm boxes, wire cables, underground utilities, and other appurtenances in the vicinity of the demolition site.

B. Provide correct type and class of fire extinguishers on site and in equipment. Provide fire extinguishers adjacent to any areas where cutting torches are used.

C. Comply with noise pollution requirements and any working hour restrictions of the Jurisdiction.

D. Prior to starting demolition, remove and properly dispose of all volatile or flammable materials such as gasoline, kerosene, benzene, cleaning fluids, paints or paint thinners, household hazardous wastes, or similar products.

E. Inspect the site for its character and the type of structures to be demolished. The Jurisdiction assumes no responsibility for the condition of existing buildings, structures, and other property within the demolition area, or the condition of the property before or after the solicitation for proposals. No adjustment of proposal price or allowance for any change in conditions that occur after the acceptance of the lowest responsible, responsive proposal will be made.

F. Pay all disposal costs, including costs related to disposal of specialty items such as household hazardous wastes, appliances, yard wastes, or electronics.

3.02 UTILITY DISCONNECTIONS

Disconnect all utilities prior to initiating demolition.

A. Sanitary Sewer: Disconnect and plug all sanitary sewer service lines according to Section 4010, 3.08 and the Jurisdiction's Plumbing Code. Notify engineer for inspection of the disconnection prior to placing backfill material.

B. Water Service: Disconnect all water services by a licensed plumber according to the Jurisdiction's Plumbing Code requirements. Notify engineer for inspection prior to placing backfill material.

C. Storm Sewer: Disconnect all sump pump and area drain connections to the storm sewer system according to the requirements of the Jurisdiction. Notify engineer for inspection prior to placing backfill material.

D. Private Utility Services: Disconnect all natural gas or propane lines, electric services, communication services, and any other services according to the requirements of the specific utility involved.

E. Backfill: Place backfill material for all service disconnects according to Section 3010, 3.05.

F. Surface Restoration:

1. **Within the Street:** Restore the street surface according to Section 7040.

2. **Public Right-of-way:** Grade and seed according to Section 9010. Provide a 1 year warranty for all seeded areas. If dates do not allow for seeding, complete fine grading and apply mulch until seeding can be completed.

3.03 PROTECTION OF THE PUBLIC

A. Temporary Fencing: Erect temporary fencing prior to any work around all excavations, buildings, or other dangerous elements to prevent unauthorized access. Provide a fence 4 feet high minimum. Ensure the fence is consistently restrictive from top to grade and without horizontal openings greater than 2 inches. Maintain fencing until all hazards are eliminated.

B. Adjacent Property: Protect structures, parking lots, driveways, sidewalks, utilities, lawns, and other property elements from damage from the demolition activities. Provide sheeting or shoring as necessary to protect adjacent property. Prevent the accumulation of debris and litter on adjacent properties.

C. Sidewalks: If sidewalks are to be closed during demolition, submit a sidewalk closure plan that meets the ADA requirements to the Engineer 48 hours prior to the scheduled closure. Install necessary signing and barricades according to the approved closure plan. Sidewalks designated to remain and damaged during the work will be replaced by the Contractor at no cost to the Contracting Authority.

D. Streets: Promptly **r**emove any demolition debris, litter, or mud from streets and rights-of-way caused by the demolition work. Repair damage to the street and right-of-way caused by the demolition at no additional cost to the Contracting Authority.

E. Vehicle Covering: Cover all open-bodied vehicles transporting demolition debris and trash.

F. Drainage Facilities: Maintain or re-establish all tiles, roadway subdrains, culverts, or other drainage facilities not identified in the contract documents for removal.

3.04 ENVIRONMENTAL REQUIREMENTS

A. Erosion and Sediment Control: Implement the approved erosion and sediment control plan for each site prior to initiating demolition by placing all required devices; include measures to prevent tracking of mud onto adjacent streets or alleys.

B. Dust Control: Comply with all applicable air pollution requirements of the Jurisdiction. Use water or appropriate chemicals for control of dust in the demolition area, on hauling equipment, on adjacent roadways, and when grading the site.

C. Litter: Take steps to prevent the generation of litter during demolition and collect all litter from the demolition area at the end of each working day. Load trucks to prevent leakage or blowing of debris.

D. Septic Tanks and Outdoor Toilets: Pump out all septic tanks and outdoor toilets using a licensed company. Remove septic tanks and dispose of properly. Demolish outdoor toilet building and remove from site.

E. Cisterns and Meter Pits: Pump out and remove all cisterns and meter pits.

F. Freon: Identify, handle, and dispose of all Freon containing appliances according to applicable state and federal regulations.

G. Mercury and PCB: Handle and dispose of any fluorescent light fixtures and ballasts or thermostats containing polychlorinated biphenyl (PCB) or mercury according to state and federal regulations.

H. Electronic Wastes: Comply with local regulations to dispose of all electronic wastes, including TVs, VCRs, DVD players, stereo equipment, cell phones, and computers.

3.05 FUEL TANK REMOVAL

Remove and dispose of all fuel tanks containing gasoline, benzene, kerosene oils, or similar volatile materials, either above or below ground, according to the State Fire Marshal and Iowa DNR regulations.

Pump out or empty all other tanks in a safe manner. Flush immediately with water, carbon dioxide, or nitrogen until gas-free. Prior to tank removal, use appropriate metering equipment to verify the tank is free of all volatile gases. Conduct the test by a competent individual in the presence of the Engineer.

3.06 WELL PLUGGING AND ABANDONMENT

Plug and abandon all wells according to the Iowa Administrative Code, Section 567, Chapter 39. File an Iowa DNR Abandoned Water Well Pugging Record upon completion of the well abandonment.

A. Plugging Procedures, All Wells:

1. Remove all obstructions from the well.
   Note: Some high horsepower submersible pumps contain mercury. Contact the Iowa DNR Private Well Program office if the pump motor is separated from the pump head assembly, the motor is positioned horizontally in the well, or if mercury contamination is observed.

2. Remove casing pipe, any curbing, frost pit, or pump house structure to a depth of 4 feet below the ground surface.

3. Introduce sealing or filling material from the bottom of the well, or interval to be filled or sealed, and place progressively upward to the top of the well or interval to be filled or sealed.

4. For placement of neat cement, sand cement grout, or concrete, utilize grout pipe, tremie pipe, cement bucket, or dump bailer to avoid segregation or dilution of the sealing materials during placement.

5. Place bentonite pellets or graded bentonite for sealing by pouring in place and agitating to avoid bridging.

6. Sealing materials may be substituted for filling materials to fill the entire well up to the well cap. This procedure is preferred but not required.

