Annual Revisions to the SUDAS Standard Specifications
2021 Edition

If you want to update your printed manual, please print this packet and follow the instructions below. The current edition of the manual, with the latest revisions fully incorporated, can be found on our website - www.iowasudas.org.

Please remove the old sheets and place the revised sheets in your manual. Some pages are completely new and do not replace an existing sheet. Also, some pages do not contain revisions, but are included due to changes on the other side of the sheet or a change in the page number. **PLEASE READ CAREFULLY - PAY ATTENTION TO THE SECTION NUMBER!** Included shading to help distinguish between divisions. Questions can be directed to Beth Richards, SUDAS Program Coordinator, at 515-294-2869 or brich@iastate.edu.

Division	***Section***	***pg #***	***Summary of Revision(s)***
Manual introductory info			Updated the Contributors and Acknowledgments page. *Note - if you want to replace the small business card for the spine of your manual, you can print a copy from our website.*
1	Table of Contents	i-iv	Updated based on changes made in Division 1.
	1010	ALL	Replace ENTIRE SECTION with enclosed pages. Added new abbreviations and definitions.
	1040, 1.06, C	3-6	Added information on paying for delivered materials if the bid item is deleted.
	1060, 1.02	1-2	Add “and other substitutions” to the title to tie the technical specs back to Division 1.
	1070, 2.08, C	9-12	Added clarification concerning maintenance of the work area during the project.
2	2010, 3.06, B and 3.09, C	17-18	Eliminated confusion and expanded options to include loaded truck and weighted/ticketed truck. Deleted old ASTM references and replaced with new one.
3	Table of Contents	i-ii	Updated based on changes made in Division 3.
	3010, 2.05, B	7-8	Changed Iowa DOT Gradation 13 to 13a.
	Figure 3010.102	1-2	(Starts on the back of Figure 3010.101). Iowa DOT requested adding a note at the top to state it is not intended for primary roadways.
	Figure 3010.103	1	Iowa DOT requested adding a note at the top to state it is not intended for primary roadways.
	Figure 3010.104	1	Iowa DOT requested adding a note at the top to state it is not intended for primary roadways.
	3020	ALL	Added information for surface restoration.
4	Table of Contents	v-vi	Updated based on changes made in Division 4.
	4010, 1.08 and 2.01	1-10	Expanded options for lining of concrete pipe to include PVC and HDPE.
	4050, 1.03	1-2	Added requirements related to styrene dispersion identified in recent research.
	4050, 2.01, A	7-8	Corrected ASTM reference typo.
	4050, 3.03, E-G	15-18	Corrected outline typos.
	4060, 3.02	3-7	Deleted visual inspection item and renumbered items that followed.
5	Table of Contents	i-ii	Updated based on changes made in Division 5.
	5010	3-11	Deleted prestressed concrete cylinder pipe and updated material requirements for ductile iron pipe.
	5020, 3.03	7-8	Clarified the fire hydrant placement and orientation to meet 2018 International Fire Code.
	Figure 5020.201	1	Clarified that the anchor tee is part of the fire hydrant assembly.
	5030, 3.06-3.08	5-6	Updated to provide an alternate sampling process.

6	Table of Contents	ALL	Updated based on changes made in Division 6.
	6010, 1.08, 2.09, and 2.13	1-10	Expanded options for lining of concrete pipe to include PVC and HDPE. Updated ASTM reference. Added steps for structures deeper than 20 feet.
	6010, 3.05 and 3.06	17-18	Corrected formatting errors.
	Figures 6010.301-405	ALL	Added steps for structures deeper than 20 feet; updated infiltration barrier depiction and note.
	Figure 6010.513	1	Updated notes.
	Figure 6010.542	1-4	(Starts on the back of Figure 6010.541, sheet 2). Reissued to remove “interim” from the title block.
7	Table of Contents	v-x	Updated based on changes made in Division 7.
	7021	ALL	Deleted Hamburg testing requirement from subsection 2.05; affected pages that followed.
	7030, 3.04 and 3.05	7-12	Clarified maximum, target, and minimum cross slope requirements, which shifted pages down. Also changed the default to curing PCC sidewalks, shared use paths, and driveways (rather than “when specified”).
	7040, 1.01, 1.02, 1.08, 2.01, and 3.01	1-8	Added information for restoring the pavement after utility locations. Designated a specific gradation to extend grout.
	7040, 3.11	15-16	Added information for restoring the pavement after utility locations.
	Figure 7040.101	1	Expanded joint options depending on paving sequence.
	Figure 7040.102	1	Expanded joint options depending on paving sequence.
	Figure 7040.107 (new)	1	Added new figure for restoring the pavement after utility locations.
	7080, 2.03	3-4	Deleted the AASHTO and ASTM references in the various aggregates as they do not match the Iowa DOT's gradations. Changed Iowa DOT Gradation 13 to 13a.
	7080, 3.01, 3.05-3.09	5-8	Updated compaction standards for the various layers when constructing a permeable interlocking pavement.
8	Table of Contents	i-ii	Updated based on changes made in Division 8.
	8010, 2.01, A, 4	3-14	Added HDPE handhole to acceptable products, which shifted pages down.
	Figure 8010.103	1-2	(Starts on the back of Figure 8010.102, sheet 4). Added an HDPE handhole.
	8030, 2.02, E	3-4	Minor correction.
9	9010, 1.08, D, 3	3-4	Clarified confusion of MGAL.
	9010, 2.07, C, 5	13-14	Updated AASHTO reference.

Contributors and Acknowledgments

In 2020, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2021 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.

SUDAS Corporation Board of Directors, 2020

Board Member	Government/Agency	Board Member	Government/Agency
Donna Buchwald	Iowa DOT	*Scott Larson	City of Coralville
*David Carney	City of Sioux City	Aaron Lincoln	City of Sergeant Bluffs
Pamela Cooksey	City of Des Moines	Brent Morlok	City of Bettendorf
Matt Cox	City of Council Bluffs	Mark Mueller	City of Ankeny
Ron DeGroot	City of Des Moines	Stuart Nielsen	Iowa DOT
Ken DeKeyser	Hall & Hall Engineers	Sarah Okerlund	Iowa DOT
Dan Eckert	Dickinson County	Mark Rahm	City of Mason City
Brenna Fall	City of Cedar Rapids	Garret Reddish	Linn County
Matt Ferrier	Bolton & Menk, Inc.	Scott Reelfs	HGM Associates Inc.
John Gade	Fox Engineering	Tom Reis	Iowa DOT
Paul Geilenfeldt	Marshall County	Dusten Rolando	Floyd/Chickasaw Counties
Daniel Harness	Iowa DOT	Brian Schadt	City of Davenport
Steve Hausner	French-Reneker Assoc.	Bob Schiesl	City of Dubuque
Eric Johnsen	Iowa DOT	Jeremiah Selby	Monroe County
*John Joiner	City of Ames	Larry Stevens	HR Green, Inc.
Ron Knoche	City of Iowa City	*Michelle Sweeney	AECOM
Jamie Knutson	City of Waterloo	Ryne Thornburg	Van Buren County
Randy Krauel	City of Carroll	Lee Tippe	City of Cedar Rapids
Jeff Krist	City of Council Bluffs	Trevor Wolf	Taylor County

Advisory Member	Government/Agency	Advisory Member	Government/Agency
Steve Klocke	Snyder & Associates	Greg Mulder	ICPA
Darwin Larson	APAI	Ron Otto	AGC of Iowa
Gabe Lee	Iowa DNR		

Staff	Position
Paul Wiegand	Program Director
Beth Richards	Program Coordinator

* Denotes an officer

Table of Contents

Section 1060 - Control of Materials (Continued) **Page No.**

Section 1070 - Legal Relations and Responsibility to the Public

Part 1 - Legal Relations

Part 2 - Responsibilities to the Public

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
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
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

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 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.

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.

3.06 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 with a truck loaded as designated 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.

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.

3.08 SUBBASE (Continued)

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

Table of Contents

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.

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

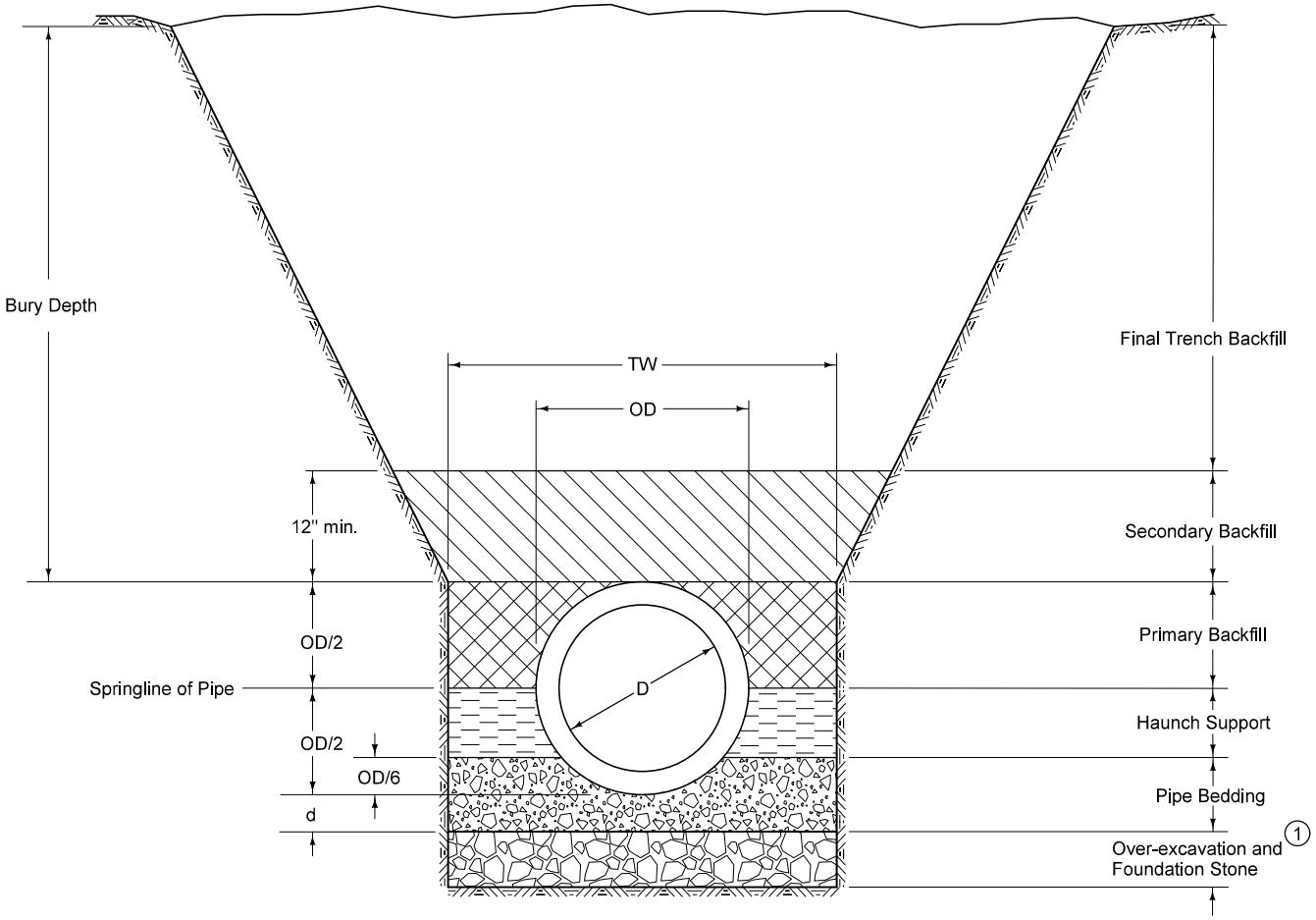


FIGURE 3010.101 SHEET 1 OF 1

SUDAS | IOWADOT | REVISION 1 04-17-18

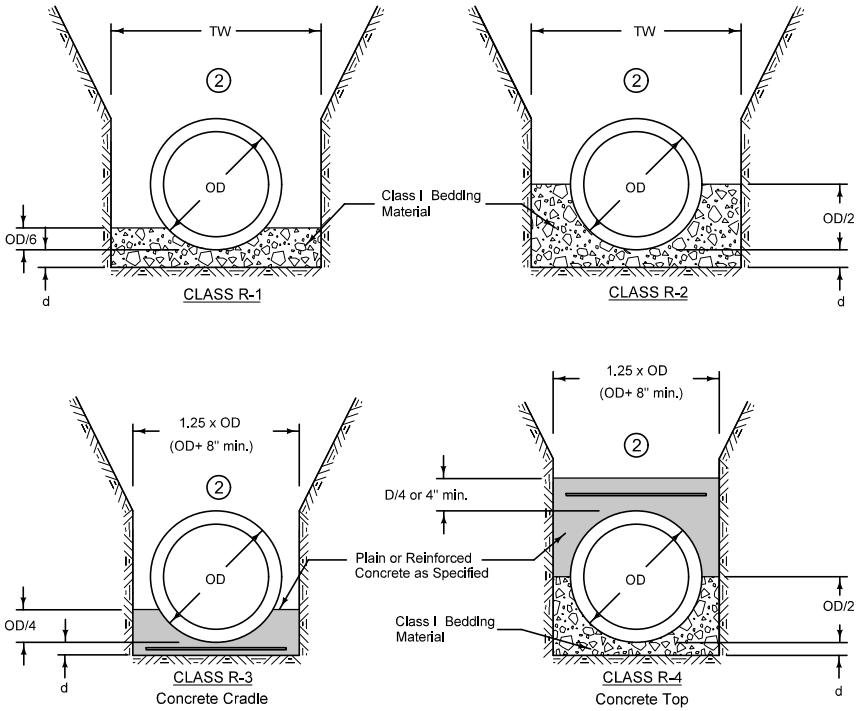
FIGURE 3010.101 | STANDARD ROAD PLAN | SW-101 | SHEET 1 of 1

REVISIONS: Replaced Iowa DOT and SUDAS logos.

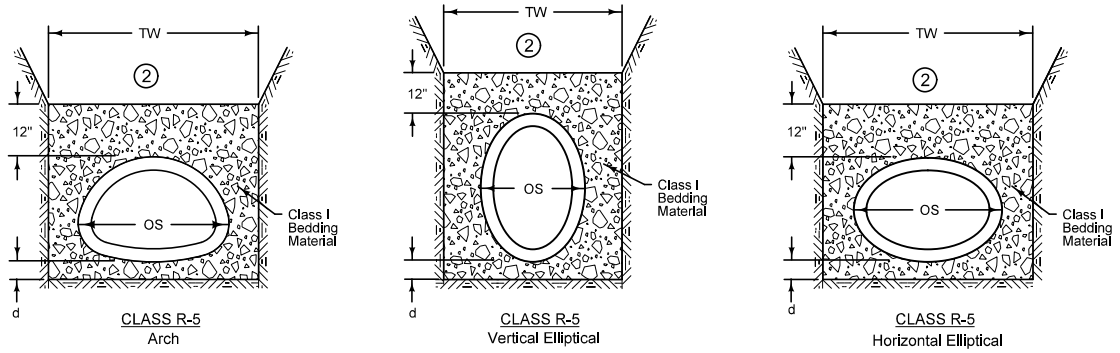
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

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.

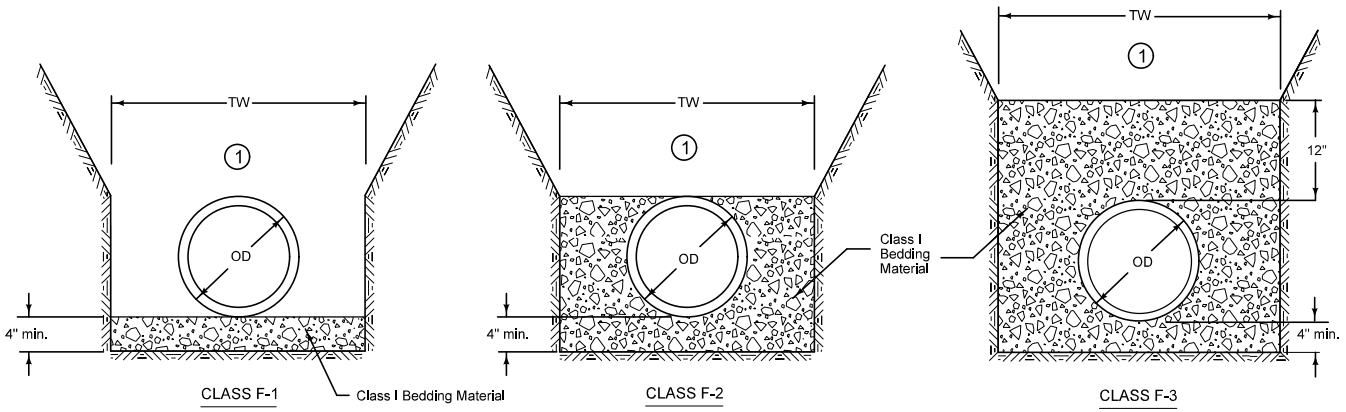
Paul D. Wigand, SUDAS DIRECTOR

Stuart Nicholson, 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'

FIGURE 3010.103 | SHEET 1 OF 1

SUDAS | IOWADOT

REVISION 4 04-20-21

FIGURE 3010.103 | STANDARD ROAD PLAN | SW-103 | SHEET 1 of 1

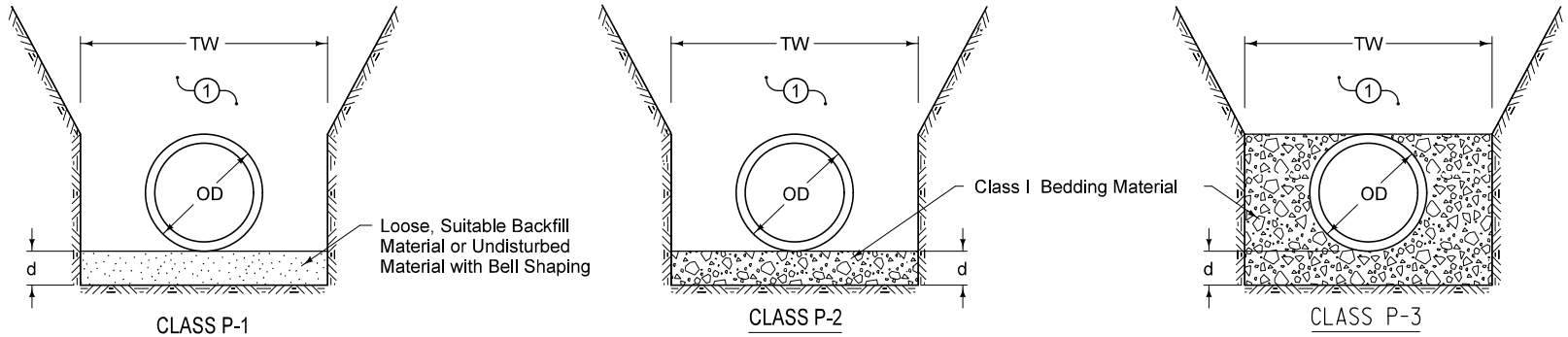
REVISIONS: Added note DO NOT USE ON PRIMARY ROADWAYS.

Paul D. Wigant, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

FLEXIBLE GRAVITY PIPE TRENCH BEDDING

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 1 OF 1

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.

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.

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; or ASTM A 53, Grade B. 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

Section 4040 - Subdrains and Footing Drain Collectors (Continued)

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 27 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 36 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 0.080 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.

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.

2.02 SANITARY SEWER FORCE MAINS (Continued)

C. 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.

D. Tracer Wire:
Comply with Section 5010, 2.05. Tracer wire will be required on all force mains.

E. 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.

PIPE REHABILITATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cured-in-place Pipe (CIPP) Main Lining

B. Cured-in-place Pipe (CIPP) Point Repair

C. Cured-in-place Pipe (CIPP) Service Repair

D. Pressure Testing and Grouting of Sewer Joints

E. Spot Repairs by Pipe Replacement

1.02 DESCRIPTION OF WORK

A. CIPP lining:

1. Mainline

2. Service (lateral) repair

3. Point repair

B. Pressure testing and grouting of sewer joints.

C. Pipe spot repairs.

D. Pre-rehabilitation cleaning and inspection is light sewer cleaning including an unlimited number of passes with a hydraulic flusher. Does not include root cutting or removal of deposits or protruding service connections.