B. Plugging Procedures, Class 1 Wells:

1. Place filling or sealing materials from the bottom of the well to 1 foot below the static water level.

2. Place sealing materials on top of the filling materials up to the static water level to act as a cap.

3. Place filling or sealing materials up to top of 4 feet below the ground surface.

4. Place 1 foot of sealing material on top of filling materials, extending 6 inches beyond the diameter of the well casing.

3.06 WELL PLUGGING AND ABANDONMENT (Continued)

C. Plugging Procedures, Class 2 Wells:

1. Bedrock Well in Single Confined Aquifer (Artesian Well):

a. Place filling material from the bottom of the well up to 10 feet below the bottom of the casing string being plugged or the confining layer.
b. If well flow cannot be overcome by sealing materials, install a bridge plug or packer in the bottom of the casing.
c. Place sealing material from a level of 10 feet below the casing string being plugged, or the confining layer if open borehole, to a depth of 10 feet below ground surface.
d. Place a 6 foot thick cap of neat cement, grout, or concrete to a depth of 4 feet below the ground surface.

2. Bedrock Well in Single Unconfined Aquifer:

a. Place filling material from the bottom of the well up to 10 feet below the bottom of the casing or confining layer, whichever is less.
b. Place sealing materials to 10 feet below the ground surface.
c. Place a 6 foot thick cap of neat cement, grout, or concrete to a depth of 4 feet below the ground surface.

3. Bedrock Well in Multiple Aquifers:

a. Place filling material in the lowest aquifer from the bottom of the well up to 10 feet below the bottom of the casing or confining layer of the lowest aquifier, whichever is less.
b. Place 20 feet of neat cement on top of filling material. Allow neat cement to develop initial set before performing subsequent filling and sealing work. High early strength cement may be used to reduce work stoppage time.
c. Place sealing materials in at least the top 10 feet of each subsequent aquifer, extending at least 10 feet into the confining layer or casing above. Allow sufficient time for initial set before performing subsequent filling or sealing work.
d. Place filling materials between subsequent aquifer seals.
e. Place fill or sealing material from the top of the uppermost aquifer seal to the static water level of the well.
f. Place sealing materials to 10 feet below the ground surface.
g. Place a 6 foot thick cap of neat cement, grout, or concrete to a depth of 4 feet below the ground surface.

3.07 SALVAGE

A. Restrictions: Salvage is allowed only on property owned by the Jurisdiction. The ownership of each site is included in the contract documents. Remove all salvaged materials from the site by the end of each day's work.

B. Authorized Workers: Only the Contractor's authorized workers are allowed to salvage or demolish the structure or its contents.

3.08 DEMOLITION AND REMOVAL

A. Structures:

1. Except for wood frame or non-rigid masonry buildings, start on the top floor and maintain structural parts of buildings, such as columns, beams, and joists, supporting the floor of any building story until the walls, flooring, and partitions of that story are removed.

2. No wall or part of a wall will be allowed to fall outward from any building except through chutes or other controlled method that will ensure safety and minimize dust, noise, and other nuisance.

3.08 DEMOLITION AND REMOVAL (Continued)

3. Remove chimneys or outside portions of chimneys in advance of general demolition. Remove inside chimneys as soon as they become unsupported by reason of removal of other parts of the building.

4. Remove all unstable, free-standing, or inadequately supported building elements prior to the end of each work day.

B. Basements and Foundations: Completely remove and dispose of all basement floors, footings, foundations, and walls unless specifically stated in the contract documents. Notify engineer for inspection prior to filling the basement excavation.

C. Surface Slabs: Remove all concrete, asphalt, or masonry slabs and appurtenances.

D. Vegetation: Remove and dispose of all brush, shrubs, trees, logs, downed timber, and other yard waste on the site unless otherwise specified in the contract documents. Do not mix with demolition material. Remove stumps to a minimum of 2 feet below finish grade.

Protect any trees or other vegetation not designated for removal by placing a fence at the drip line encompassing the entire tree and keeping all operations outside of the fenced in area, including storage of equipment or materials. At no additional cost to the Contracting Authority, replace any trees that are designated for protection but are damaged beyond treatment. The Engineer will determine size and species of the replacement tree.

E. Retaining Walls: Remove all retaining walls unless otherwise specified in the contract documents. Complete work without damage to adjacent public or private property. Following removal, grade the adjacent slope to a 3:1 (horizontal to vertical) slope or flatter.

F. Fences: Remove all fences, guardrails, posts, and other appurtenances unless on a property line with adjacent private property and designated for retention in the contract documents. Fill and compact soil in all post holes.

G. Miscellaneous Objects: Remove all clotheslines, signs, piping, posts, or any other objects protruding from the ground and fill any resulting hole.

3.09 DISPOSAL

A. Appliances, Electronics, Tires, Trash, Household Hazardous Waste, and Rubbish: Remove all appliances, electronics, tires, trash, household hazardous wastes, and rubbish from the site leaving the site free of debris. Dispose of appliances, electronics, tires, rubbish, household hazardous wastes, and trash according to local and state regulations and not with the demolition material.

B. Demolition Material: Deliver all demolition material to the disposal facility designated in the contract documents according to the rules for that facility. Cover all vehicles used to transport demolition material. The Contractor may submit an alternate disposal facility, fully licensed by the state, for consideration by the Engineer. Submit all disposal tickets received from the disposal facility clearly indicating the specific address of the origin of the demolition debris. Pay all fees associated with disposal of the demolition material.

3.10 ASBESTOS ABATEMENT

All asbestos or asbestos containing materials will be removed prior to the demolition by a licensed asbestos contractor through a separate contract. Notify the Engineer if asbestos is discovered in the demolition process. No further work will be allowed until the asbestos has been removed by a licensed contractor.

3.11 RECYCLING

If specified in the contract documents, certain materials may be required to be recycled from the demolition site. These include bricks, concrete, and recoverable metals. All costs related to recycling and the value received from recycled materials are the Contractor's.

3.12 BACKFILL AND GRADING

A. Backfill: Place backfill material in all excavation areas and holes with material meeting Section 2010, 2.03. Unless otherwise specified in the contract documents, compact using Type A compaction as indicated in Section 2010, 3.04. If compaction with moisture and density control is specified, use Section 2010, 3.09. Notify the Engineer 24 hours in advance of compaction testing so a soil density sample can be obtained and analyzed. Provide density testing as specified in the contract documents.

B. Topsoil: Strip and stockpile the top 12 inches of topsoil for use as a final topsoil and grading material. If topsoil quality does not meet Section 2010, 2.01, supply additional material to place a minimum of 8 inches over the site. The Engineer will approve the borrowed topsoil material. No payment will be made for supplying additional topsoil material.

C. Borrow: If sufficient fill material is not available, supply additional material of equal quality to the soil on the site. Supply suitable material meeting Section 2010. No payment will be made for supplying additional fill material.

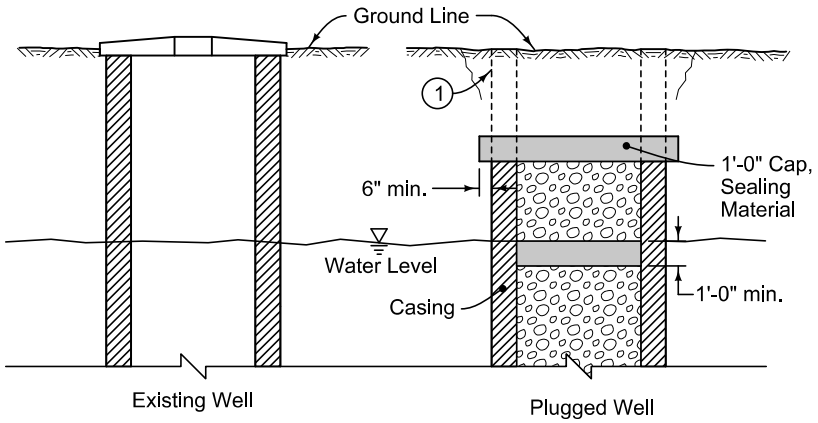
D. Grading: Grade site to conform with all surrounding areas with a uniform surface that will not allow ponding and does not change drainage patterns that existed prior to demolition. Remove excess excavation material from the site.

3.13 CLEAN UP AND SEEDING

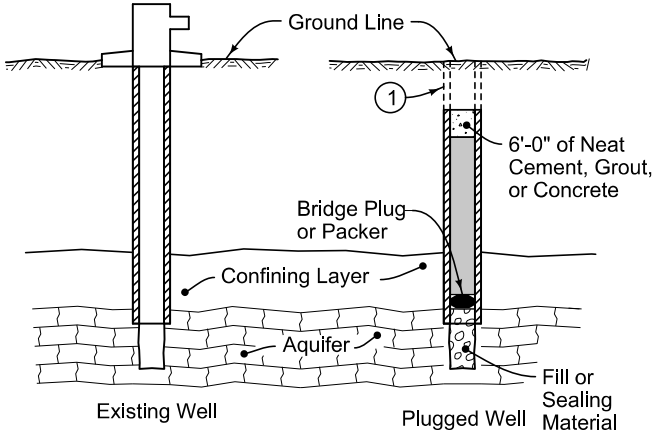
A. Clean Up: Remove all unused material and rubbish from the site. Remove all salvaged materials and any materials recycled. Restore all areas occupied during the course of the work, including the public right-of-way and any private property.

B. Seeding: Complete seedbed preparation, seeding, fertilizing, and mulching of the site according to the requirements for permanent urban seeding in Section 9010, 2.02, A. If unable to comply with permanent seeding dates, apply the urban temporary erosion control mixture in Section 9010, 2.02, D.

END OF SECTION

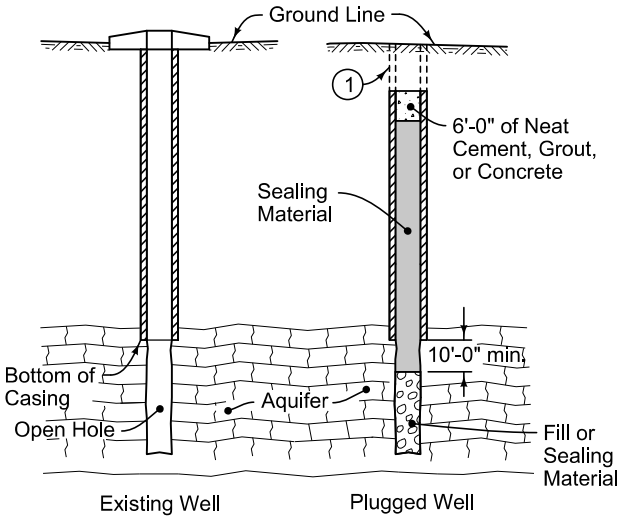


CLASS 1 WELL

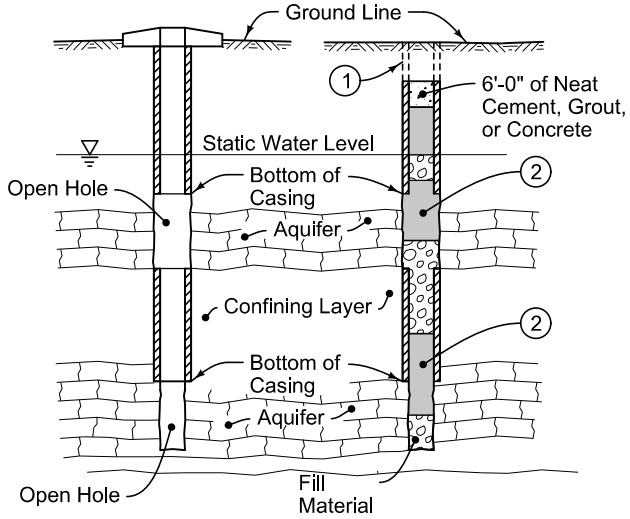


CLASS 2 BEDROCK WELL IN SINGLE CONFINED AQUIFER
(Artesian Well)

1. Remove the top 4 feet of the existing casing pipe.
2. Place sealing material to a minimum thickness of 20 feet (10 feet minimum above and below bottom of casing or top of the aquifer).



CLASS 2 BEDROCK WELL IN SINGLE UNCONFINED AQUIFER



CLASS 2 BEDROCK WELL IN MULTIPLE AQUIFERS

Sealing Material

Fill or Sealing Material

Neat Cement, Grout, or Concrete

SUDAS

REVISION	
1	10-21-14

10010.101

SHEET 1 of 1

SUDAS Standard Specifications

DETAILS FOR PLUGGING WATER WELLS

FIGURE 10010.101

SHEET 1 OF 1

Insert tab here called

DIVISION 11
Miscellaneous

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CONSTRUCTION SURVEY

PART 1 - GENERAL

1.01 SECTION INCLUDES

Construction survey includes personnel, equipment, and supplies required for, but not limited to, the following:

A. Construction Survey:

1. Project Control
2. Grading
3. Bridges, Structural Walls, and Reinforced Box Culverts
4. Pipe Culverts
5. Sanitary and Storm Sewers
6. Water Mains
7. Paving
8. Replacement of Disturbed Monuments
9. Additional Items Included in the Contract Documents

B. Monument Preservation and Replacement

1.02 DESCRIPTION OF WORK

Construction survey and staking necessary for construction of the project as shown in the contract documents.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Documentation: Format the survey work documentation in a manner acceptable to the Engineer. Ensure documentation is sufficient to prove means and methods used to transfer design intent to construction stakes. Check tie-ins with existing roadways, structures, and utilities prior to staking; notify the Engineer if discrepancies are found.