E. 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.

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.

1.08 MEASUREMENT AND PAYMENT (Continued)

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.

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:

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:

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:

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.

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. 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.

4. 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. Inspect all lateral connections and other observations at right angles utilizing the pan and tilt capabilities of the camera.

4. Center the video camera in the pipe during the inspection.

5. 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.

3.03 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.

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.

3.03 SANITARY SEWER LEAKAGE TESTING (Continued)

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

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.

3.03 SANITARY SEWER LEAKAGE TESTING (Continued)

D. Sanitary Sewer Vacuum Testing:

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.

3.04 DEFLECTION TESTING (Continued)

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

Table of Contents

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.

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.

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) Tensile 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) Tensile 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) Tensile 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. Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet unless:
   - The top of a sewer main is at least 18 inches below the bottom of the water main, and
   - 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.

2. 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, the sewers must be constructed of water main materials meeting the requirements of Section 5010, 2.01. However, provide a linear separation of at least 2 feet.

B. 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.

C. Separation of Sewer and Water Main Crossovers:

1. Vertical separation of sanitary and storm sewers crossing under any water main should be 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, the sewer may be placed not closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases. The sewer and water pipes must be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

2. Where the sanitary sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material so both joints are as far as possible from the water main.

3. Where the storm sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material or reinforced concrete pipe (RCP) with flexible gasket joints meeting ASTM C 443 so both joints are as far as possible from the water main.

D. Surface Water Crossings: Comply with the Recommended Standards for Water Works, 2007 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 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

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.

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 46 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.

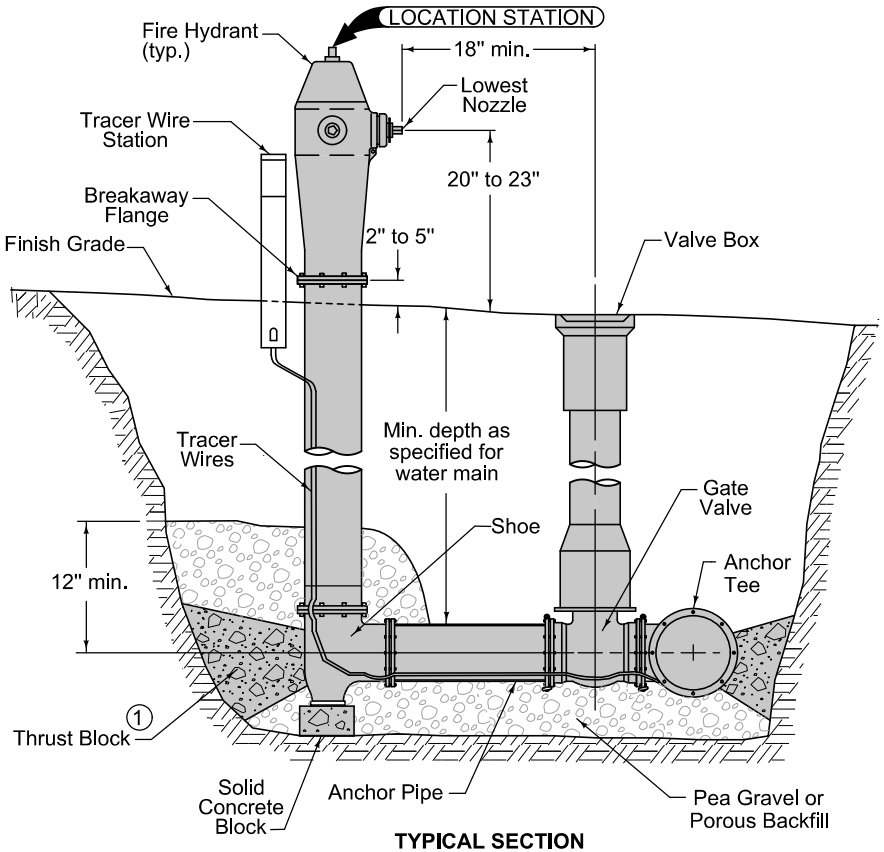
3.04 ADJUSTMENT OF EXISTING VALVE BOX OR FIRE HYDRANT (Continued)

D. Fire Hydrant Adjustment:

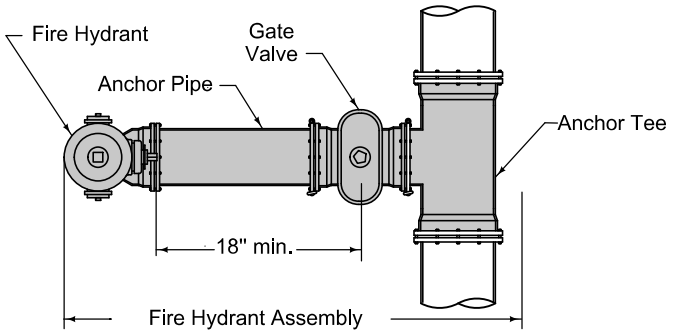
1. Add extension barrel sections and stems as necessary to set existing fire hydrant at finished grade.

2. Paint exterior of new barrel section to match existing fire hydrant unless otherwise specified.

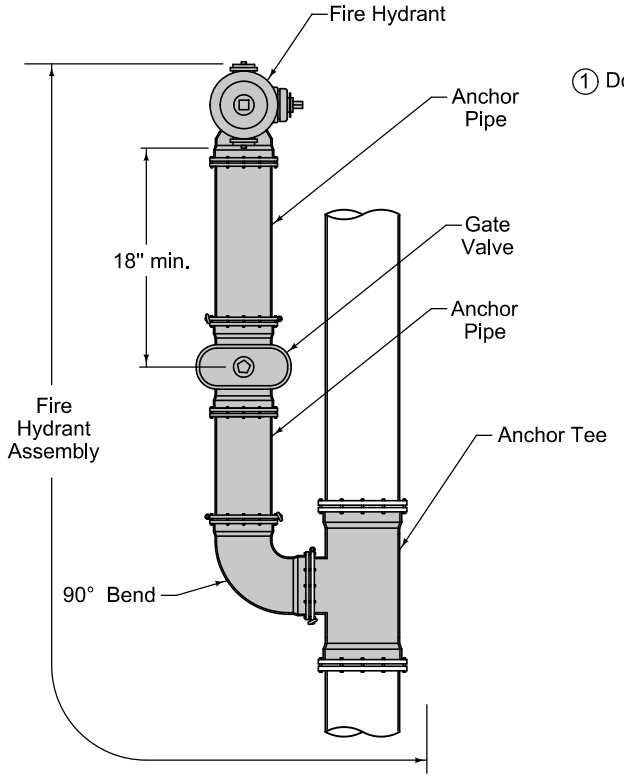
END OF SECTION



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.

(1) Do not cover drain holes or tracer wire.

SUDAS	IOWADOT	REVISION 3 04-20-21
FIGURE 5020.201	STANDARD ROAD PLAN	WM-201
		SHEET 1 of 1

REVISIONS: Added general note for bid items.

Paul D. Wigand — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

FIRE HYDRANT ASSEMBLY

FIGURE 5020.201 SHEET 1OF 1

3.05 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 according to AWWA C600:

$$L = \frac{(S)(D)(P)^{0.5}}{148{,}000}$$

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

J. If the average measured leakage per hour exceeds the maximum allowable leakage rate, repair and retest the water main.

3.05 PRESSURE AND LEAK TESTING (Continued)

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.

3.06 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, the Engineer may 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.

3.07 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.

3.08 PUTTING WATER MAIN IN SERVICE

Put the completed water system in service only after obtaining permission from the Jurisdiction.

END OF SECTION

Table of Contents

Section 6010 - **Structures for Sanitary and Storm Sewers (Continued)** **Page No.**

Figures **Figure No.**

STRUCTURES FOR SANITARY AND STORM SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Manholes and Intakes for Storm Sewers

B. Manholes for Sanitary Sewers

C. Adjustment of Existing Manholes and Intakes

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; and adjustment rings.

C. Drop Connection:

1. **Internal Drop Connection:**
   a. **Measurement:** Each internal drop connection will be counted.
   b. **Payment:** Payment will be at the unit price for each 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 external drop connection will be counted.
   b. **Payment:** Payment will be at the unit price for each 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.

E. Manhole or Intake Adjustment, Minor:

1. **Measurement:** Each existing manhole or intake adjusted to finished grade by addition or removal of adjustment rings or adjustment of adjustable casting will be counted.

2. **Payment:** Payment will be made at the unit price for each minor manhole or intake adjustment.

3. **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).

F. Manhole or Intake Adjustment, Major:

1. **Measurement:** Each existing manhole or 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.

2. **Payment:** Payment will be at the unit price for each major adjustment.

3. **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.

G. Connection to Existing Manhole or Intake:

1. **Measurement:** Each connection made to an existing manhole or intake will be counted.

2. **Payment:** Payment will be made at the unit price for each sewer connection.

3. **Includes:** Unit price includes, but is not limited to, coring or cutting into the existing manhole or intake, pipe connections, grout, and waterstop (when required).

H. Remove Manhole or Intake:

1. **Measurement:** Each manhole or intake removed will be counted.

2. **Payment:** Payment will be made at the unit price for each manhole or intake.

3. **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.

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 HMA pavement or 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 with the proper butyl rubber sealant/adhesive.

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. Do not use when heat shrinkable infiltration barrier is used.

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.

C. 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.

2.10 CASTINGS (Ring, Cover, Grate, and Extensions) (Continued)

D. 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.

2.11 ADDITIONAL MATERIALS FOR SANITARY SEWER MANHOLES (Continued)

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 polypropylene or 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.

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 4020, 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.

2.16 DROP CONNECTION (Continued)

B. External:

1. **Pipe and Fittings:** Comply with Section 5010, 2.01, B for ductile iron pipe and Section 5010, 2.03 for 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.

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.

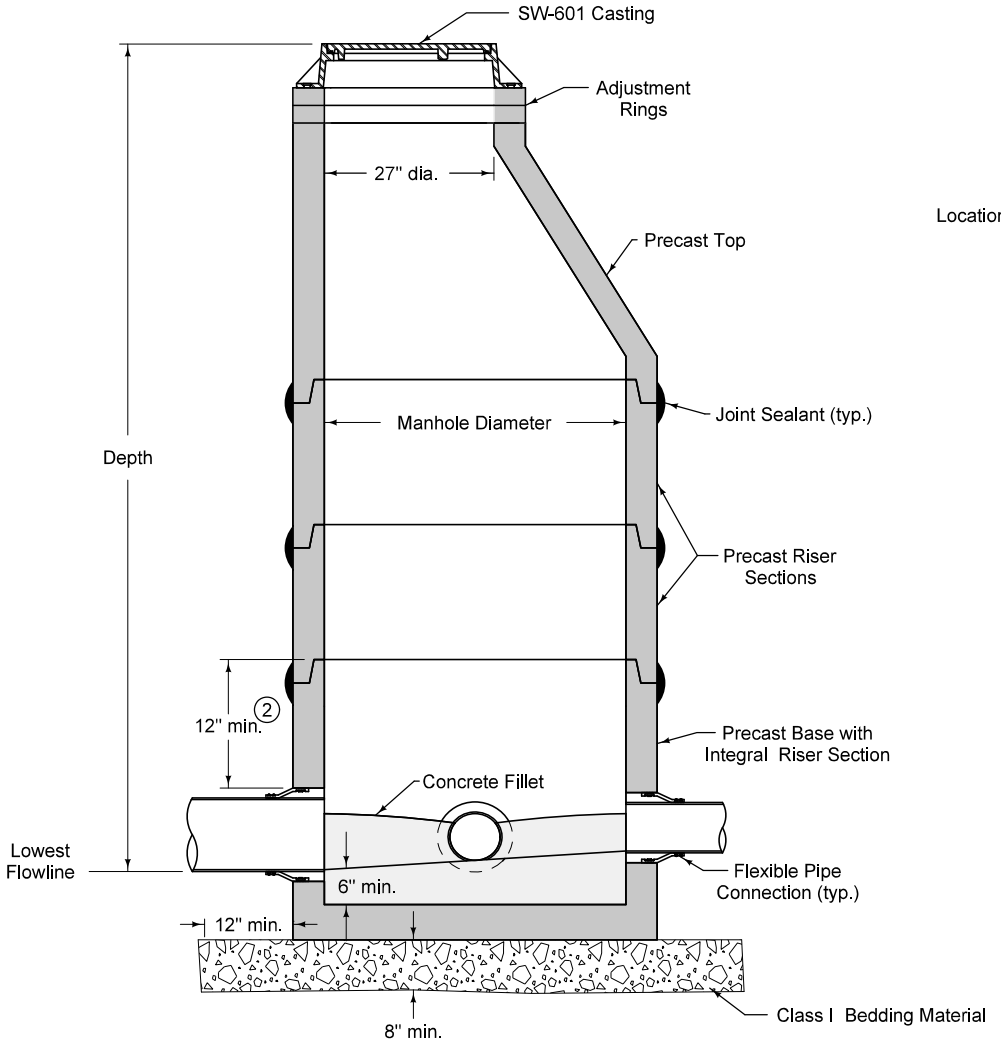
END OF SECTION

If manhole depth exceeds 20 feet, install steps.

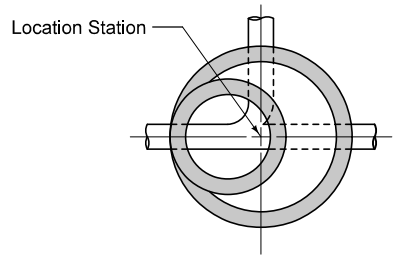
Install infiltration barrier.

(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.



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

SUDAS | IOWADOT | REVISION 4 04-20-21

FIGURE 6010.301 | STANDARD ROAD PLAN | SW-301 | SHEET 1 of 1

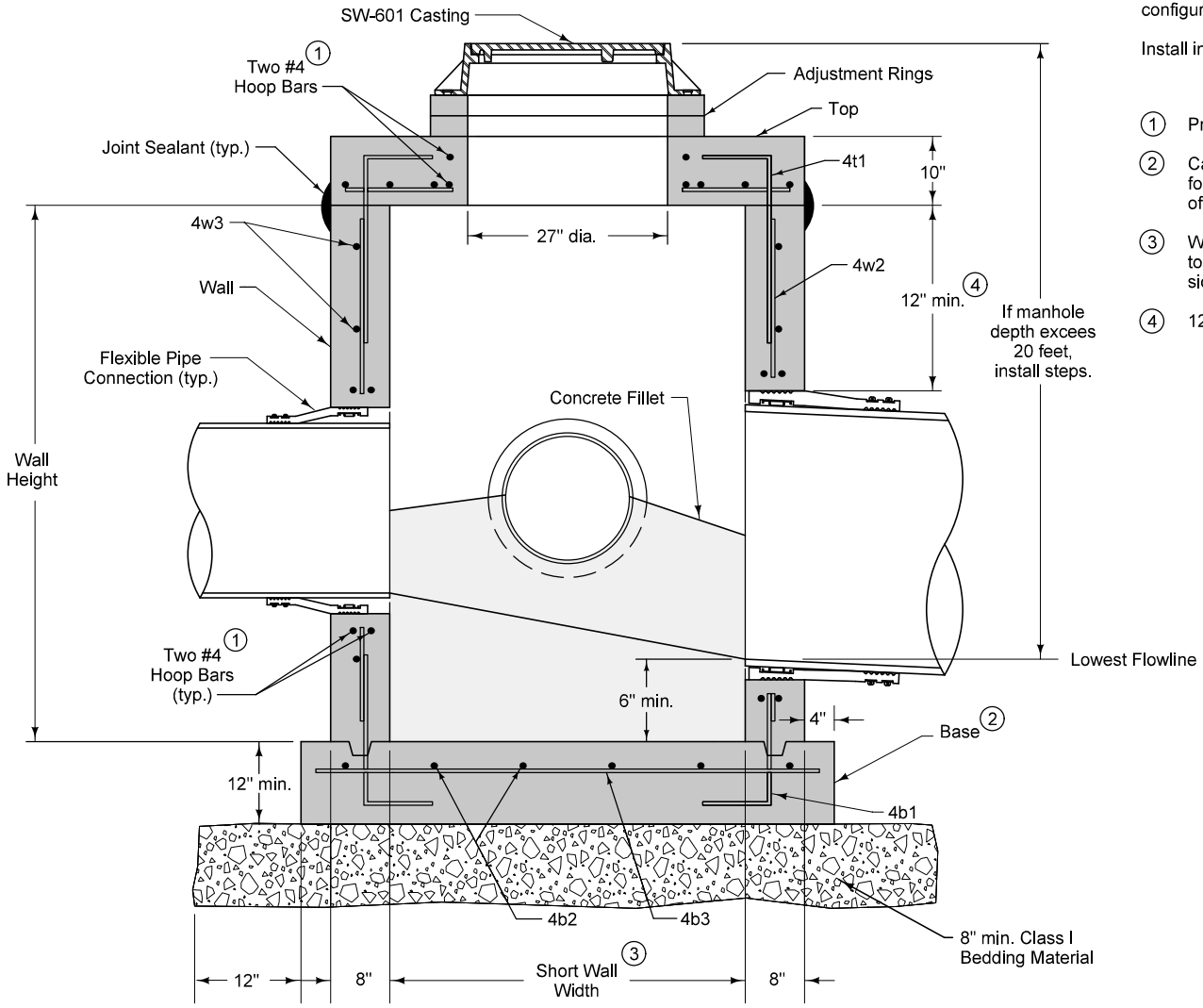
REVISIONS: Added manhole depth note and infiltration barrier note.

Paul D. Wigand, SUDAS DIRECTOR

Stuart Nicholson, DESIGN METHODS ENGINEER

CIRCULAR SANITARY SEWER MANHOLE

FIGURE 6010.301 | SHEET 1 OF 1



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

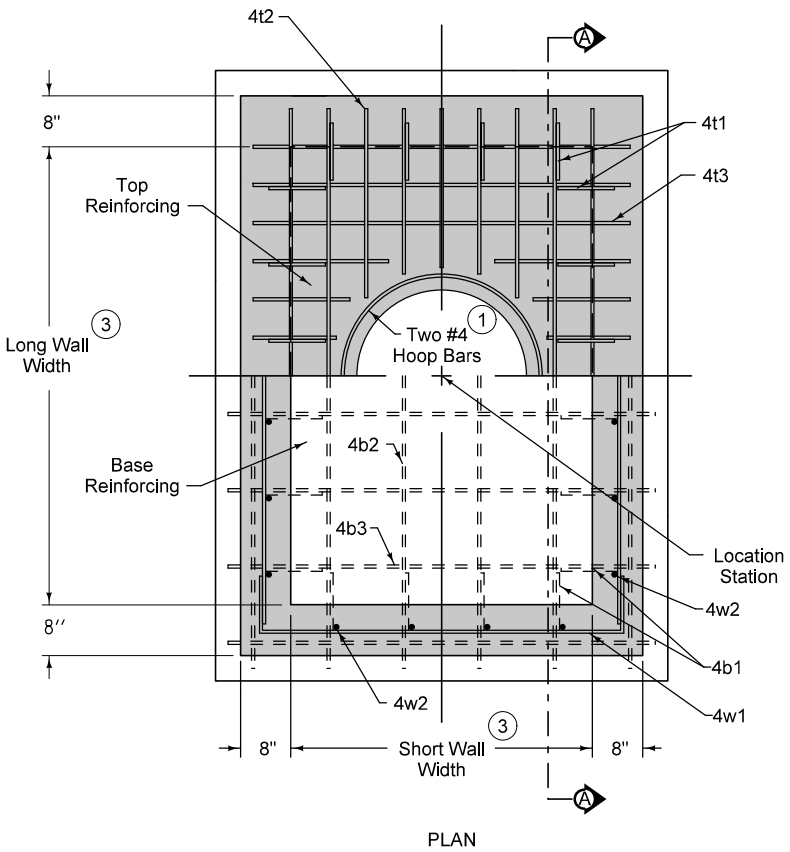
SUDAS	IOWADOT	REVISION 3	04-20-21
FIGURE 6010.302	STANDARD ROAD PLAN	SW-302	SHEET 1 of 2

REVISIONS: Added infiltration barrier note.

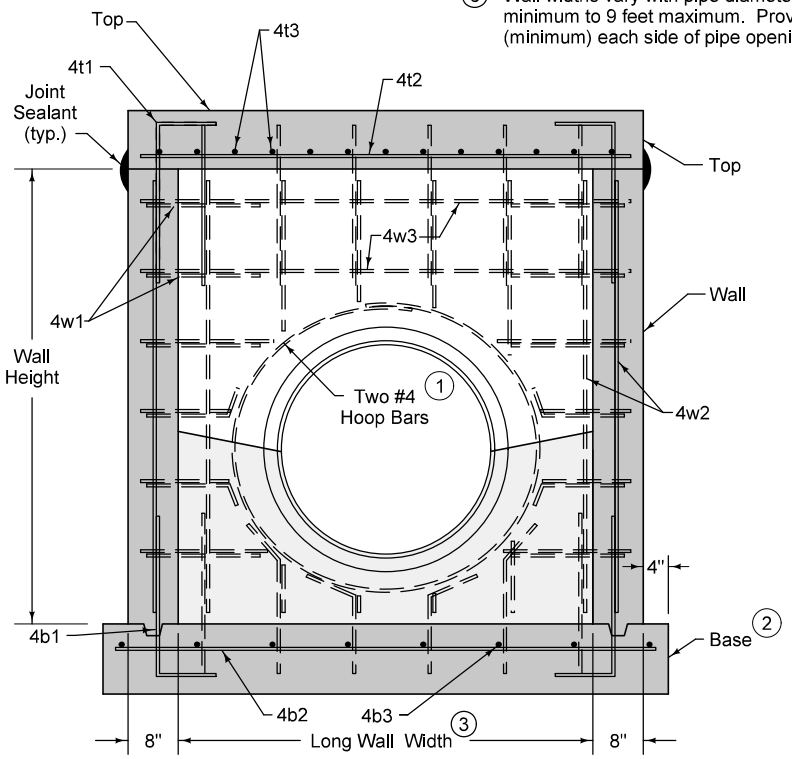
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

RECTANGULAR SANITARY SEWER MANHOLE



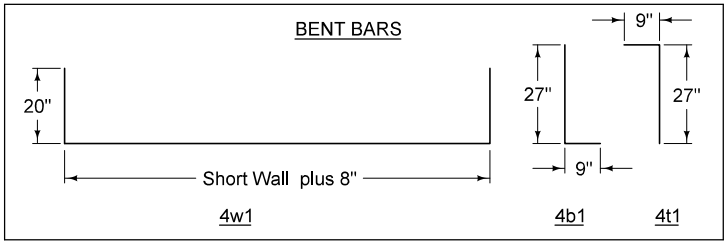
PLAN



SECTION A-A

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.

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"



SUDAS | IOWADOT | REVISION 3 04-20-21

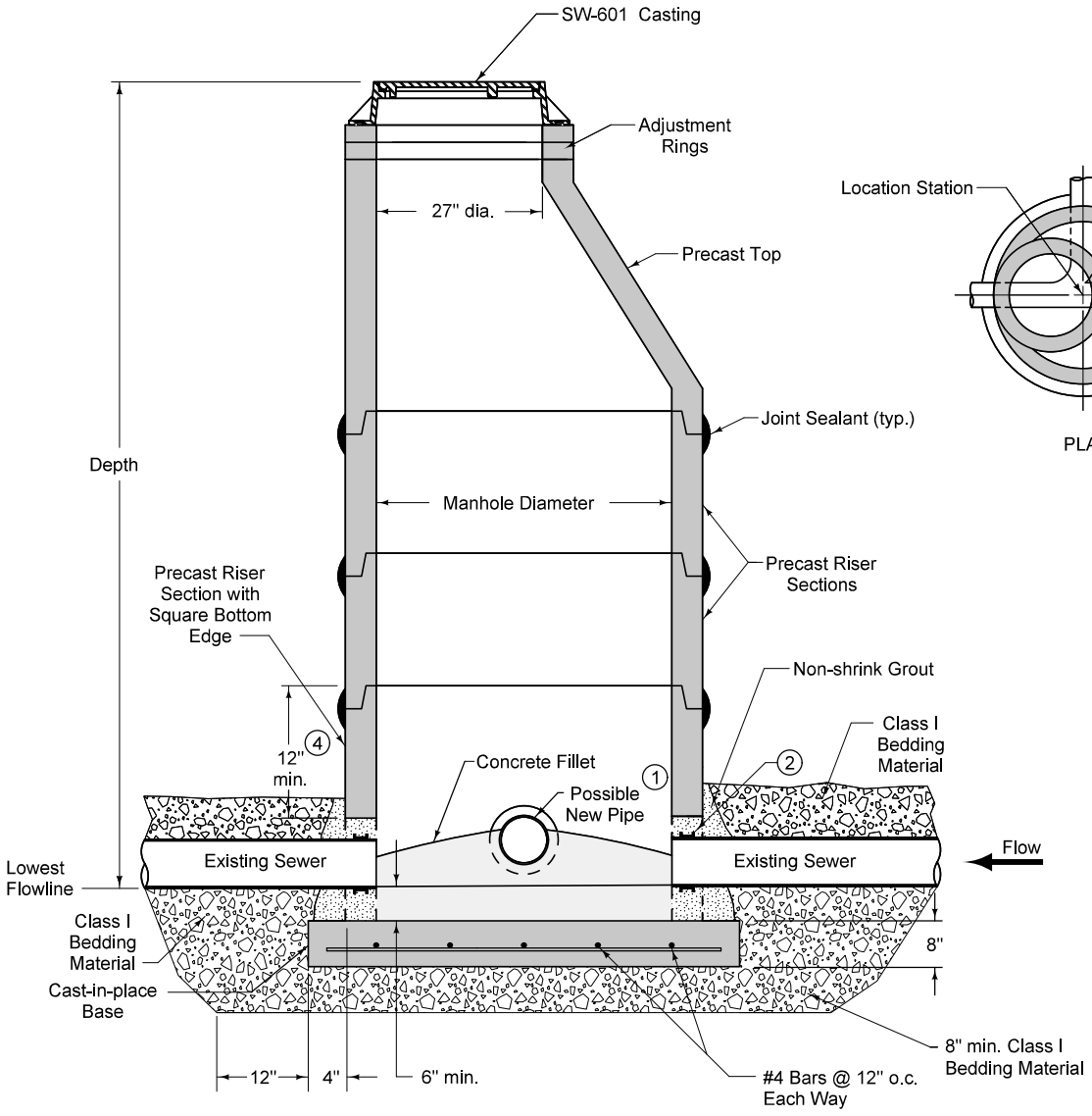
FIGURE 6010.302 | STANDARD ROAD PLAN | SW-302 | SHEET 2 of 2

REVISIONS: Added Infiltration barrier note.

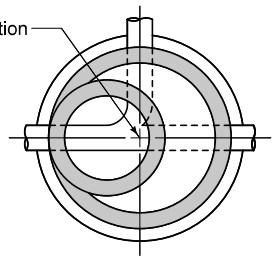
Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

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.

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 4 04-20-21

FIGURE 6010.303 | STANDARD ROAD PLAN | SW-303

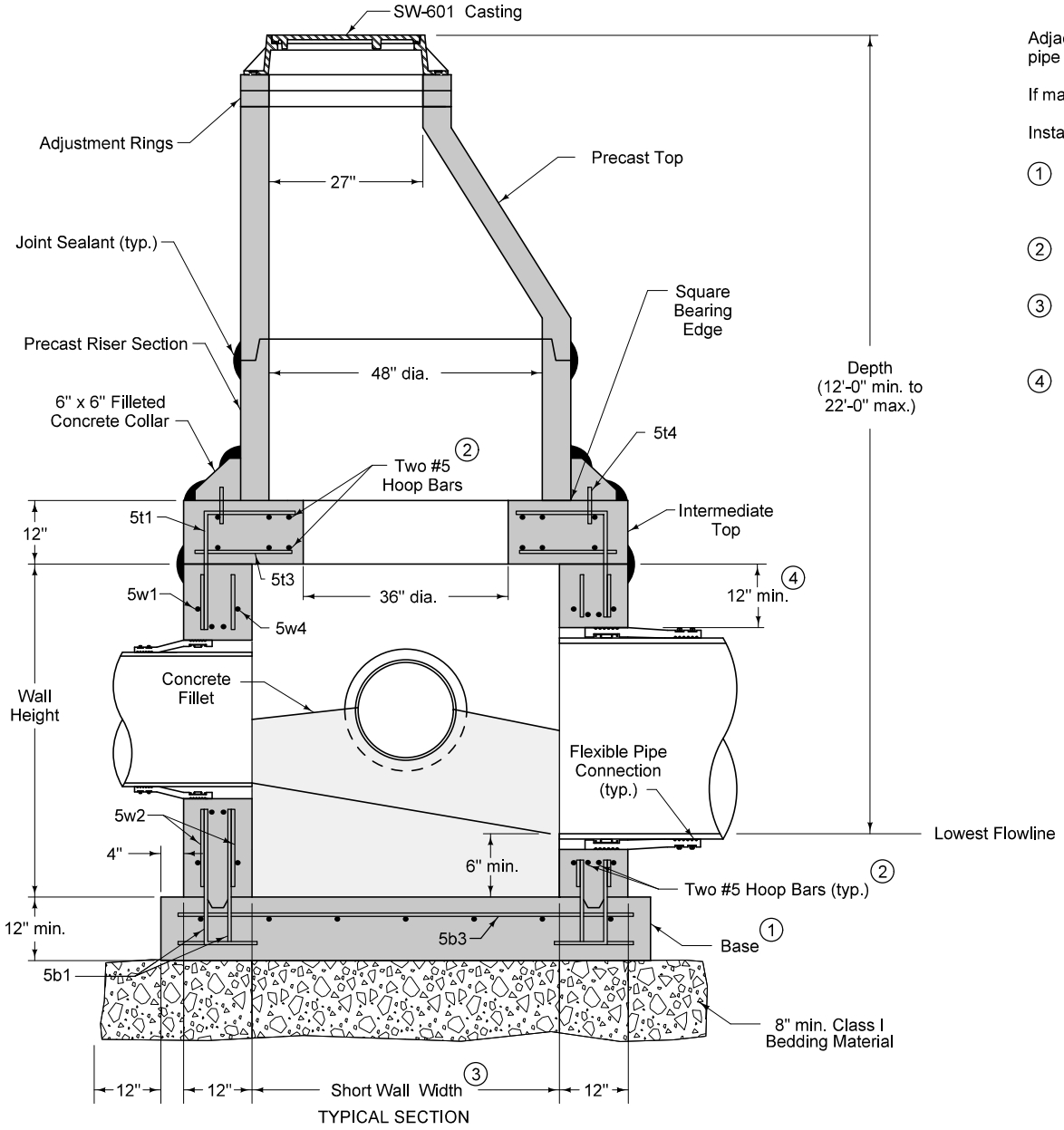
SHEET 1 of 1

REVISIONS: Added manhole depth note

Paul D. Wigand
SUDAS DIRECTOR

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

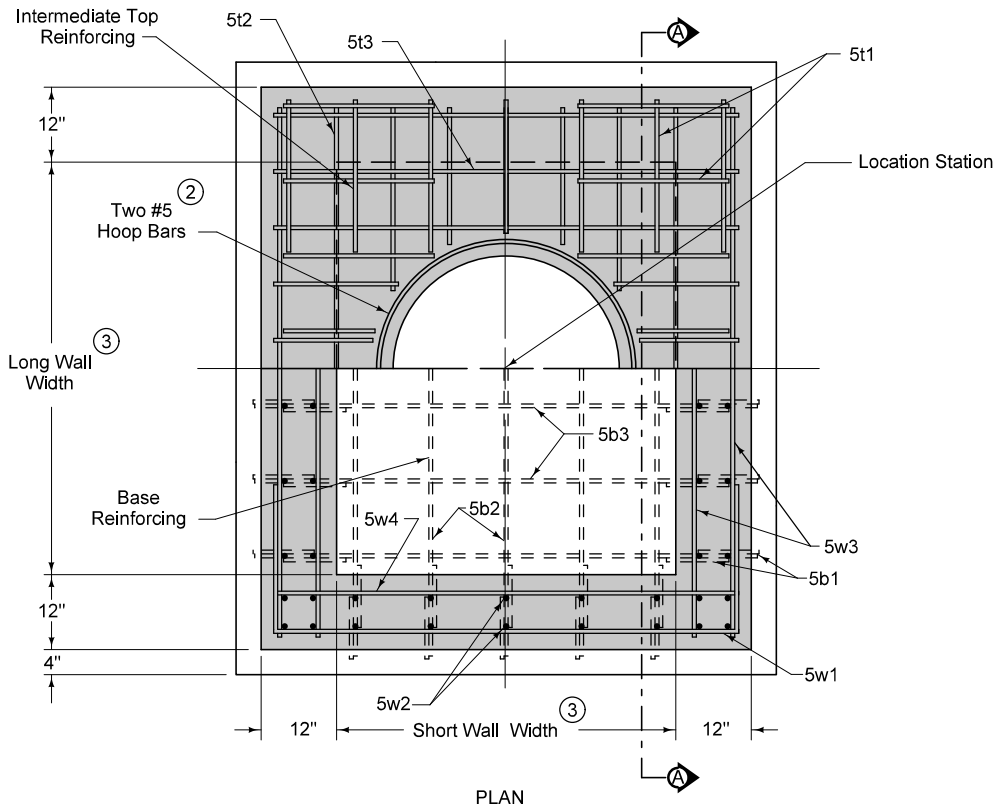
SUDAS	IOWADOT	REVISION 4 04-20-21
FIGURE 6010.304	STANDARD ROAD PLAN	SW-304 SHEET 1 of 2

REVISIONS: Added manhole depth note and infiltration barrier note.

Paul D. Wigand — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

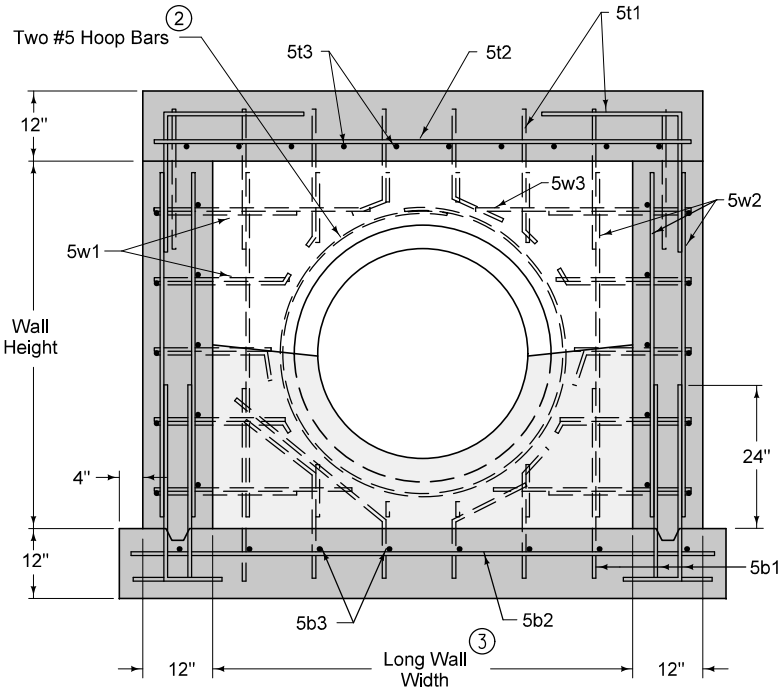
RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE



PLAN

2 Provide two #5 hoop bars at intermediate top opening and at all pipe openings.

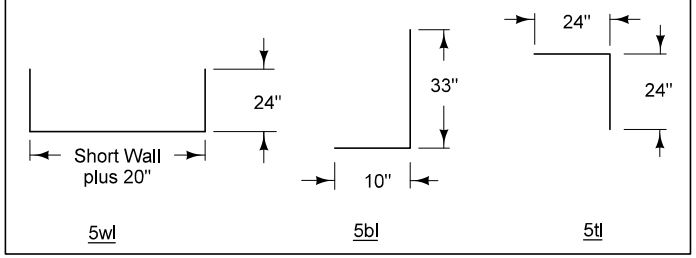
3 Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall opening (minimum) each side of pipe opening.



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

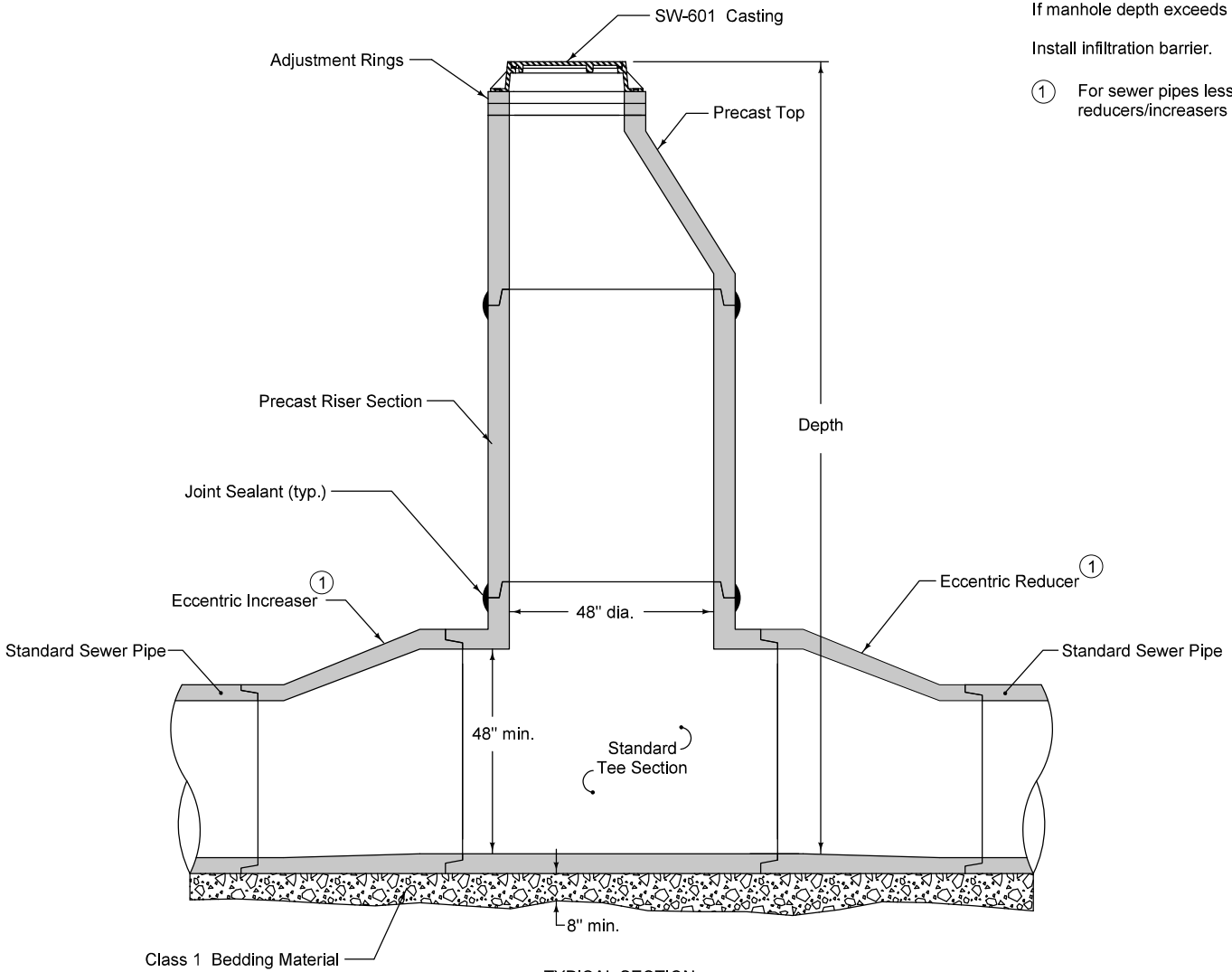
FIGURE 6010.304 | STANDARD ROAD PLAN | SW-304 | SHEET 2 of 2

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

STANDARD TEE 1

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.