1. Benchmarks: Submit descriptions and elevations of new permanent benchmarks. Establish benchmarks on existing durable fixtures not subject to frost action or disturbance.

2. Staking Records: Upon request, submit all field books, computer-aided design and drafting (CADD) files, digital log files, etc.

3. Monument Preservation and Replacement: If the contract documents include a bid item for monument preservation and replacement, submit copies of all documents developed for compliance with the requirements of Iowa Code Section 355 and Iowa Administrative Code 193C to the Engineer.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. Qualifications:

1. Perform construction survey directly by or under responsible charge of a Professional Engineer or Professional Land Surveyor licensed in the State of Iowa.

2. Reset disturbed monuments with new monuments under the responsible charge of a Professional Land Surveyor licensed in the state of Iowa.

B. Obtain Engineer's approval when interpolating grades or using cross-sections to obtain alignments and elevations.

C. The Jurisdiction will provide benchmarks, right-of-way corners, and primary control points from the original survey in the contract documents. Roadway alignment data will be provided as required for construction.

D. If the contract documents do not include a bid item for monument preservation and replacement, the Contracting Authority will be responsible for replacing disturbed monuments located within the project area and not noted for protection.

1.08 MEASUREMENT AND PAYMENT

A. Construction Survey: If the contract documents specify that the Contractor is responsible for construction survey, measurement and payment will be as follows.

1. Measurement: Lump sum item; no measurement will be made.

2. Payment: Payment will be at the lump sum price for construction survey.

3. Includes: Lump sum price includes, but is not limited to, the costs of resetting project control points, re-staking, and any additional staking requested beyond the requirements of this section.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Monument Preservation and Replacement: If the contract documents specify the Contractor is responsible for replacing monuments, measurement and payment will be as follows.

1. Measurement: Lump sum item; no measurement will be made.

2. Payment: Payment will be at the lump sum price for replacement of disturbed monuments.

3. Includes: Lump sum price includes, but is not limited to, property research and documentation, locating monuments prior to construction, replacement of disturbed monuments, and preparation and filing of the monument preservation certificate.

PART 2 - PRODUCTS

2.01 HUBS

Provide hardwood, metal, or plastic stakes of sufficient size and length to prevent stake movement due to adjacent construction activity.

2.02 LATH

Provide wood lath that is approximately 3/8 inch thick by 1 1/2 inches wide by 48 inches long.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Utilize survey equipment with a level of accuracy appropriate for the type of work being staked.

B. Do not use GPS equipment for staking the vertical elements of paving hubs, bridges, structural walls, or reinforced box culverts.

3.02 PROJECT CONTROL

Provide all horizontal and vertical control data to the Jurisdiction at the completion of each phase of the construction survey work activity.

A. Primary Monuments: Primary survey monuments are established by the Jurisdiction prior to project construction.

1. Replace primary monuments disturbed by construction.

2. Reference a minimum of three ties to durable objects (trees, fence posts, station marks, etc.) in the description of the new monument.

B. Secondary Monuments: Secondary control points are established by the Contractor or Contractor's Surveyor during construction to facilitate staking or instrument calibration.

1. Place in locations likely to survive construction.

2. Reference to the primary monuments with a resulting error radius not to exceed 0.10 feet.

3. Replace any points disturbed during construction. Points do not need to be replaced after construction.

C. Benchmarks: Utilize the benchmarks shown in the contract documents to establish all other vertical control on the project site.

1. Establish new permanent vertical control benchmarks on new structures (bridges, reinforced box culverts), fire hydrants, or power poles located in the project limits.

2. Identify permanent benchmarks.

3. Transfer elevations from construction plan benchmarks to new permanent benchmarks using a digital level or a three-wire leveling method.

4. Record descriptions and elevations of new permanent benchmarks.

D. Property Limits: If specified, mark all construction easements, permanent easements, and rights-of-way with flagged lath at 100 feet intervals on tangents; at the PC and PT of curves; at 25 feet intervals on curves; and at all angle points.

3.03 CONSTRUCTION STAKING

For each construction operation specified in the contract documents, provide stakes as follows. If approved by the Engineer, staking frequency may be modified as long as the level of accuracy appropriate for the type of work is achieved.

A. Grading:

1. Conventional Grading:

a. Set slope stakes left and right (nails or wood hubs) at 100 foot intervals, or less if needed, for all embankment or roadway excavation. Mark slope stakes with wooden lath depicting station, offset, and elevation reference (cut or fill) to all pertinent breaks in the slope.

b. In lieu of slope stakes, set a 100 foot grid with lath over project limits for mass grading with cut or fill marked for finished grade elevation. Finished grade refers to the finished surface of construction (top of paving for paved areas, top of black dirt for unpaved areas).

c. For paved areas, in addition to the 100 foot grid, set lath at appropriate offsets around the perimeter at 50 foot intervals, high and low points, and points of inflection. Mark lath with cut or fill to finished grade (top of paving).

d. For building pads, set lath at appropriate offsets for building corners or gridlines. Provide a semi-permanent benchmark, consisting of a 2 foot wooden hub or rebar, set to the same elevation as the proposed finished floor elevation.

e. Set finished grade stakes (blue tops) at 100 foot intervals at both edges of paving and along centerline for roadways, and in a 100 foot grid in parking areas. Mark blue tops with a stake chaser or similar method.

2. GPS Machine-Controlled Grading:

a. Establish GPS control points consisting of a minimum of 5 semi-permanent points located around the perimeter of the site. Points may be established horizontally using GPS, but transfer elevations of said points from an original benchmark located in the construction documents using a total station or level.

b. Provide grade check stakes at an approximate spacing of 300 feet on roadways.

c. Provide approximately 20 grade control check stakes for building pad and parking areas.

B. Bridges, Structural Walls, and Reinforced Concrete Box Culverts:

1. Provide appropriate offsets for centerline of abutments, piers, back of parapets, face of walls, etc.

2. Provide stakes consisting of a tacked wooden hub with a lath. Clearly mark offset distance and referenced line identification: centerline roadway, abutment, pier, etc.

3. Clearly mark height of cut or fill to a pre-determined elevation reference: flowline, top of wall, top of footing, etc. For structural walls, provide elevation reference to either top of wall or top of footing. Do not reference off of bottom of wall.

4. Set a minimum of two semi-permanent benchmarks, consisting of a 2 foot wooden hub or rebar, for each structure. Transfer elevation to benchmarks from construction plan benchmarks using a total station or level.

3.03 CONSTRUCTION STAKING (Continued)

5. Perform an independent check of all the above stakes. Independent check can be performed by an independent survey crew or by arbitrary verification of the location of the stakes as placed in the field.
   a. For an arbitrary verification, survey stakes and control points in an arbitrary coordinate system and then rotate digitally into the design file to verify accuracy with the contract documents.
   b. Notify Contractor of any discrepancies within 24 hours of placing the stakes for each structure.