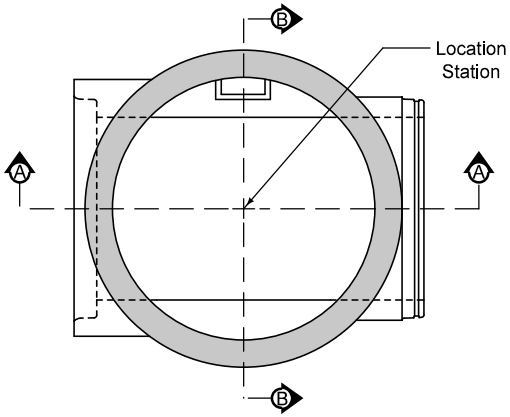
FIGURE 6010.305 SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 3 04-20-21
FIGURE 6010.305	STANDARD ROAD PLAN	SW-305
		SHEET 1 of 2

REVISIONS: Added manhole depth note .

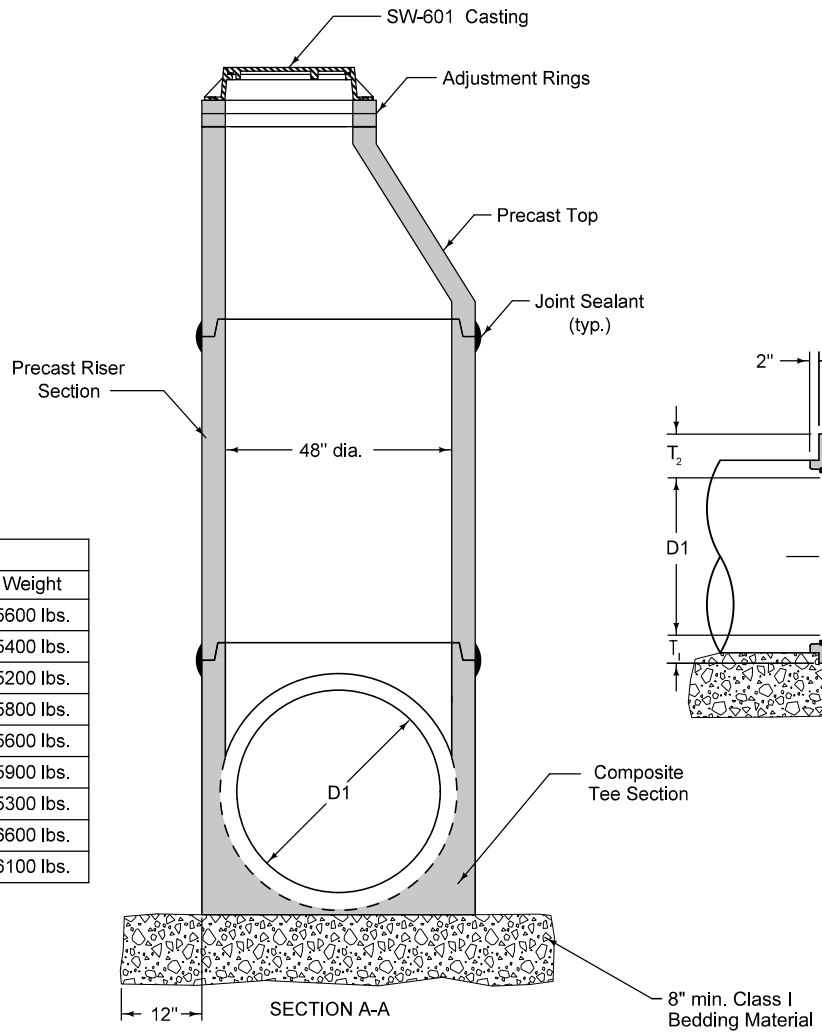
Paul D. Wigard, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

TEE-SECTION
SANITARY SEWER MANHOLE



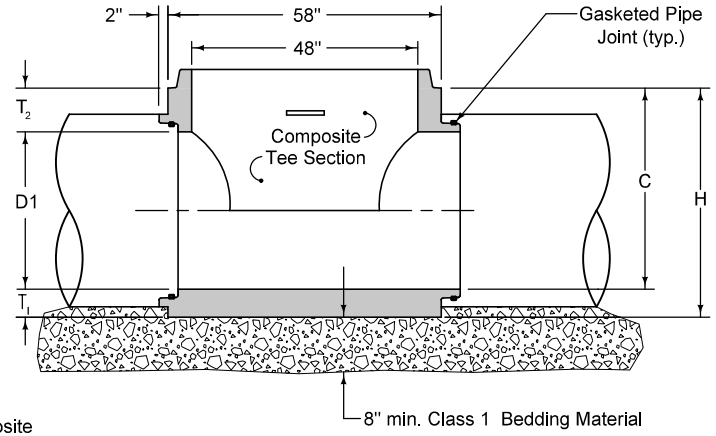
PLAN

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.



SECTION A-A

Install infiltration barrier.



SECTION B-B

COMPOSITE TEE

Alternate to standard tee with eccentric reducer (for pipes 36" and smaller).

FIGURE 6010.305 SHEET 2 OF 2

SUDAS | IOWA DOT | REVISION 3 4-20-21

FIGURE 6010.305 | STANDARD ROAD PLAN | SW-305 | SHEET 2 of 2

REVISIONS: Added manhole depth note

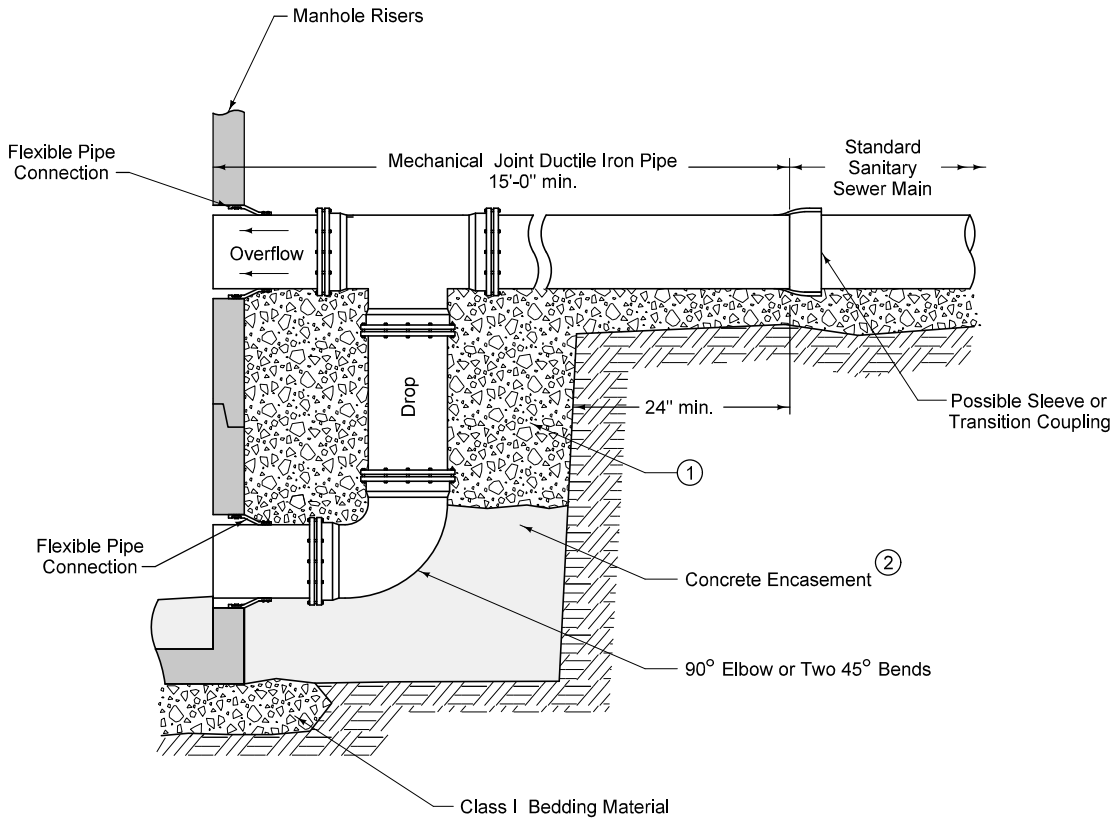
Paul D. Wigant
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

TEE-SECTION
SANITARY SEWER MANHOLE

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.

FIGURE 6010.307 SHEET 1 OF 1

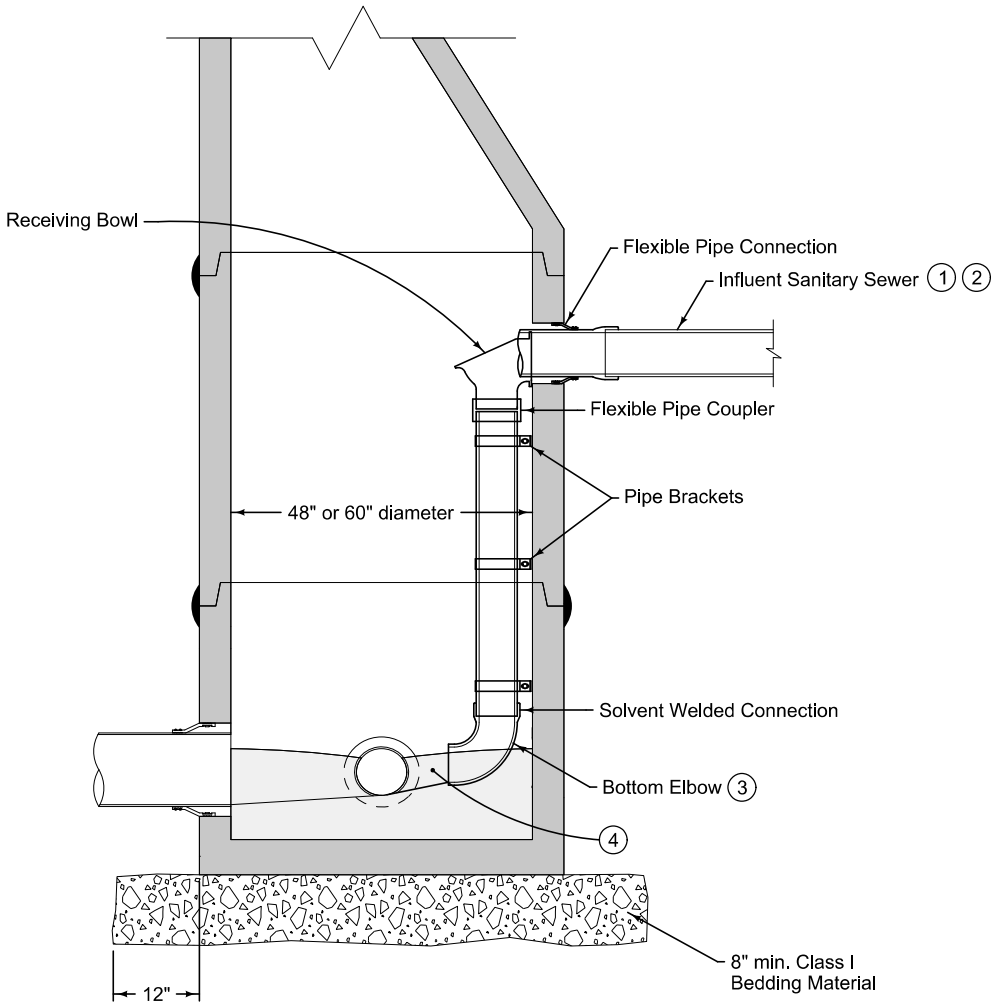
SUDAS | IOWADOT | REVISION 2 04-21-20

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 | Stuart Nicholson, DESIGN METHODS ENGINEER

EXTERNAL DROP CONNECTION FOR SANITARY SEWER MANHOLE



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

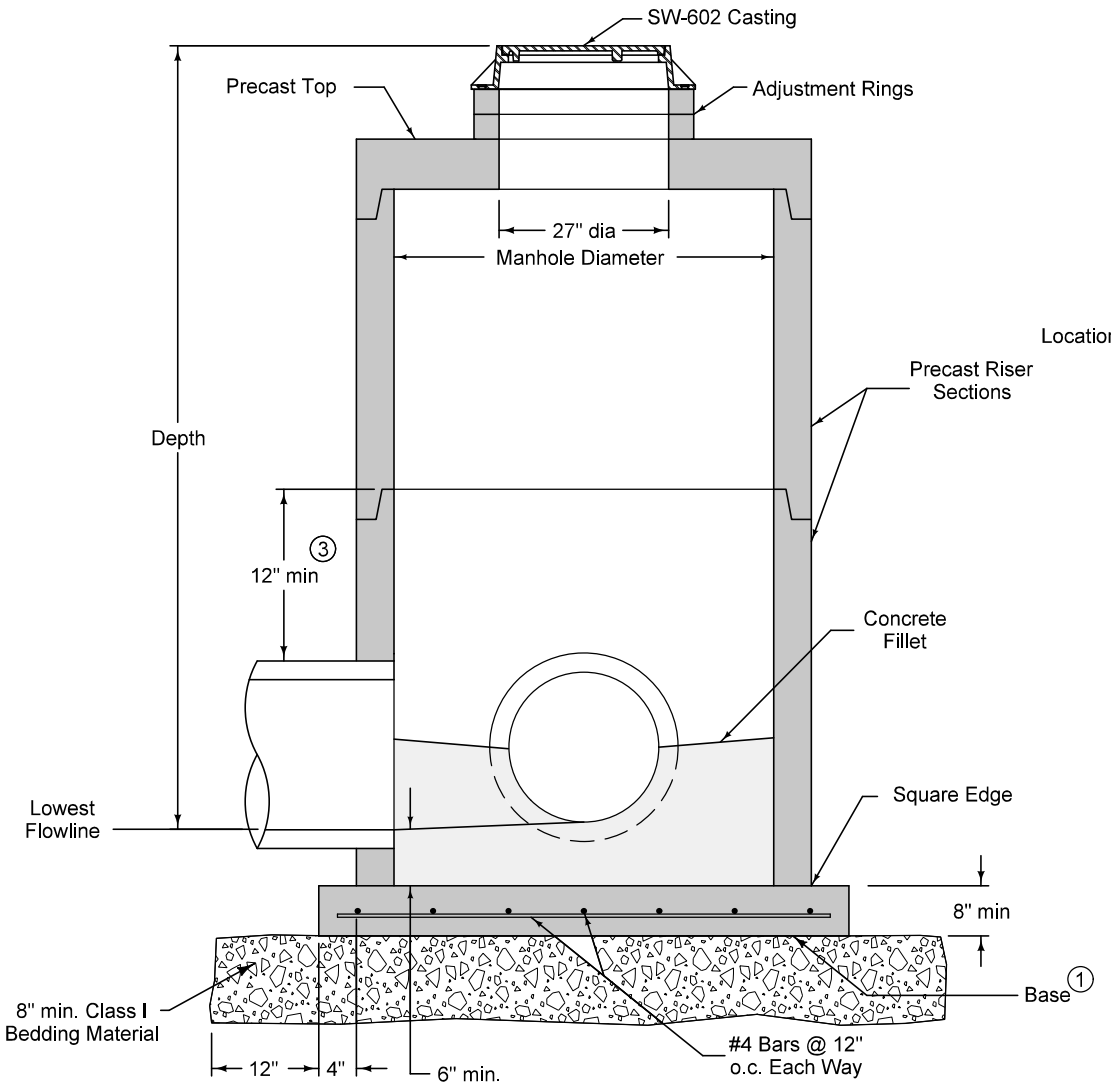
REVISION	
1	04-20-21

FIGURE 6010.308 | STANDARD ROAD PLAN | SW-308 | SHEET 1 of 1

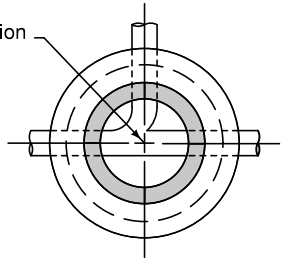
REVISIONS: Deleted top of manhole.

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

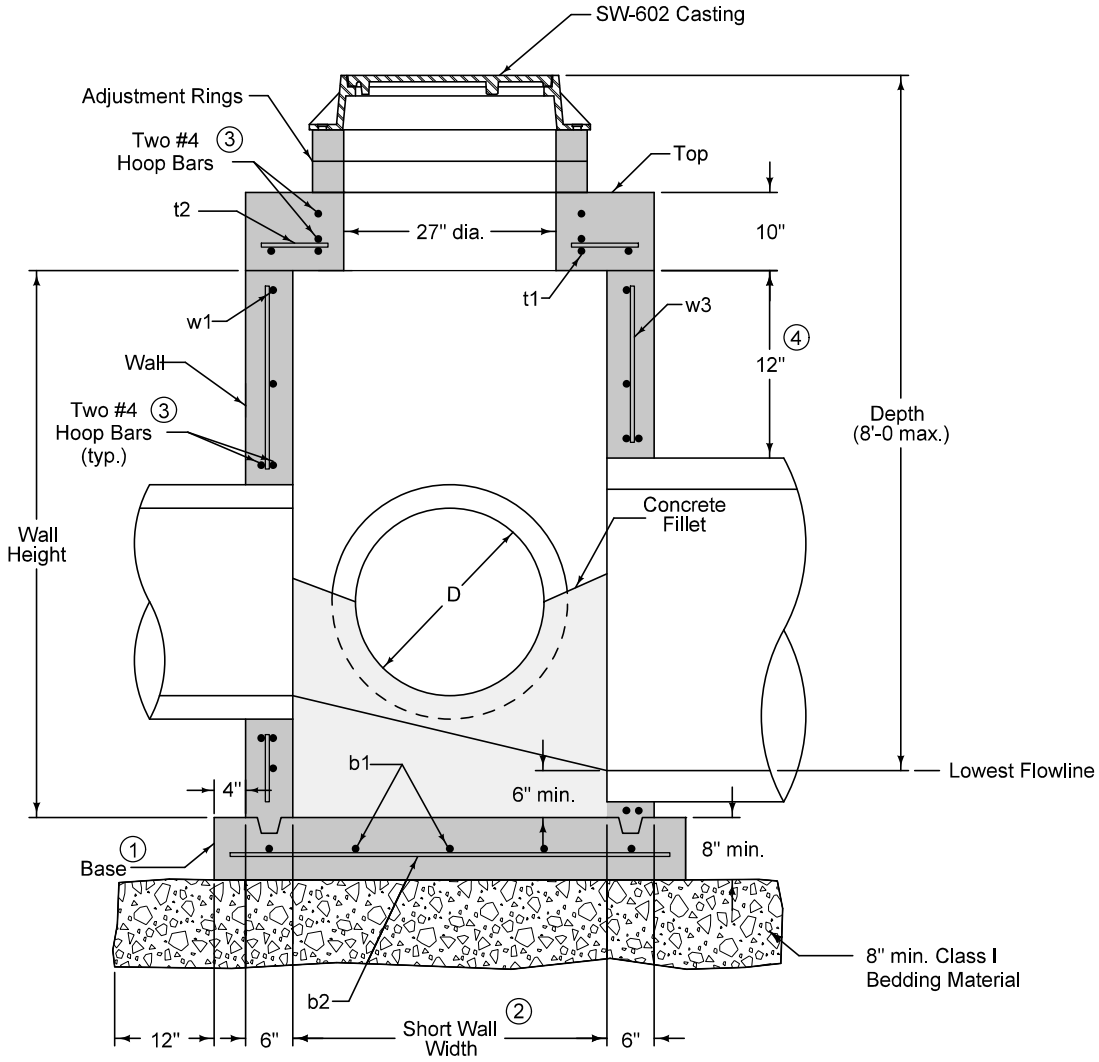
SUDAS | IOWADOT | REVISION 3 04-20-21

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.