C. Pipe Culverts:

1. Place stakes for offsets to ends of pipe, labeled with offset distance, and cut or fill to proposed flowline of the new culvert.

2. Place stakes for all bends in the pipe alignment. Provide two offset stakes, one along each pipe segment bearing, at bends to accurately place bend location.

3. For culverts over 100 feet in length, set offset stakes 50 feet and 100 feet from end of pipe and every 100 feet thereafter. Label stakes with offset distance and elevation reference to the flowline of the proposed pipe.

D. Sanitary and Storm Sewers:

1. Place stakes for all manholes, intakes, cleanouts, and other structures associated with new sewer.

2. Provide offset stake for each structure set at 10 to 15 feet. Offset may be increased for deep sewers.

3. For back of curb intakes, set two offset stakes along the curb alignment to properly align the new grate. Stakes may also be offset perpendicular to the curb alignment as required to avoid conflicts with the proposed storm sewer.

4. Place stakes for all bends in the pipe alignment. Provide two offset stakes, one along each pipe segment bearing, at bends to accurately place bend location.

5. For pipe sections over 100 feet in length, set offset stakes 50 feet and 100 feet from end of pipe and every 100 feet thereafter. Label stakes with offset distance and elevation reference to the flowline of the proposed pipe.

E. Water Mains:

1. Place stakes for proposed water main on line (no offset) at 100 foot intervals. Label stakes as centerline of water main with elevation reference to the top of the proposed pipe to ensure sufficient depth is achieved.

2. Place stakes for all hydrants, valves, bends, tees, and other appurtenances with appropriate offsets. Label stakes with offset distance and elevation reference to proposed finished grade adjacent to the hydrant, valve, bend, tee, or other appurtenance.

3. Place stakes at all crossings of storm sewers and sanitary sewers. Label stakes with top of pipe elevations at the crossing for water mains and sewer mains to ensure proper depth and vertical separation.

3.03 CONSTRUCTION STAKING (Continued)

F. Paving:

1. Conventional Paving:

a. Set paving hubs at appropriate offsets around perimeter of paved areas. Place hubs at grade breaks (high and low points), points of horizontal deflection (bends), and 25 foot intervals in between. Label stakes with offset distance and elevation reference to the top of paving.
b. For paving areas wider than 60 feet, set paving hubs at appropriate offsets on 25 foot intervals along interior bays or drive lanes. Label stakes with offset distance and elevation reference to the top of paving.
c. Place stakes for curb drop locations for sidewalk ramps and driveways. Set hubs on both sides of the drop curb at the bottom of the drop to ensure the appropriate width of curb opening is achieved. Label stakes with offset distance and elevation reference to top of paving.
d. Place stakes for sidewalks and trails on one side only at appropriate offsets. Place stakes at 50 foot intervals in straight and level sections and 25 foot intervals for horizontal or vertical curves. Label stakes with offset distance and elevation reference to the top of paving.

2. Stringless Paving:

a. When stringless paving is used, set additional control points on each side of the pavement, as necessary, to meet the manufacturer's requirements for the equipment used. Furnish x, y, and z coordinates and station offset information for each point. Points may be established horizontally using GPS, but transfer elevations of said points from an original benchmark located in the construction documents using a total station or level.
b. Provide grade check paving hubs at appropriate offsets around the perimeter of the paved areas. Location and elevation of the finished slab should be verified against grade check hubs at 25 foot intervals for the first 100 feet of each days run and at critical locations, such as intakes and through intersections where grades may be flat. The Engineer may waive these requirements if experience has shown compliance with the design elevations.
c. Place stakes for curb drop locations for sidewalk ramps and driveways. Set hubs on both sides of the drop curb at the bottom of the drop to ensure the appropriate width of curb opening is achieved. Label stakes with offset distance and elevation reference to top of paving.
d. Provide grade check stakes for sidewalks and shared use paths at appropriate offset on one side only. Provide grade check stakes for sidewalks and shared use paths at a maximum interval spacing of 100 feet.

3.04 MONUMENT PRESERVATION AND REPLACEMENT

Comply with the requirements of Iowa Code Section 355 and the Iowa Administrative Code Section 193C for the replacement of all disturbed monuments within the project area.

END OF SECTION

MOBILIZATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

Project Mobilization

1.02 DESCRIPTION OF WORK

Mobilization includes preparatory work, operations performed, or costs incurred prior to beginning work on the various items on the project site.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. When a bid item for mobilization is included on the proposal form, comply with this section for measurement and payment.

B. When the proposal form does not include a bid item for mobilization, all costs incurred by the contractor for mobilization are incidental to other work and no separate payment will be made.

1.08 MEASUREMENT AND PAYMENT

A. Mobilization:

1. Measurement: Lump sum item; no measurement will be made.

2. Payment:
a. When 5% of the original contract amount has been completed, 25% of the contract price for mobilization will be paid.
b. When 10% of the original contract amount has been completed, 50% of the contract price for mobilization will be paid.
c. When 50% of the original contract amount has been completed, 100% of the contract price for mobilization will be paid.

3. Includes: The unit price for mobilization may include the following.
a. The movement of personnel, equipment, and supplies to the project site.
b. The establishment of offices, buildings, and other facilities necessary for the project.
c. Bonding, permits, or other expenses incurred prior to construction.

PART 2 - PRODUCTS

None.

PART 3 - EXECUTION

None.

END OF SECTION

TEMPORARY SERVICES DURING CONSTRUCTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Maintenance of Postal Service

B. Coordination of Solid Waste Collection

1.02 DESCRIPTION OF WORK

A. Maintain postal service to all properties within the project area.

B. Maintain solid waste collection to all properties within the project area. Solid waste includes garbage, recycling, and yard waste.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Maintenance of Postal Service:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for maintenance of postal service.

3. **Includes:** Lump sum price includes, but is not limited to, coordinating with USPS and erecting and maintaining temporary mailboxes.

B. Maintenance of Solid Waste Collection:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for maintenance of solid waste collection.

3. **Includes:** Lump sum price includes, but is not limited to, coordinating and maintaining solid waste collection services including establishing alternate collection sites if required.

PART 2 - PRODUCTS

2.01 MAILBOXES

A. Curbside Mailboxes: Provide standard curbside mailboxes complying with US Postal Service (USPS) STD-7B.

B. Cluster Mailboxes: Provide cluster box units complying with USPS-B-1118.

PART 3 - EXECUTION

3.01 POSTAL SERVICE

A. Coordinate delivery of mail with the USPS.

B. Maintain postal service to all properties within the project area. Meet the needs of physically challenged individuals within the project area.