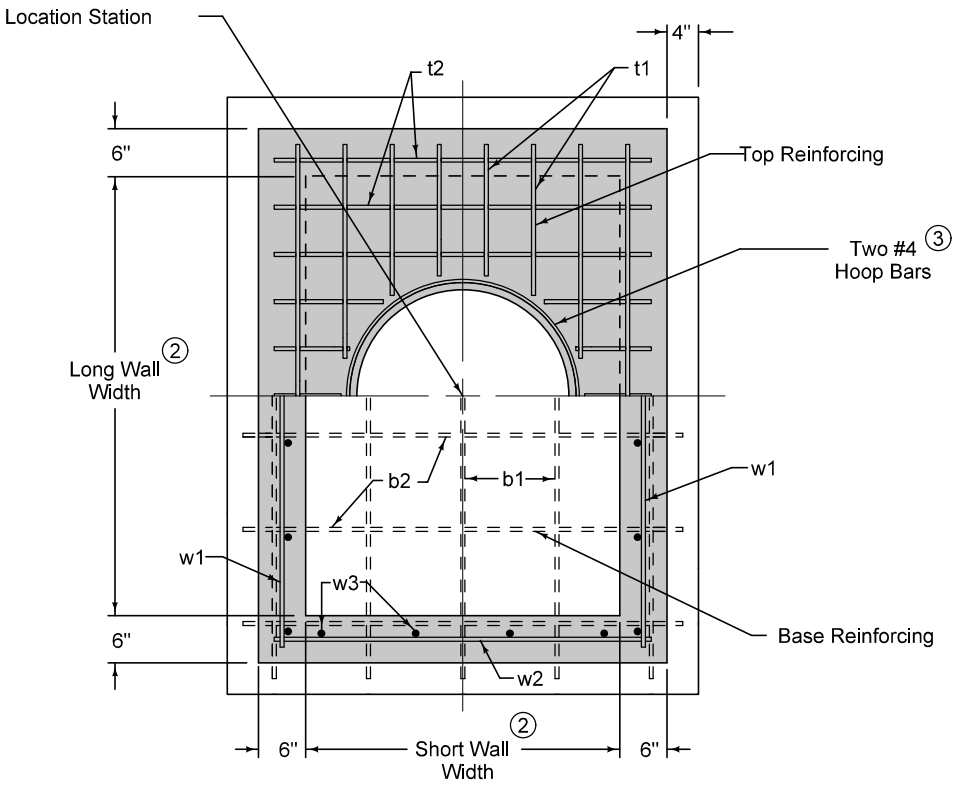
FIGURE 6010.402 | SHEET 1 OF 2

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. Wigant — SUDAS DIRECTOR
Stuart Nielsen — DESIGN METHODS ENGINEER

RECTANGULAR STORM SEWER MANHOLE



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

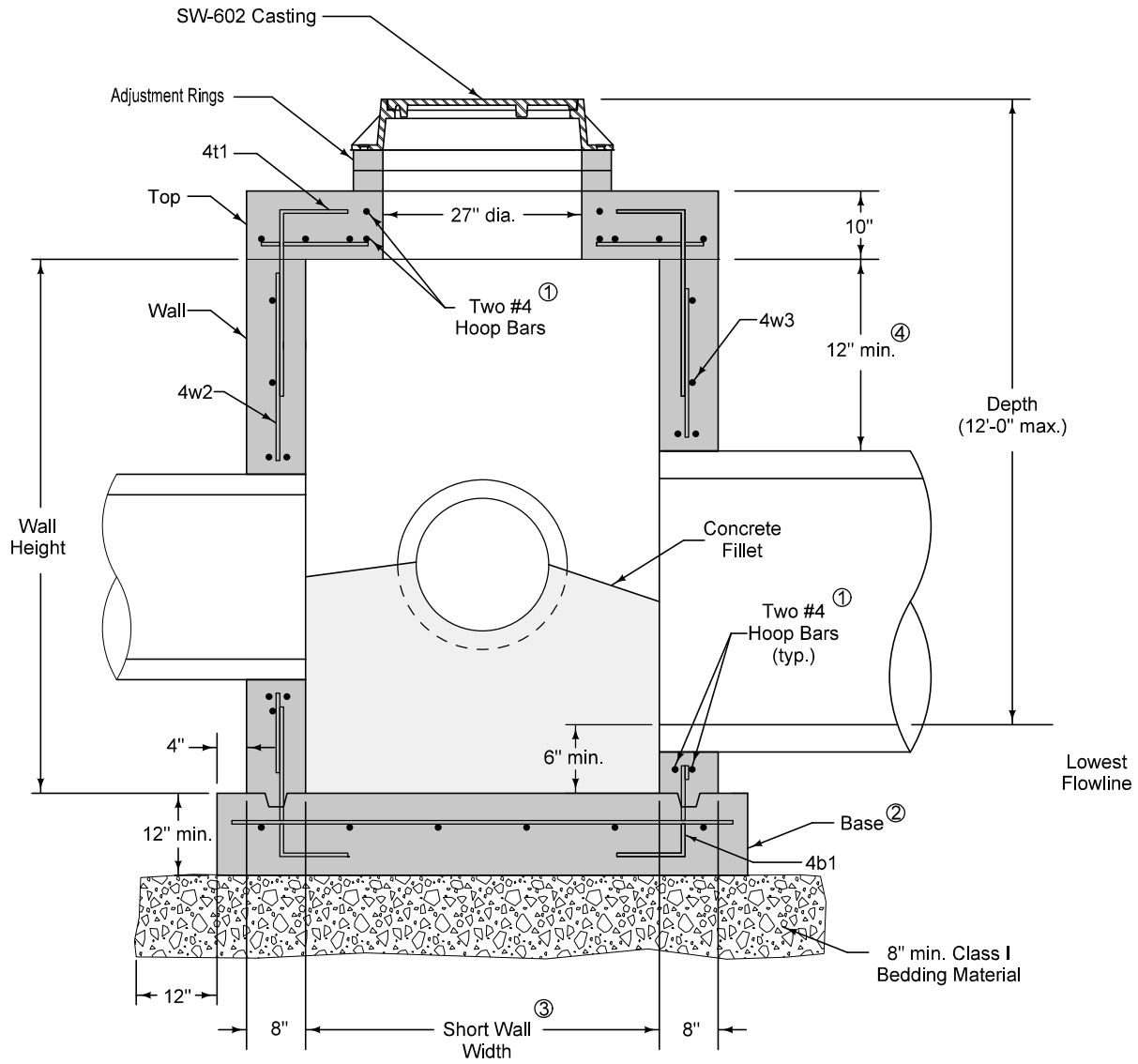
FIGURE 6010.402 | STANDARD ROAD PLAN | SW-402 | SHEET 2 of 2

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

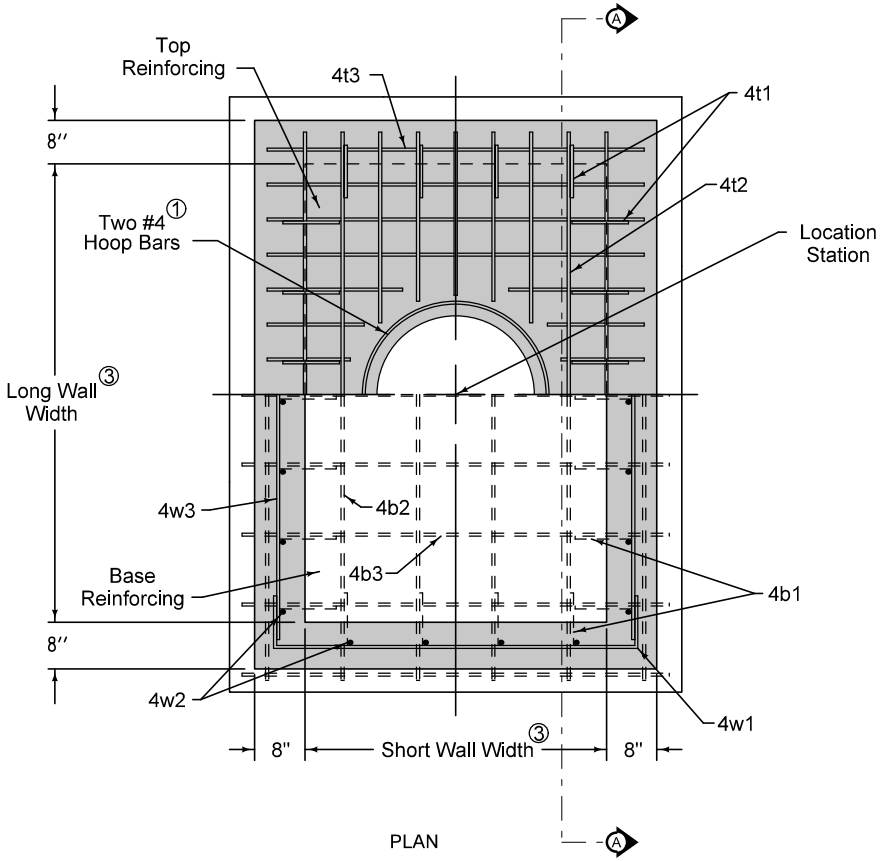
DEEP WELL RECTANGULAR STORM SEWER MANHOLE

FIGURE 6010.403 SHEET 1 OF 2

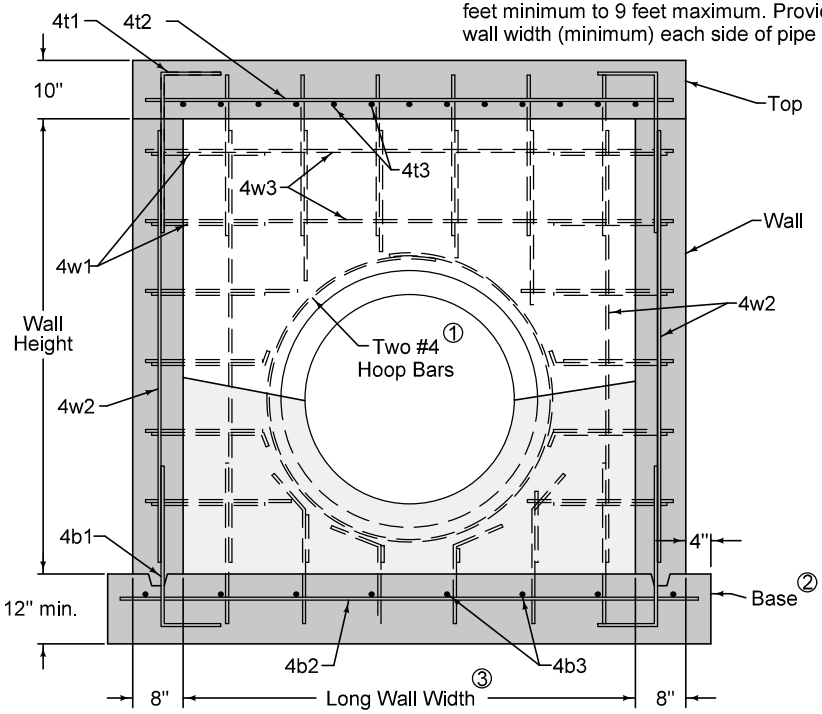
① Provide two #4 hoop bars at top opening and at all pipe openings.

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.



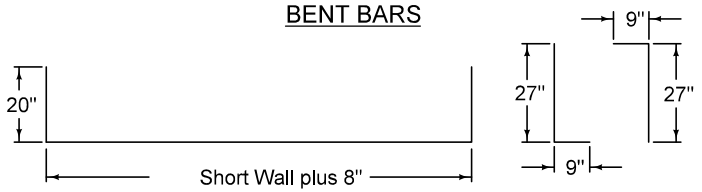
PLAN



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"

BENT BARS



SUDAS | IOWA DOT | REVISION 2 04-21-20

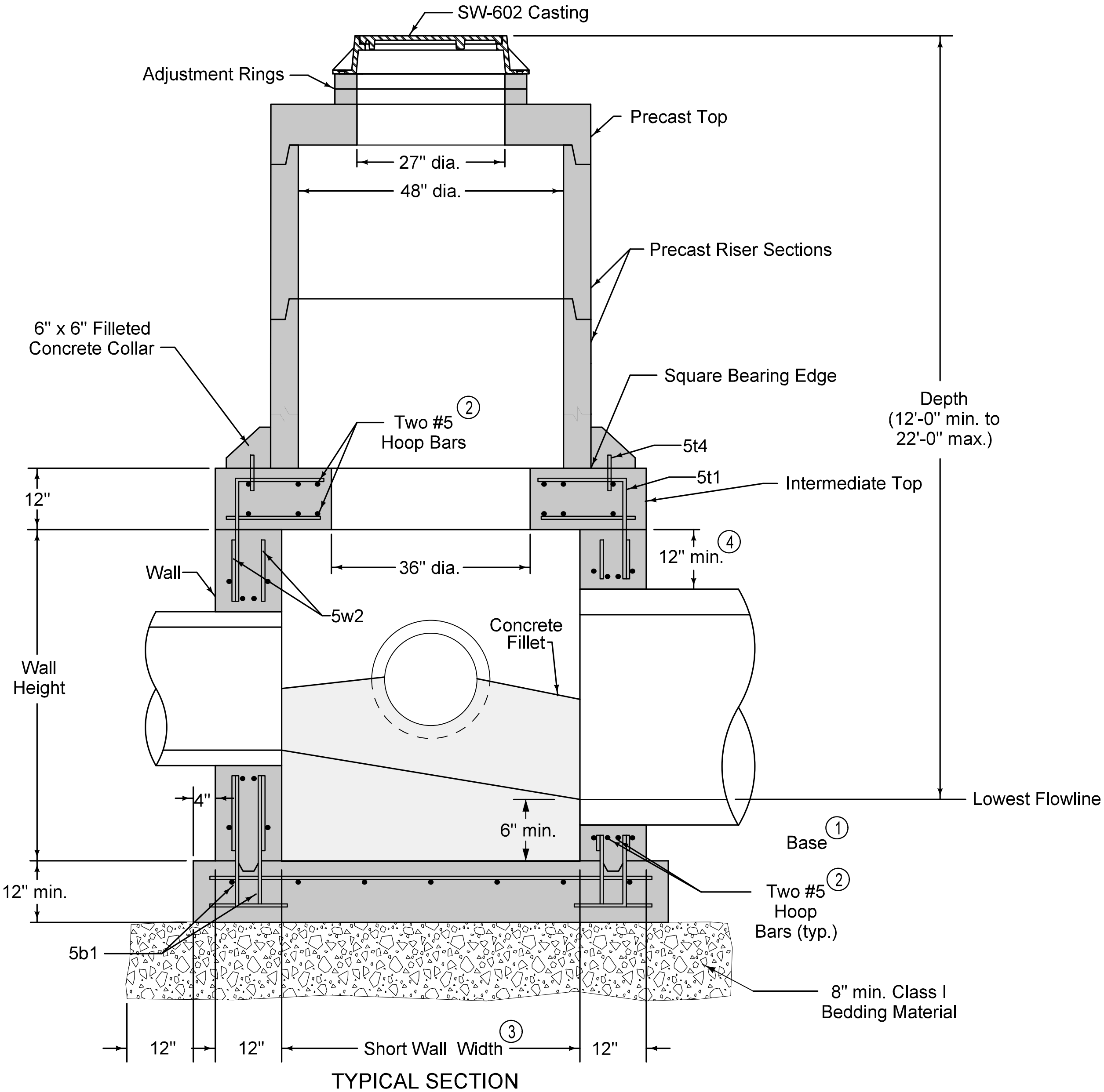
FIGURE 6010.403 | STANDARD ROAD PLAN | SW-403 | SHEET 2 of 2

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



Adjacent walls may have different widths based upon pipe configuration, but structure must be rectangular.

If manhole depth exceeds 20 feet, install steps.

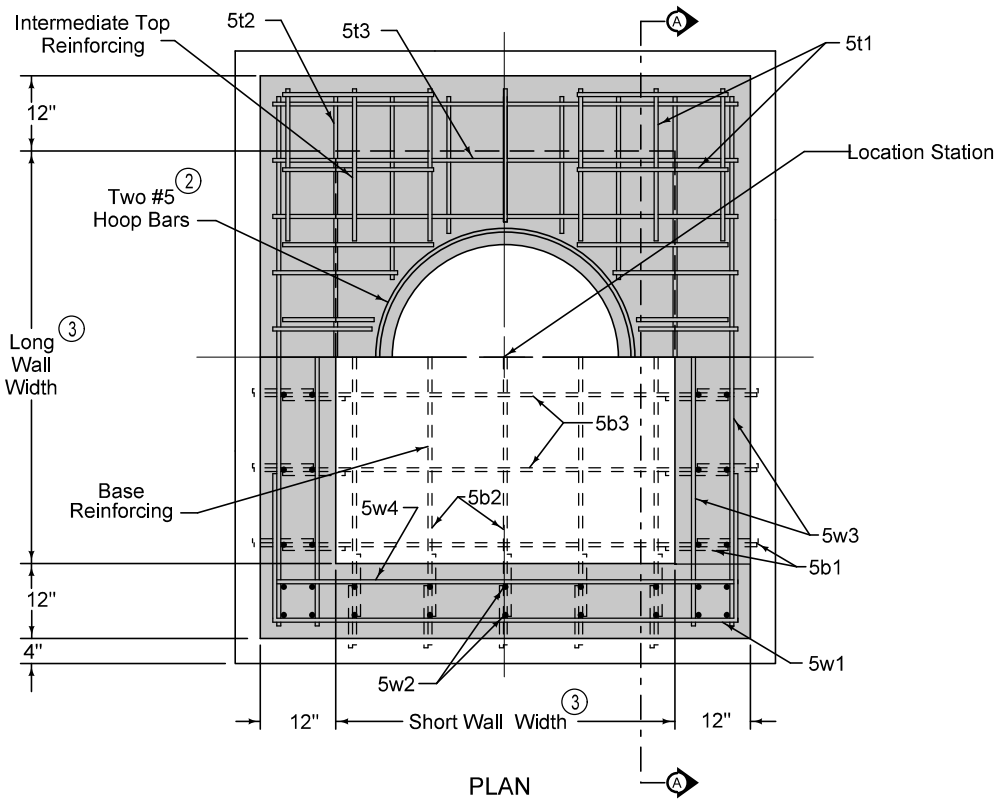
1. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
2. Provide two #5 hoop bars at intermediate top opening and at all pipe openings.
3. Wall widths vary with pipe diameter and range from 4 feet minimum 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.

SUDAS	IOWADOT	REVISION 4 04-20-21
FIGURE 6010.404	STANDARD ROAD PLAN	SW-404 SHEET 1 of 2

REVISIONS: Added manhole depth note.