C. When construction staging prohibits access to normal mailbox locations by the USPS, establish temporary mail service as follows:

1. Coordinate with the USPS to establish an acceptable location for a temporary group mailbox.

2. Verify proposed location with the Engineer prior to installation.

3. Erect and maintain a temporary group mailbox or provide a temporary USPS approved cluster box unit complying with Figure 11,030.101.

3.02 SOLID WASTE COLLECTION

A. Coordinate collection of solid waste with property owners and the solid waste collection agencies operating in the project area.

B. Maintain access for solid waste collection vehicles during construction.

C. When construction staging prohibits access to normal collection locations by solid waste collection vehicles, comply with the following:

1. Coordinate with solid waste collection agencies to establish a common location for collection outside the inaccessible area.

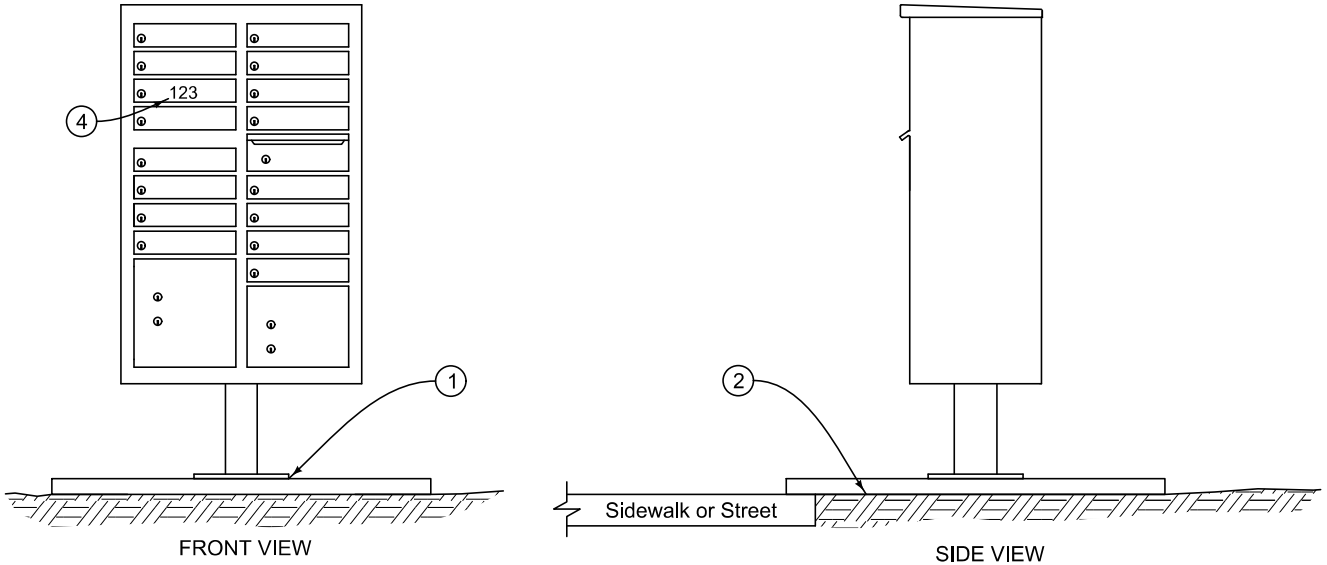
2. Coordinate with residents/businesses within the project area for the alternate solid waste collection procedures.

3. Affix a temporary label to solid waste containers identifying the property owner’s or renter's name or address.

4. Prior to the normal collection time, gather containers from properties within the inaccessible area, and transport to the common location accessible by solid waste collection vehicles.

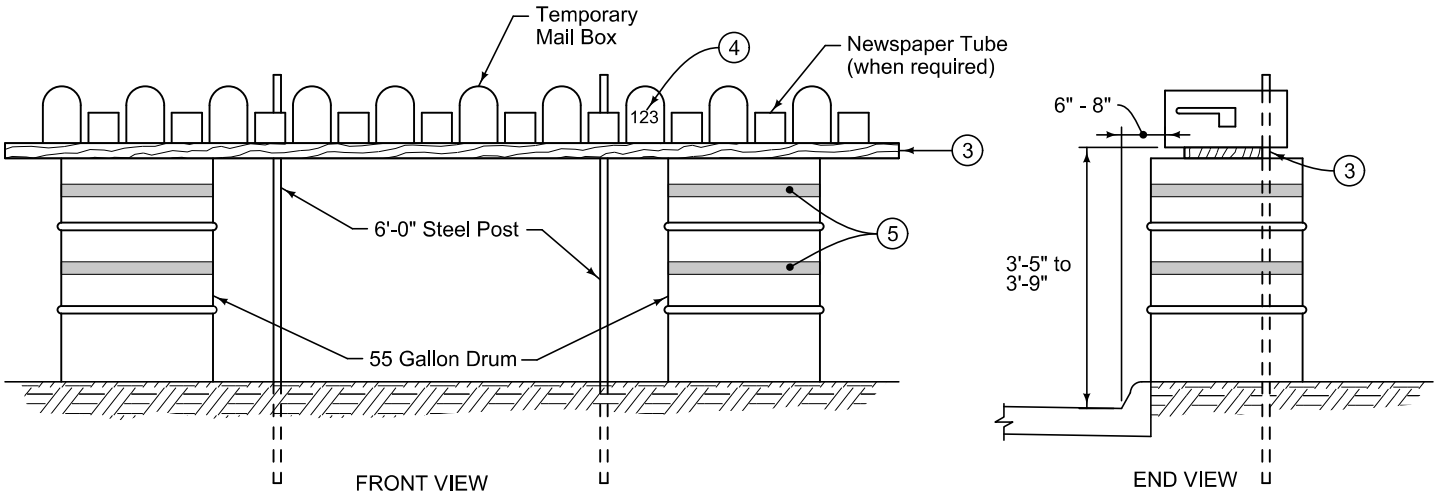
5. Return solid waste containers to each property within 24 hours after collection.

END OF SECTION



TEMPORARY CLUSTER BOX UNIT

1. Attach cluster box unit to a stable skid or anchor plate.
2. Set cluster box on firm and level ground adjacent to sidewalk or street paving. Provide anchorage as needed to prevent overturning.
3. Provide a 2 inch x 12 inch plank with length as required. Firmly attach mailboxes and newspaper tubes to plank. Secure plank to steel posts for lateral support.
4. Label each mailbox with property address.
5. Attach two bands of 2 inch wide reflectorized tape to each barrel.



TEMPORARY GROUP MAILBOX

FIGURE 11030.101

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TEMPORARY MAILBOXES

TEMPORARY SIDEWALK ACCESS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary Residential Access

B. Temporary Granular Sidewalk

C. Temporary Longitudinal Channelizing Device

1.02 DESCRIPTION OF WORK

A. Construct a temporary access to residential properties impacted by construction.

B. Construct a granular surfaced, temporary, public sidewalk.

C. Construct temporary longitudinal channelizing device along a public sidewalk to delineate the pedestrian access route.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Temporary Pedestrian Residential Access:

1. **Measurement:** Granular surfacing for temporary pedestrian residential access will be measured in square yards.