SUDAS DIRECTOR — DESIGN METHODS ENGINEER

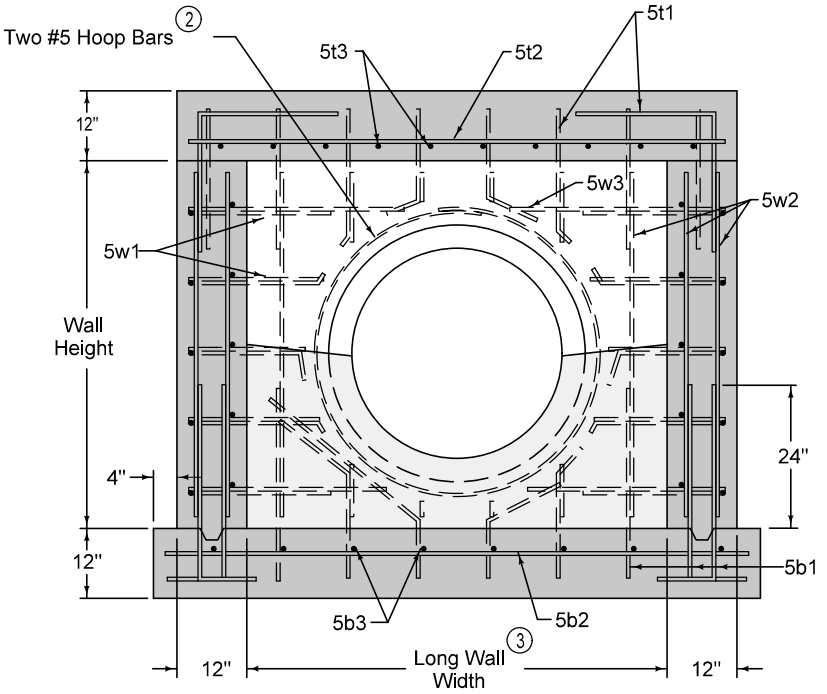
RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE



PLAN

② Provide two #5 hoop bars at intermediate top opening and at all pipe openings.

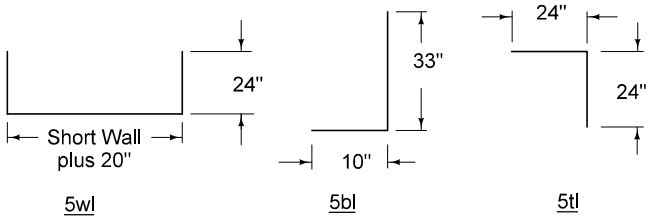
③ Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.



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

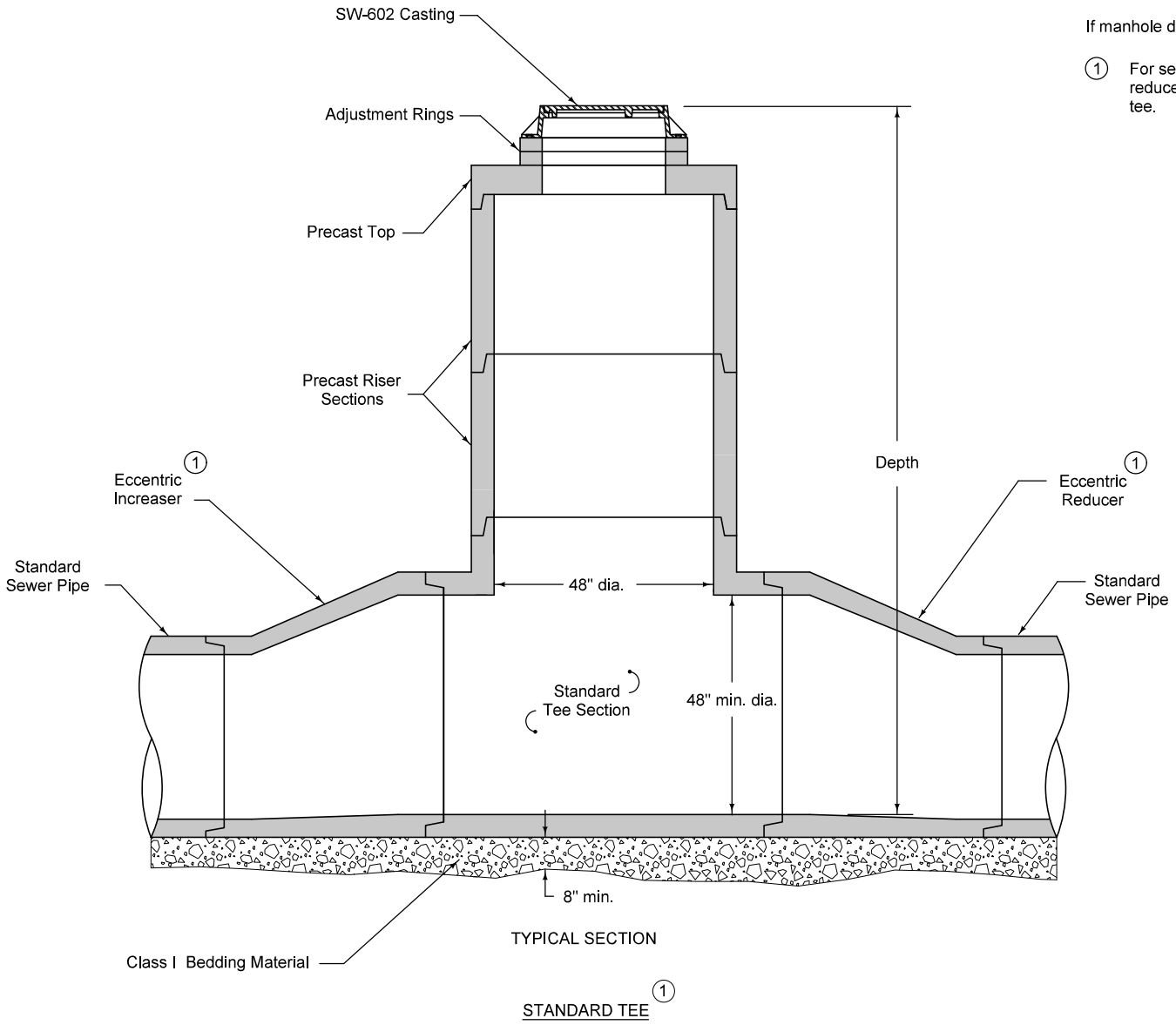
FIGURE 6010.404 | STANDARD ROAD PLAN | SW-404 | SHEET 2 of 2

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.

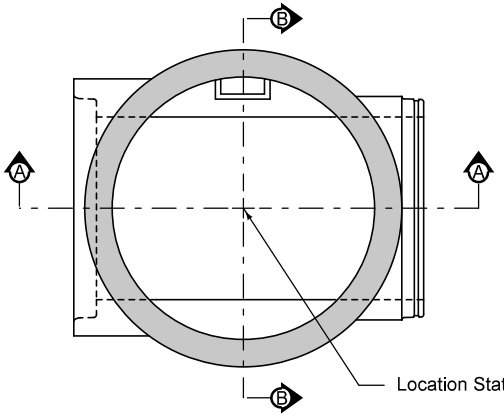
SUDAS	IOWA DOT	REVISION 4 04-20-21
FIGURE 6010.405	STANDARD ROAD PLAN	SW-405
		SHEET 1 of 2

REVISIONS: Added manhole depth note.

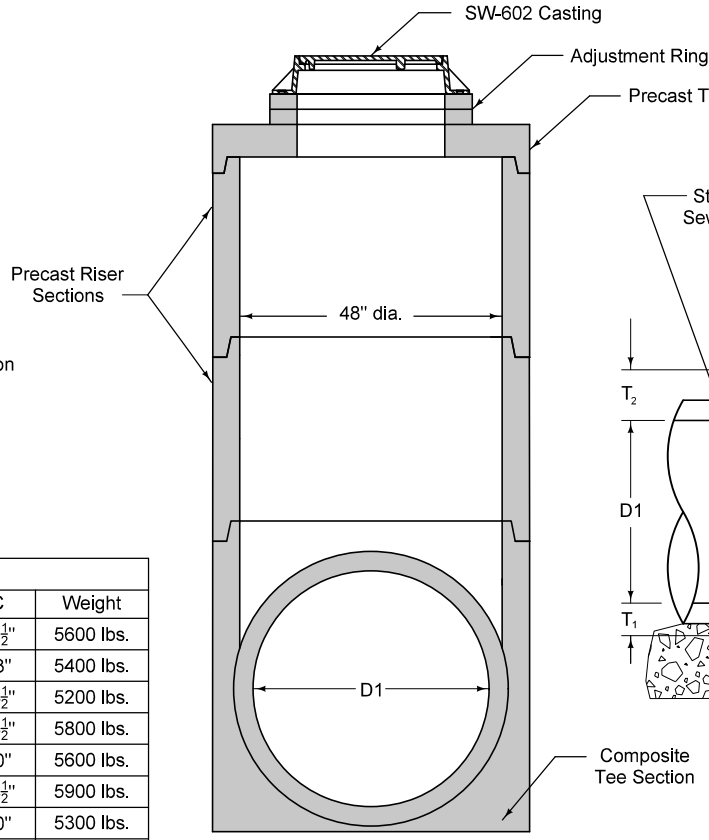
Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

TEE-SECTION
STORM SEWER MANHOLE

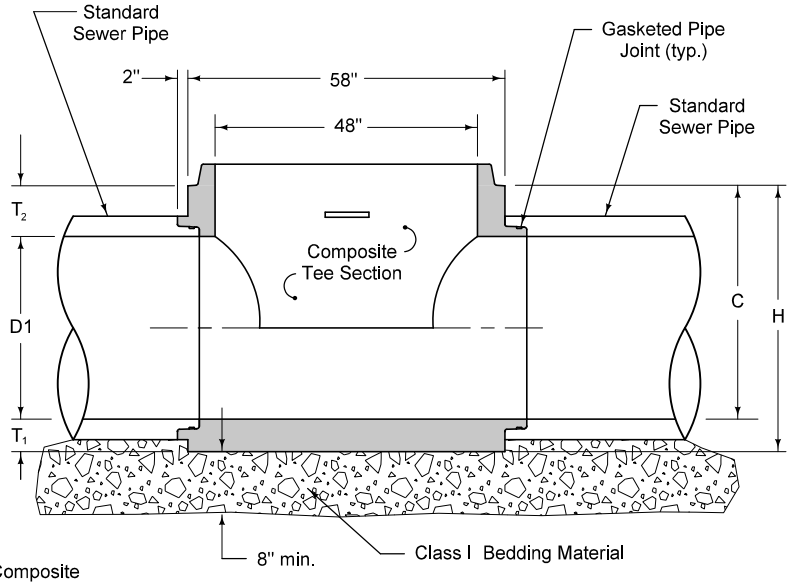
FIGURE 6010.405 SHEET 1 OF 2



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

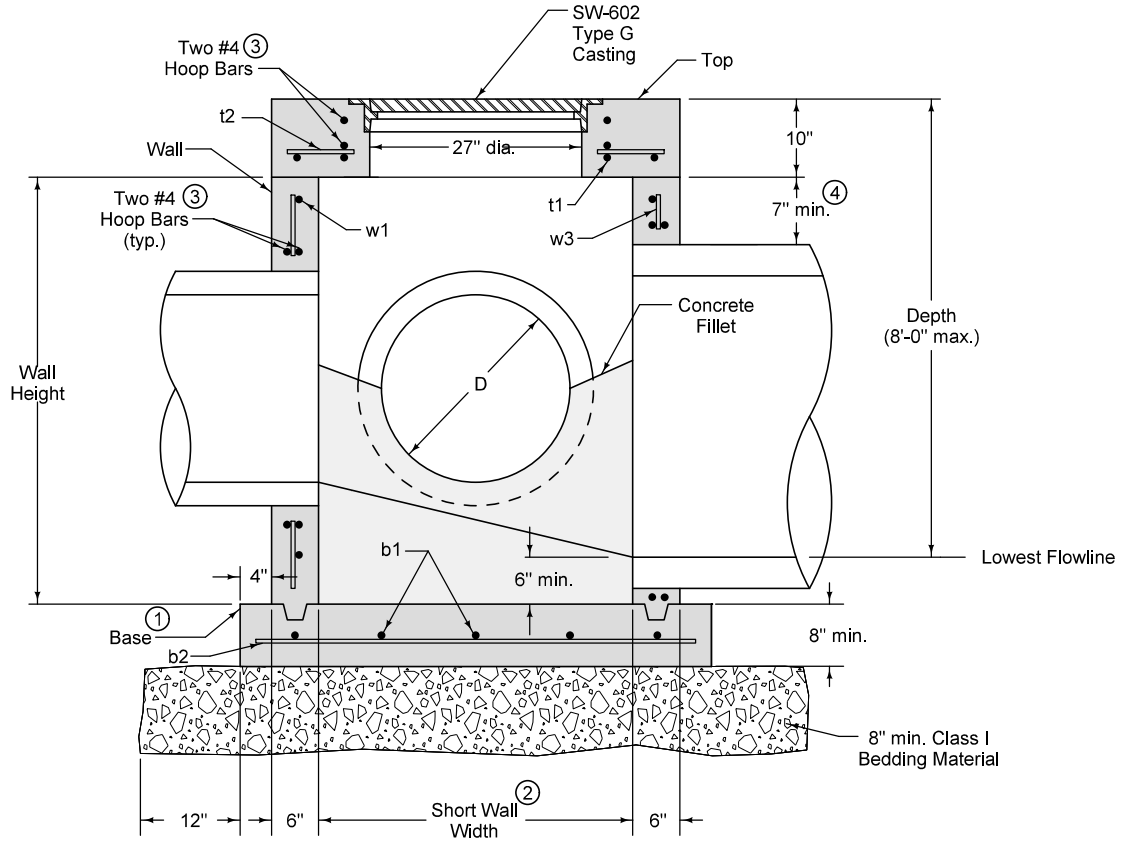
FIGURE 6010.405 | STANDARD ROAD PLAN | SW-405 | SHEET 2 of 2

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

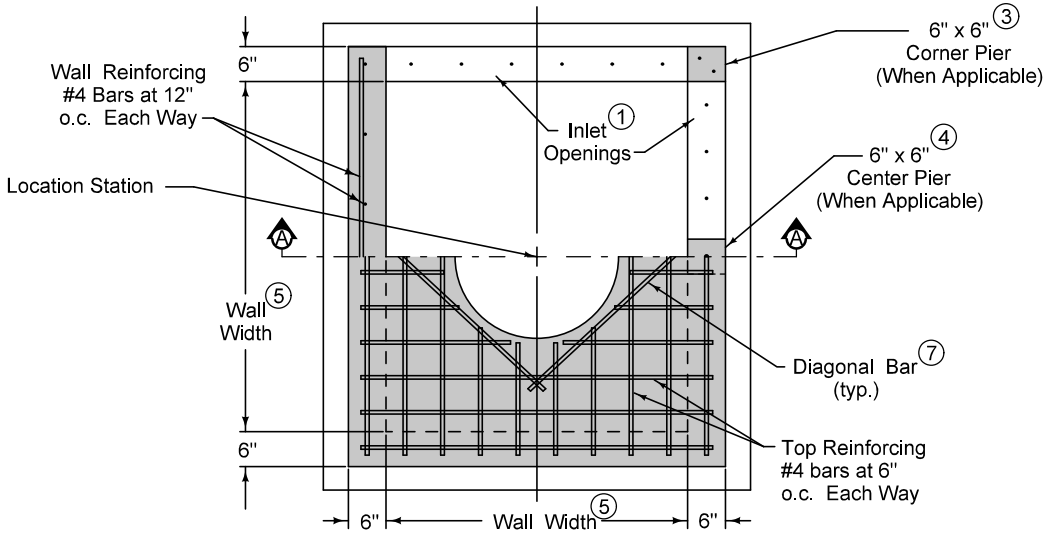
SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 6010.406	STANDARD ROAD PLAN	SW-406
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

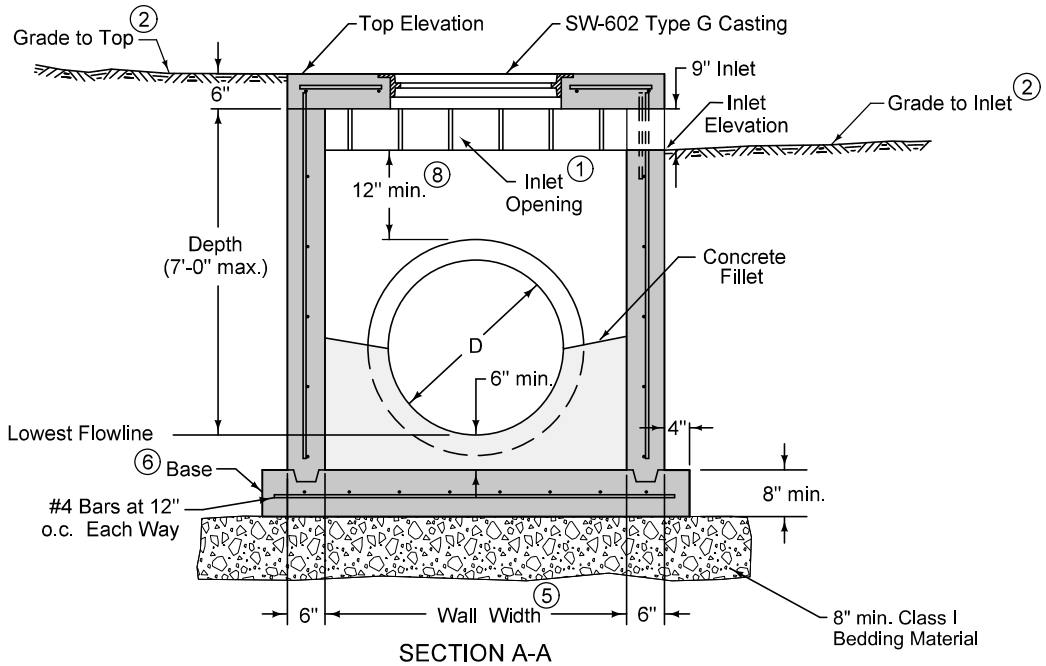
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

SHALLOW RECTANGULAR STORM SEWER MANHOLE



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

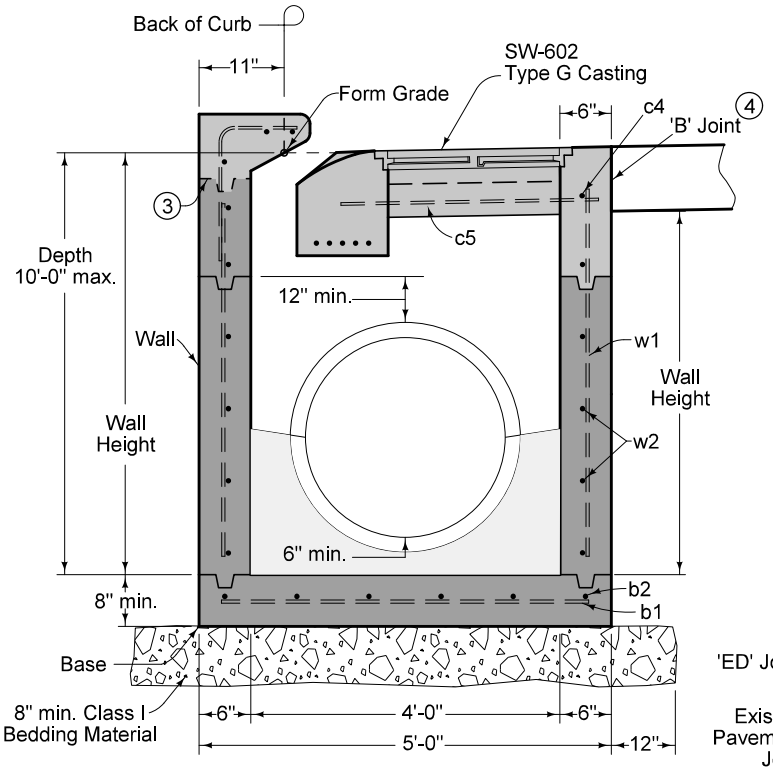
OPEN-SIDED AREA INTAKE

FIGURE 6010.513 SHEET 1 OF 1

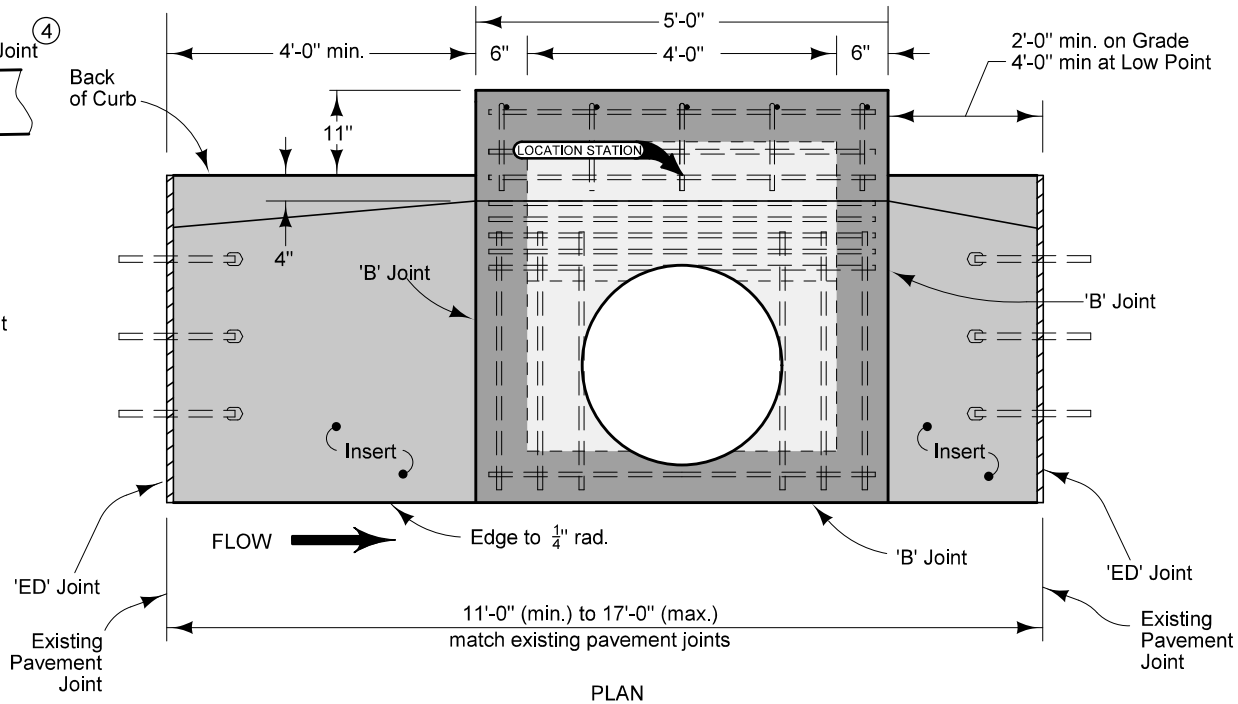
For joint details, refer to PV-101.

③ Additional keyed construction joint when attaching the SW-542 extension unit.

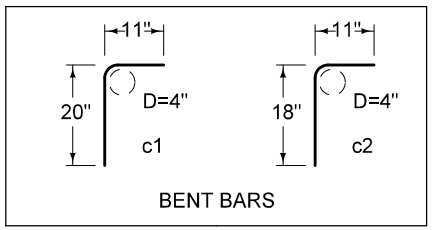
④ Top of well flush with pavement.



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

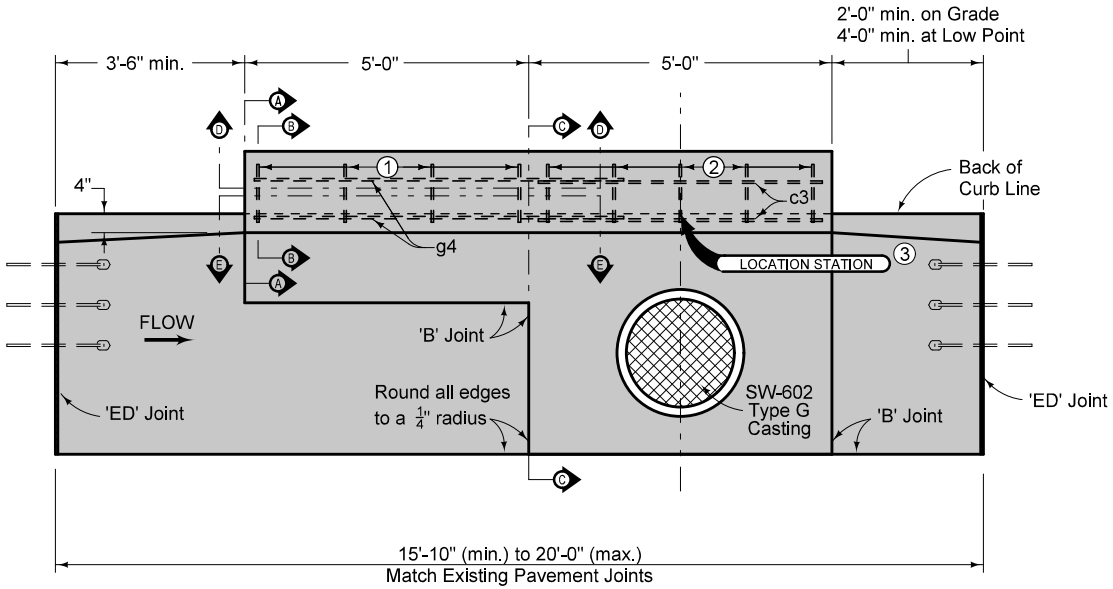
FIGURE 6010.541 | STANDARD ROAD PLAN | SW-541 | SHEET 2 of 2

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.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

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.

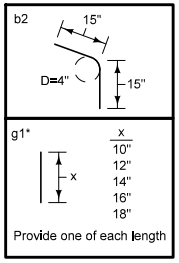
① g3 for 6 inch standard curb; g5 for 4 inch sloped curb.

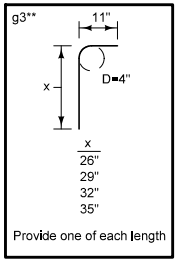
② c1 for 6 inch standard curb; c2 for 4 inch sloped curb. See SW-541 for reinforcing.

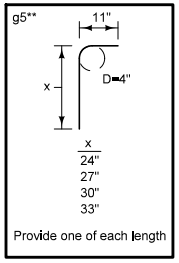
③ The location station is where the centerline of intake meets the back of the curb line.

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

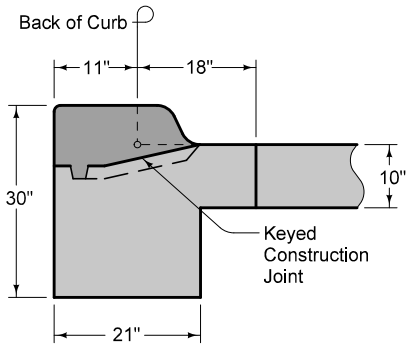
FIGURE 6010.542 | STANDARD ROAD PLAN | SW-542 | SHEET 1 of 4

REVISIONS: Removed Interim from standard.

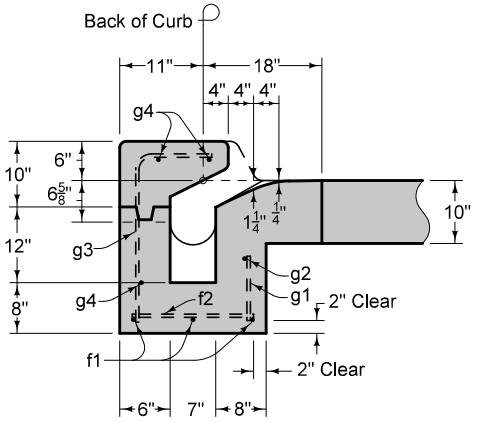
Paul D. Wigard, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

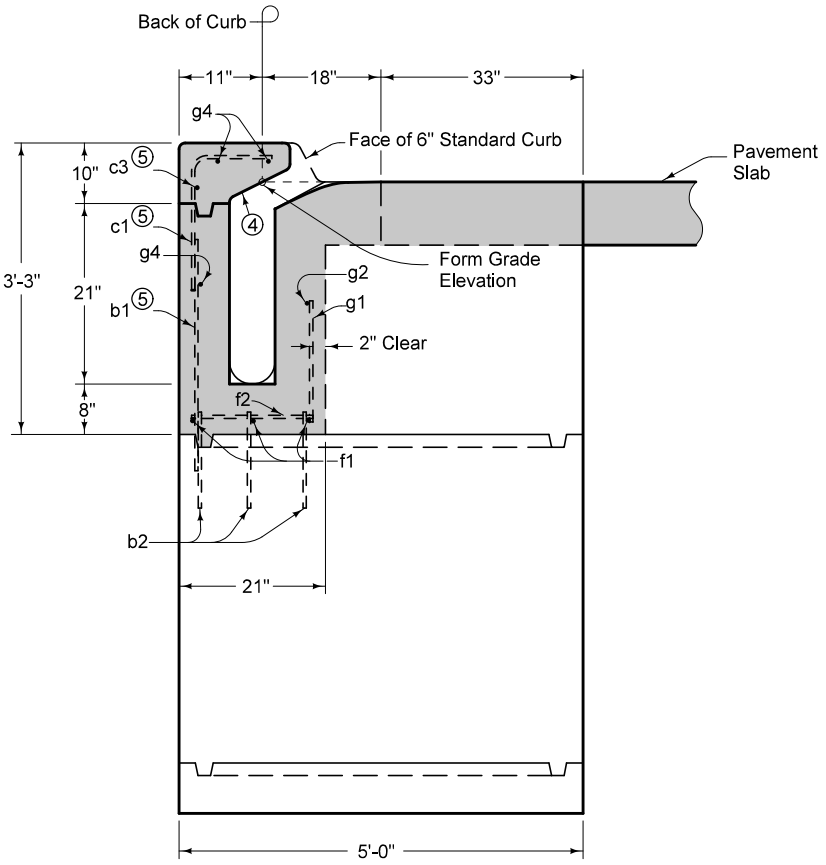
FIGURE 6010.542 | SHEET 1 OF 4



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

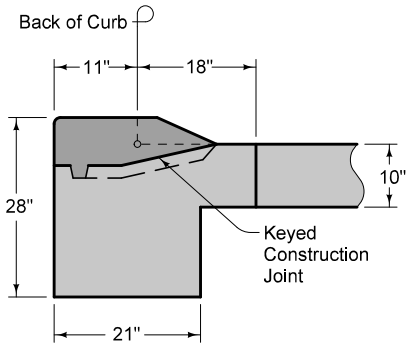
FIGURE 6010.542 | STANDARD ROAD PLAN | SW-542 | SHEET 2 of 4

REVISIONS: Removed Interim from standard.

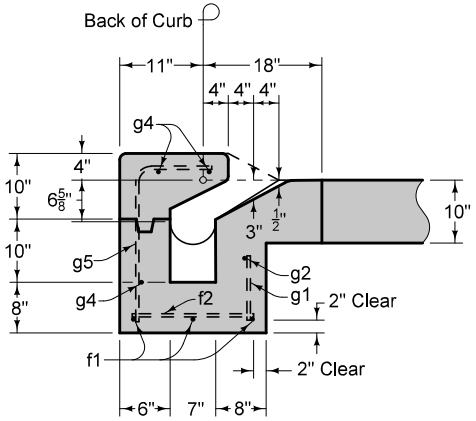
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

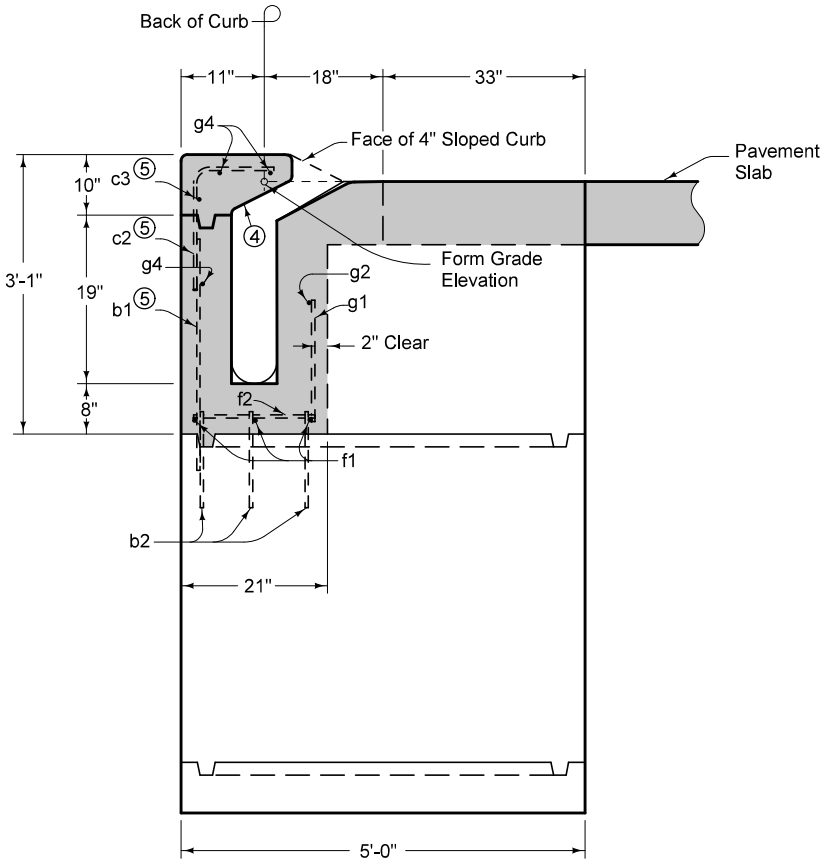
EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT



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

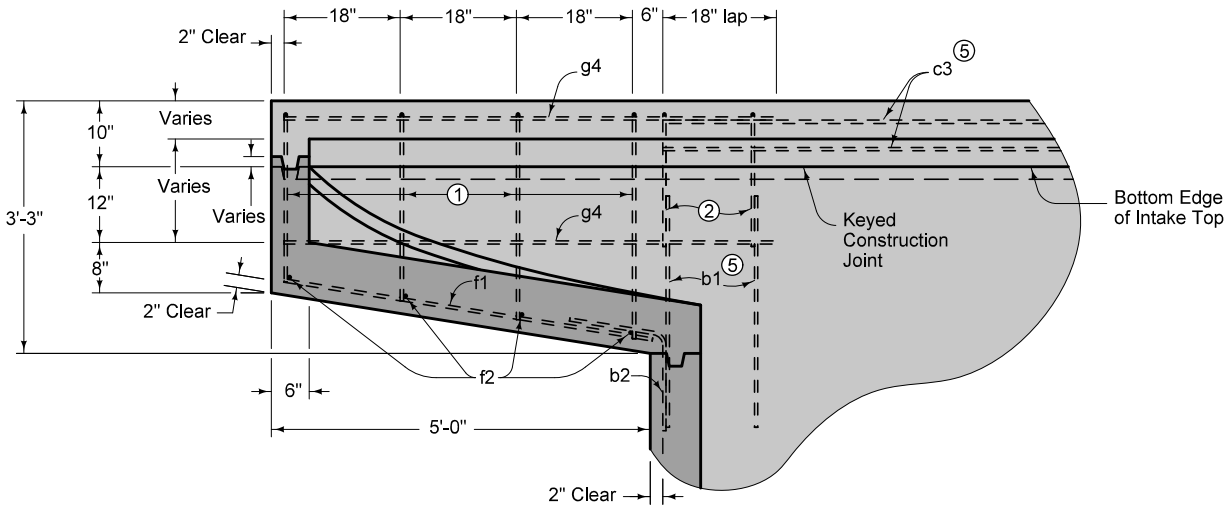
FIGURE 6010.542 | STANDARD ROAD PLAN | SW-542 | SHEET 3 of 4

REVISIONS: Removed Interim from standard.

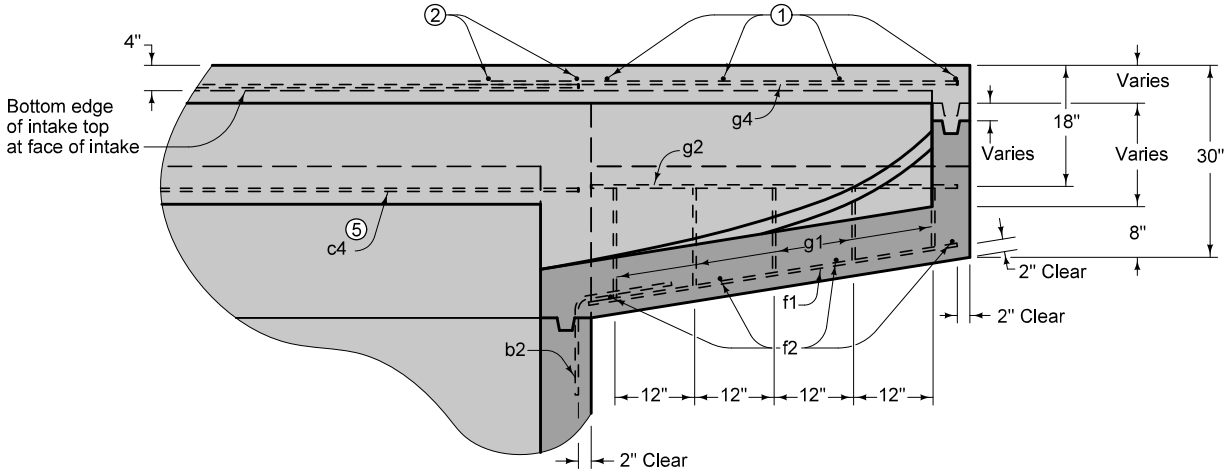
Paul D. Wigand — SUDAS DIRECTOR

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

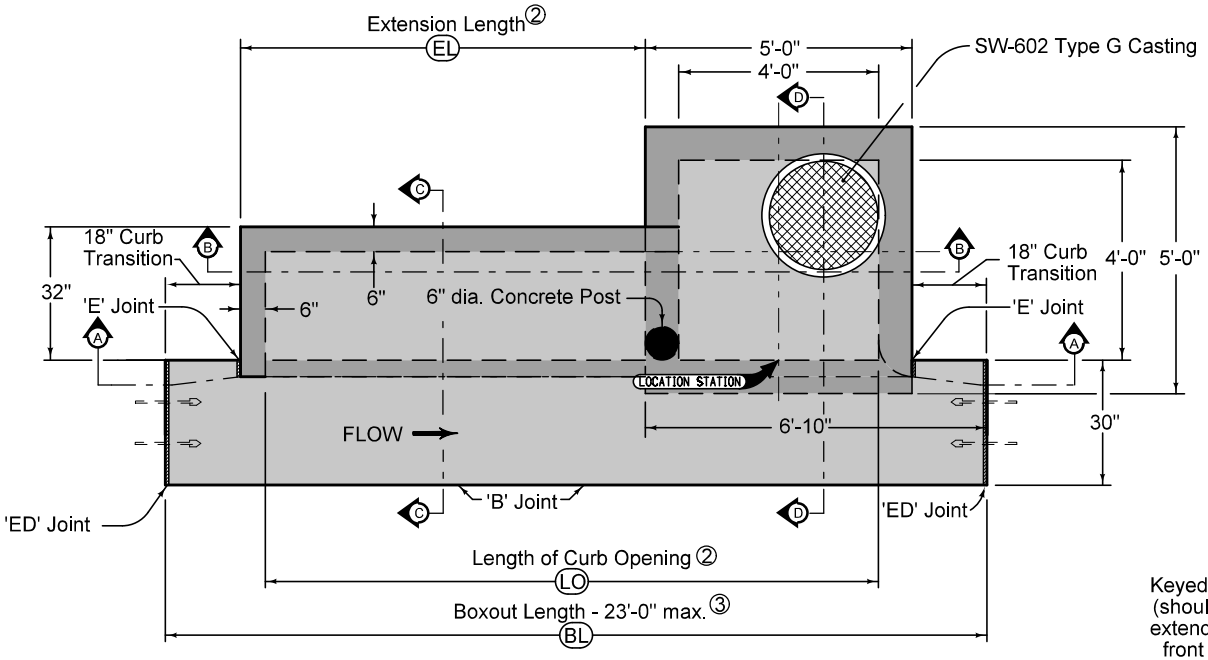
SHEET 4 of 4

REVISIONS: Removed Interim from standard.