2. **Payment:** Payment for temporary pedestrian residential access will be made at the unit price per square yard.

3. **Includes:** The unit price for temporary pedestrian residential access includes, but is not limited to, supplying and placing granular material, continuous maintenance of granular surface, removal of temporary granular sidewalk, and restoring disturbed surfaces to a condition equal to that which existed prior to construction.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Temporary Granular Sidewalk:

1. **Measurement:** Temporary granular sidewalk will be measured in square yards.

2. **Payment:** Payment for temporary granular sidewalk will be made at the unit price per square yard.

3. **Includes:** The unit price for temporary granular sidewalk includes, but is not limited to, excavation, grading, timber edging, supplying and placing granular material, continuous maintenance of granular surface, removal of temporary granular sidewalk, and restoring disturbed surfaces to a condition equal to that which existed prior to construction.

C. Temporary Longitudinal Channelizing Device:

1. **Measurement:** Temporary longitudinal channelizing device will be measured in linear feet along the top rail support.

2. **Payment:** Payment for longitudinal channelizing device will be made at the unit price per linear foot.

3. **Includes:** The unit price for temporary longitudinal channelizing device includes, but is not limited to, construction, placement, maintenance, and removal of the device.

PART 2 - PRODUCTS

2.01 GRANULAR SURFACING

Provide fine limestone complying with Iowa DOT Article 4109.02, Gradation No. 8 in the Aggregate Gradation Table and the quality requirements of Iowa DOT Article 4117.03 for temporary residential access or a temporary granular sidewalk.

2.02 TEMPORARY LONGITUDINAL CHANNELIZING DEVICE

A. Construct channelizing device from common dimensional lumber and construction fasteners. Comply with Figure 11040.102.

B. Provide a manufactured pedestrian guidance system complying with the requirements of the *American's with Disabilities Act Accessibility Guidelines for Buildings and Facilities* (ADAAG) and the MUTCD.

C. Other alternatives that comply with the ADAAG and MUTCD requirements may be allowed upon approval of the Engineer.

PART 3 - EXECUTION

3.01 TEMPORARY PEDESTRIAN RESIDENTIAL ACCESS

This item is for the construction of a temporary granular path through the project area for pedestrian access to residential properties when street and sidewalk access area is impacted by construction. This access is not intended to provide access to the general public.

A. Construct a 4 foot wide granular path through the project area as required to maintain access to residential properties.

B. Place granular material directly on the existing surface to a nominal depth of 3 inches.

C. Grade the granular surface smooth and compact.

D. Maintain the surface of the path in a firm, stable, and slip resistant condition.

E. Relocate or replace path as required by construction staging.

F. Place additional granular material as directed by the Engineer.

3.02 TEMPORARY GRANULAR SIDEWALK

A. Construct temporary granular sidewalk at locations specified in the contract documents.

B. Excavate existing ground surface to a nominal depth of 4 inches. Install 2 by 4 edging along both sides of the excavation.

C. Place granular surfacing between edging and compact.

D. Maintain the surface of the granular sidewalk in a firm, stable, and slip resistant condition.

E. Place additional granular material as directed by the Engineer.

3.03 TEMPORARY LONGITUDINAL CHANNELIZING DEVICE

A. Construct temporary longitudinal channelizing device according to Figure 11040.102, or erect manufactured or other approved pedestrian railing system.

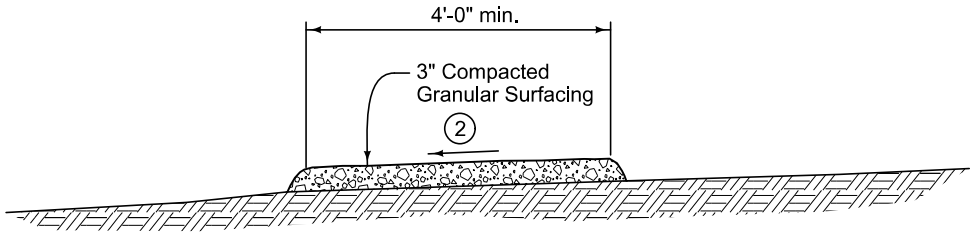
B. Locate device as specified in the contract documents.

C. Add additional posts, braces, base plates, screws, nails, sandbags, or other appurtenances as required to maintain device in a stable condition at no additional cost to the Contracting Authority.

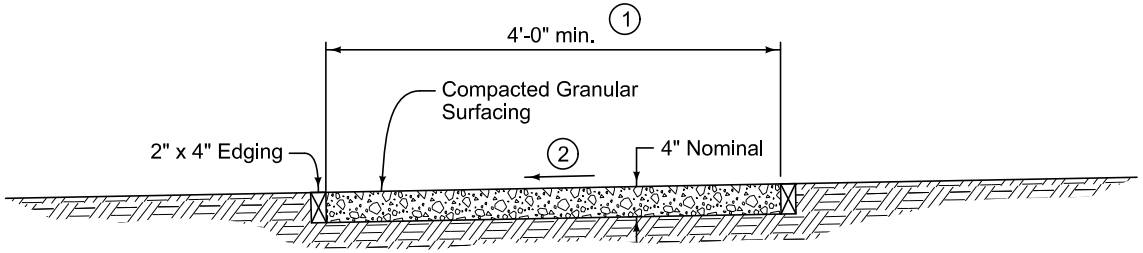
END OF SECTION

(1) If sidewalk width is less than 5 feet, provide 5 foot long by 5 foot wide passing spaces at 200 foot intervals.

(2) Target cross slope of 1.5% with a maximum cross slope of 2%.



TEMPORARY RESIDENTIAL ACCESS



TEMPORARY GRANULAR SIDEWALK

FIGURE 11040.101 | SHEET 1 OF 1

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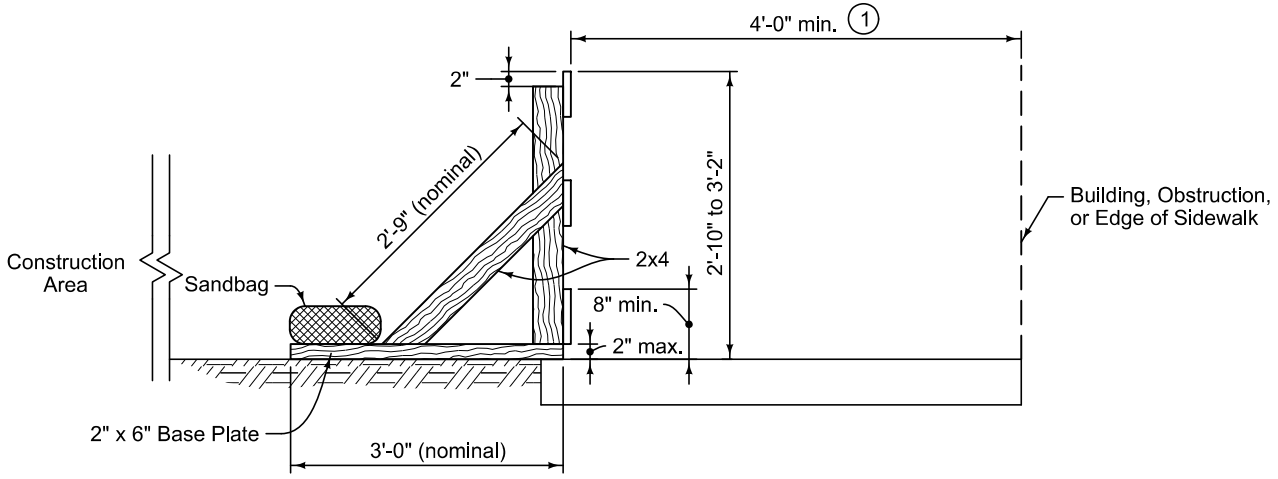
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TEMPORARY GRANULAR SIDEWALK
AND
TEMPORARY RESIDENTIAL ACCESS



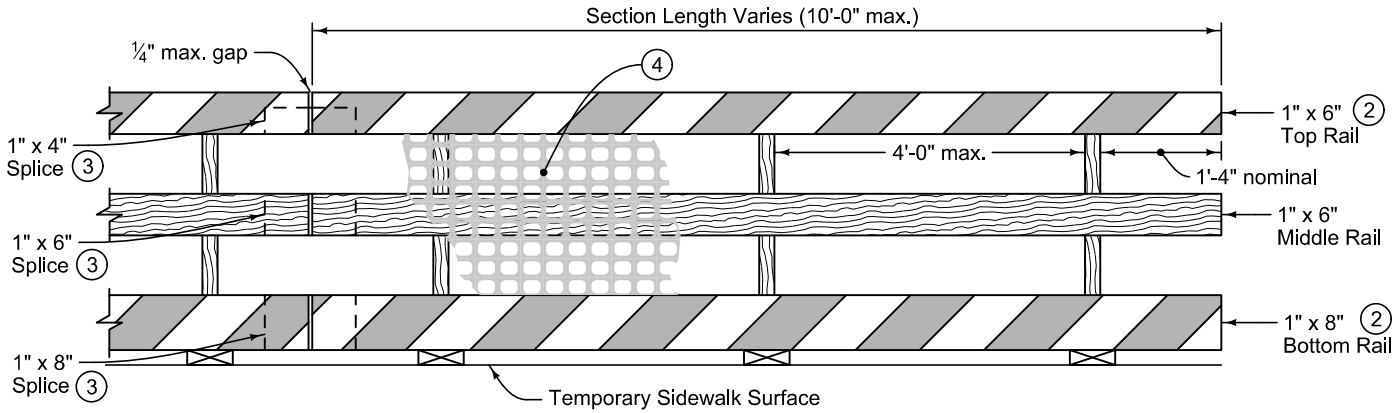
END VIEW

(1) If sidewalk width is less than 5 feet, provide 5 foot long by 5 foot wide passing spaces at 200 foot intervals.

(2) Provide non-reflective orange and white sheeting on top and bottom rails.

(3) Attach 12 inch long splice boards on the back side of rails at joints between sections.

(4) When specified in the contract documents, install orange construction safety fence between the top of the bottom rail and the bottom of the top rail.



FRONT VIEW

FIGURE 11040.102 SHEET 1 OF 1

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SUDAS Standard Specifications

TEMPORARY PEDESTRIAN CHANNELIZING DEVICE

CONCRETE WASHOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

Concrete Washout

1.02 DESCRIPTION OF WORK

Provide and maintain concrete washout system.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Concrete Washout:

1. **Measurement:** Lump sum item; no measurement will be made.

2. **Payment:** Payment will be at the lump sum price for concrete washout.

3. **Includes:** Lump sum price includes, but is not limited to, providing concrete washwater containment, collection, and disposal.

PART 2 - PRODUCTS

2.01 CONCRETE WASHOUT

Provide a concrete washout system that retains all concrete washwater and complies with one of the following:

A. Manufactured Washout Containment:

1. **Concrete Washout Containers:** Provide roll-off type metal container that is leak-proof and designed specifically for collection of concrete and concrete washwater. When concrete pumper trucks are utilized, provide a ramp or other means to allow access for pumper trucks.

2. **Concrete Washout Collection Bags:** Provide leak-proof collection bags designed specifically for collection of concrete and concrete washwater.

3. **Chute Washout Box:** Provide ready mixed trucks with on-vehicle chute washout system to collect concrete washwater for return to the ready mixed plant.

B. Non-Manufactured Containment:

1. **Below-grade System:** For excavated pits, provide an impermeable plastic liner with a minimum thickness of 10 mils.

2. **Above-grade Containment:** For containment areas constructed from earthen berms, provide a double thickness of impermeable plastic liner with a minimum thickness of 10 mil per sheet.

C. Prohibited Products: Silt fence, unlined hay bales, unlined earthen embankments, and other practices that may allow concrete washwater to leak out of the containment area or to come in direct contact with the ground are not allowed.

PART 3 - EXECUTION

3.01 CONCRETE WASHOUT

A. Provide concrete washwater containment on all projects where concrete washwater will be generated. Clearly mark the location of the washout area and provide directions to truck drivers.

B. Locate concrete washout containment systems a minimum of 50 feet from proposed or existing storm sewer intakes, open ditches, or waterbodies.

C. Collect all concrete washwater from ready mixed trucks, pumper trucks, and cleaning of tools and other equipment.

D. Retain concrete washwater within the containment system until the water evaporates or is collected and disposed.

E. Prior to rain events, lower the liquid level or cover the concrete washout containment area to prevent overflow.

F. Clean out the concrete washwater containment area when it reaches 75% of the total capacity.

G. Hardened solids may be removed from the containment area and disposed of as other non-hazardous wastes or may be broken up and used on the site for other appropriate uses.

3.02 CLEANUP AND REMOVAL

A. Remove all manufactured washout containment facilities from the project area.

B. For excavated pits, pump out and properly dispose of all remaining water, remove any hardened solids, and remove all plastic liner materials and fill pit area flush with surrounding ground.

C. For above-grade containment facilities, pump out and properly dispose of all remaining water, remove any hardened solids, and remove all plastic liner materials and spread out earthen berms.

END OF SECTION