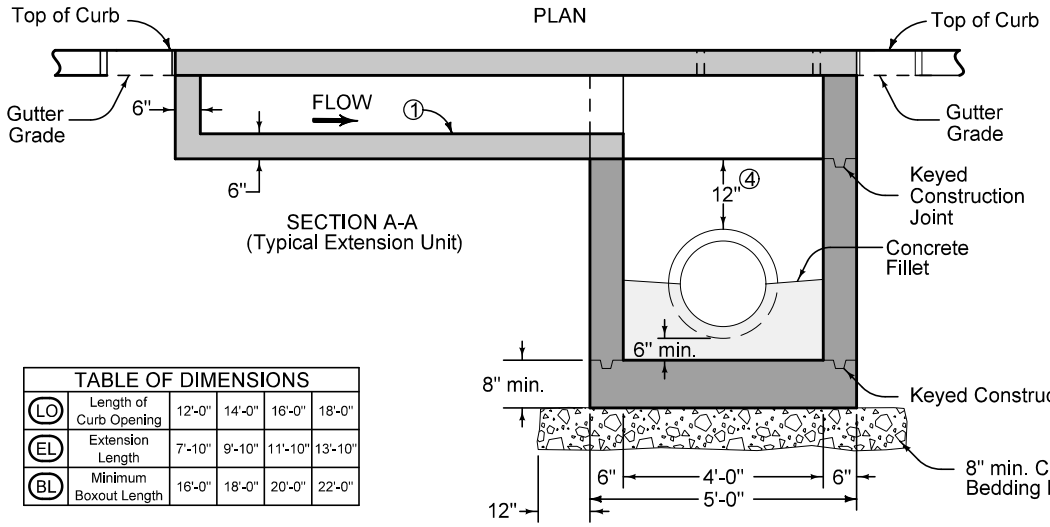
Paul D. Wigant
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

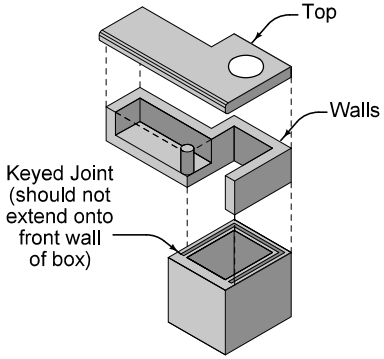


PLAN



SECTION A-A
(Typical Extension Unit)

SECTION B-B
(Typical Intake Well)



ISOMETRIC
INTAKE WELL, WALLS AND TOP

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"

MAXIMUM PIPE DIAMETERS	
Precast Structure	Cast-in-place Structure
30"	36"

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.

FIGURE 6010.545 SHEET 1 OF 4

SUDAS | IOWADOT | REVISION 5 04-21-20

FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545 | SHEET 1 of 4

REVISIONS: Changed well walls to 6 inch reinforced. Modified 4b1 and 4b2 bar spacing. Modified bars 4e1 and 4e6. Modified SECTION C-C on Sheets 3 and 4.

Paul D. Wigard
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

Section 7030 - Sidewalks, Shared Use Paths, and Driveways **Page No.**

Section 7080 - Permeable Interlocking Pavers (Continued) **Page No.**

Figures **Figure No.**

HOT MIX ASPHALT OVERLAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES

HMA Overlays

1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of HMA 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. HMA Overlay by Ton:

1. **Measurement:** Measurement will be in tons of HMA overlay.

2. **Payment:** Payment will be at the unit price per ton of HMA 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. HMA Overlay by Square Yards:

1. **Measurement:** Measurement will be in square yards for each different thickness of HMA 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 HMA 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 HMA OVERLAY MATERIALS

Comply with Iowa DOT Section 2303, with the following exception:

Follow the procedure outlined in Iowa DOT Materials I.M. 510 for HMA mixture designs, except replace Table 1 in Appendix A, HMA Mixture Design Criteria with the SUDAS HMA 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. HMA 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 HMA 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 HMA Interlayer:

1. Apply tack coat prior to placement of thin lift overlay and HMA interlayer. Comply with Section 7020.

2. Compact with static steel wheel roller.

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 HMA 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

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 HMA 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 HMA 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 HMA 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 in SUDAS Design Manual Section 12A-2.

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. HMA Density and Thickness Tests: When the area of HMA 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 HMA 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

PAVEMENT REHABILITATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Full and Partial Depth PCC Patches

B. Full and Partial Depth HMA 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, HMA, and composite patches.

B. Construct partial depth PCC and HMA patches.

C. Grind existing PCC pavement surface for profile improvement using a diamond grinder.

D. Mill the surface of HMA 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 HMA 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. HMA 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. HMA: 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 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 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. **Hot Mix Asphalt for Crack Filling:**
   a. **Measurement:** Measurement will be in tons of HMA 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 HMA 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 HMA 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:** Measurement will be by count of the number of dowel bars satisfactorily placed.

2. **Payment:** Payment will be made at the contract unit price per 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. HMA: 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. **HMA for Filling Cracks:**
   a. Provide a 3/4 inch, 1/2 inch, or 3/8 inch HMA 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 hot mix 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.

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, H.
   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, I. 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 HMA 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 HMA 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.

3.10 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.

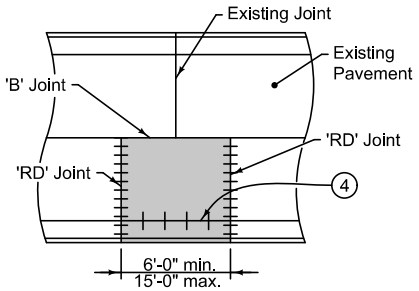
1. If allowed by the Jurisdiction, replace pavement core utilizing waterproof bonding material. Mix and place bonding material according to the manufacturer's recommendations to fill the annular space around the core and the original slab. Ensure reinstalled core is in its original orientation and is 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.

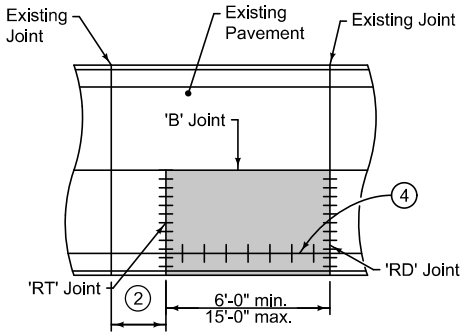
3. For asphalt pavements, use standard traffic surface, 1/2 inch mix, and PG 58-28S binder. Maximum lift thickness is 2 inches. If allowed by the Engineer, replace core with low slump concrete or pre-mixed high performance cold mix generally meeting the asphalt mixture noted above. Match elevation of existing pavement.

END OF SECTION

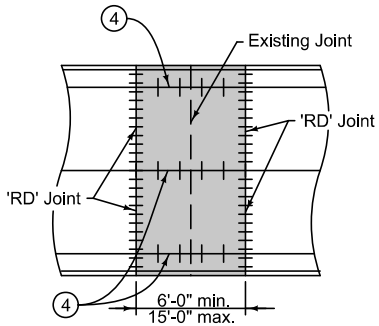
GUTTERLINE JOINTING



ONE PANEL WIDTH PATCH WITH OPPOSING JOINT

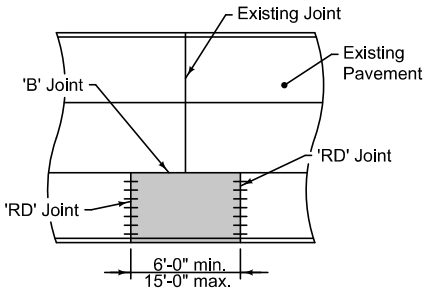


ONE PANEL WIDTH PATCH NO OPPOSING JOINT

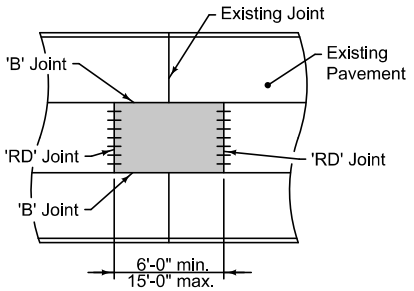


FULL ROADWAY WIDTH PATCH

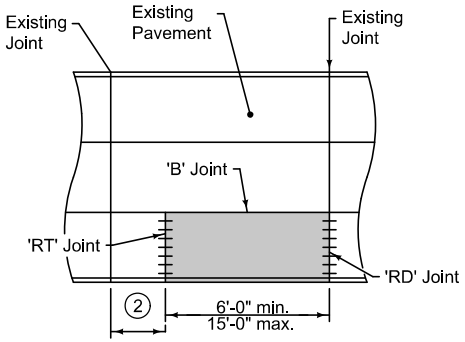
THIRD POINT JOINTING (1)



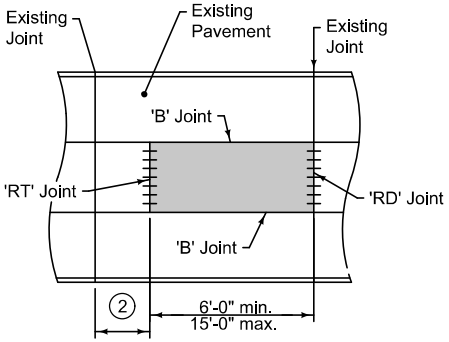
OUTSIDE PANEL PATCH WITH OPPOSING JOINT



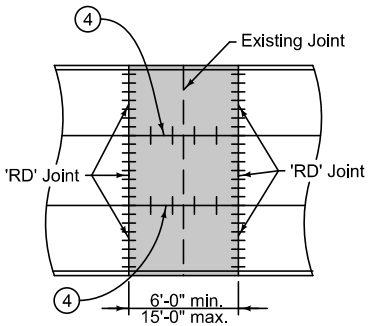
CENTER PANEL PATCH WITH OPPOSING JOINTS



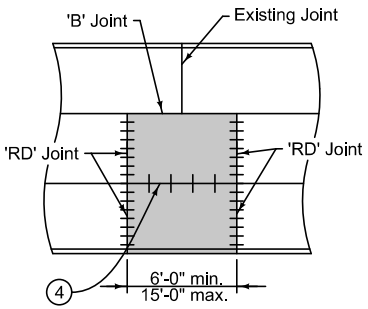
OUTSIDE PANEL PATCH NO OPPOSING JOINT



CENTER PANEL PATCH NO OPPOSING JOINT



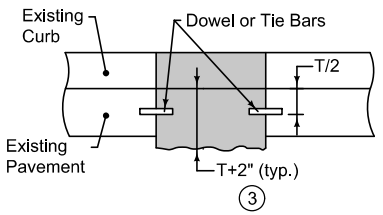
FULL ROADWAY WIDTH PATCH



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

REVISION
3 | 2021 Edition

7040.101

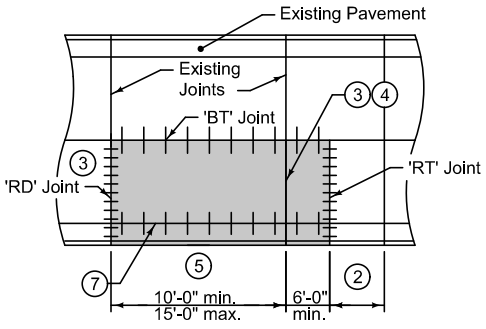
SHEET 1 of 1

SUDAS Standard Specifications

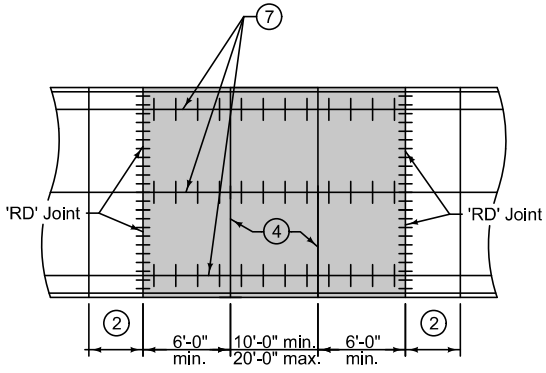
FULL DEPTH PCC PATCHES
LESS THAN OR EQUAL TO 15' LONG

FIGURE 7040.101 | SHEET 1 OF 1

GUTTERLINE JOINTING

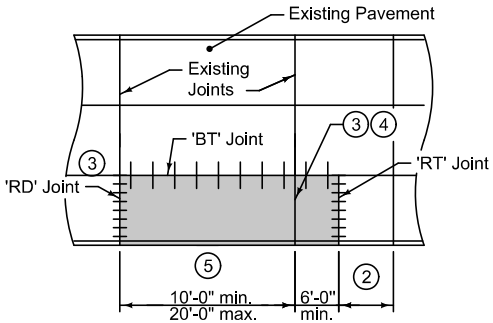


ONE PANEL WIDTH PATCH

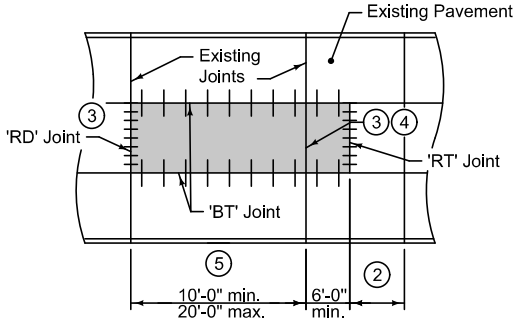


FULL ROADWAY WIDTH PATCH

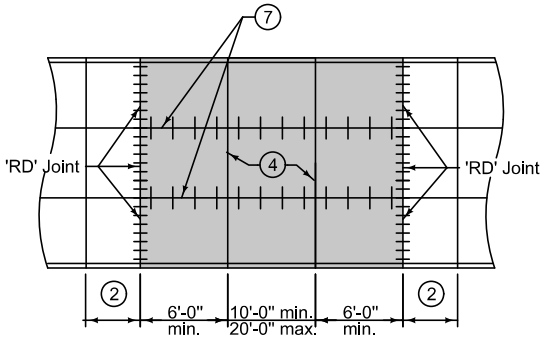
THIRD POINT JOINTING (1)



OUTSIDE PANEL PATCH



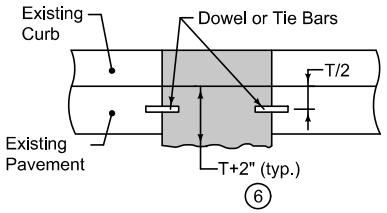
CENTER PANEL PATCH



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.
4. 'C' joint unless 'CD' joint is specified.
5. If existing joint spacing is greater than 20 feet, add a 'CT' joint at mid-panel.
6. If subgrade or subbase material is required below patch, bring material to a level 2 inches below bottom of existing pavement.
7. BT, KT, or L joint depending on pavement thickness and pouring sequence

LONGITUDINAL SECTION THRU PCC PATCH



SUDAS

REVISION
4 | 2021 Edition

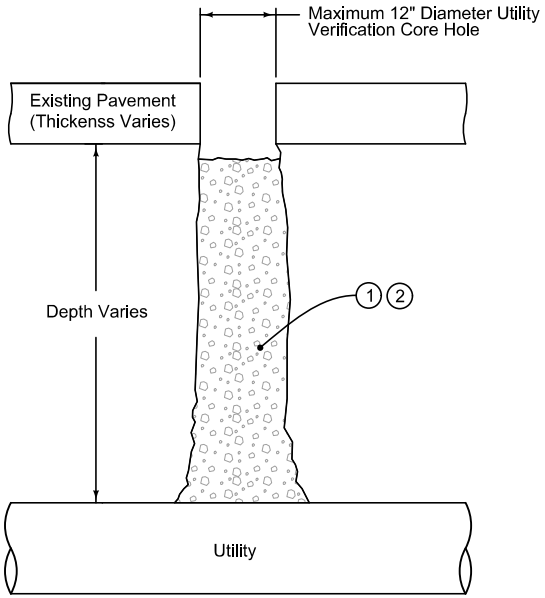
7040.102

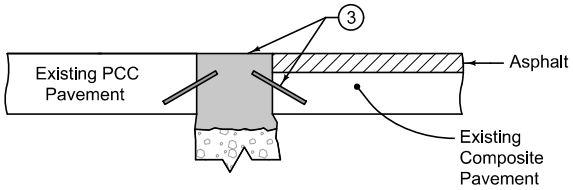
SHEET 1 of 1

SUDAS Standard Specifications

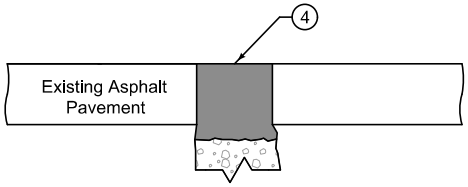
FULL DEPTH PATCHES GREATER THAN 15' LONG

FIGURE 7040.102 | SHEET 1 OF 1

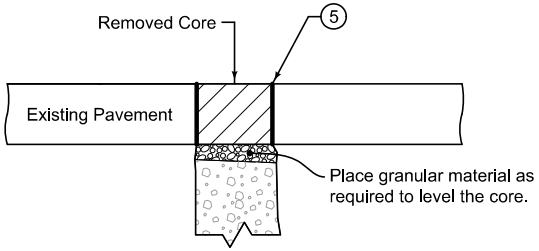




PCC CORE HOLE REPAIR



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

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

Table of Contents

PART 2 - PRODUCTS

2.01 UNDERGROUND

A. Handhole:

1. General:

a. Cable Hooks: 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 withstands a load of 20,000 pounds. 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 20,000 pound load.

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)

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 40 heavy wall type.
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 orange colored conduit.
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. Communications Cable: Comply with IMSA Specifications 39-2 or 40-2 for #19 AWG, solid copper conductor, twisted pairs. Use polyethylene insulated, aluminum shielded, complying with REA Specification PE-39 for paired communication cable with electrical shielding.

5. Category 5E (Cat5E) Cable: Provide outdoor use rated cable.

6. 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), and Telecommunications Industries Association (TIA).
c. Multimode Fiber:
Core Diameter: 62.5 µm ± 1.0 µm
Cladding Diameter: 125.0 µm ± 1.0 µm
Core Concentricity: ± 1%
Max. Attenuation: 3.50 dB/km @ 850 nm

2.01 UNDERGROUND (Continued)

d. Single-Mode Fiber:
Typical Core Diameter: 8.3 µm ± 1.0 µm
Cladding Diameter: 125.0 µm ± 1.0 µm
Core Concentricity: ± 1%
Attenuation Uniformity: No point discontinuity greater than 0.1 dB at either 1310 nm or 1550 nm
Max. Attenuation: 0.25 dB/km @ 1550 nm, 0.35 dB/km @ 1310 nm

e. Dual layer UV cured acrylate coating applied by the fiber manufacturer, mechanically or chemically strip-able without damage to the fiber.

f. 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.

g. 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.

h. Buffer tubes and fibers meeting TIA/EIA-598A, "Color coding of fiber optic cables," with 12 fibers per buffer tube.

i. Cable tensile strength provided by a high tensile strength aramid yarn and/or fiber glass.

j. All dielectric cables, without armoring, sheathed with medium density polyethylene (1.4 mm minimum nominal jacket thickness). Jacketing material 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.

k. Cable fabricated to withstand a maximum pulling tension of 600 pounds during installation (short term) and 135 pounds upon installation (long term).

l. Shipping, storing, and operating temperature range of the cable: -40° C to + 70° C. Installation temperature range of cable: -10° C to + 60° C.

m. 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

n. 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

o. Make cable ends available for testing. Seal cable ends to prevent moisture impregnation.

p. Fiber Distribution Panel: Provide a fiber distribution panel capable of terminating a minimum of 24 fibers, or as specified in the contract documents.

q. 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.

2.01 UNDERGROUND (Continued)

r. 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.
s. 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.
t. 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. 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: All cables must be UL approved.
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.

2.02 DETECTION (Continued)

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.
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^{0}F.

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.
c. Switch: Solid state rated at 20 million operations minimum.
d. Operating Temperature: -30 to + 165^{0}F.

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.

2.02 DETECTION (Continued)

1. Video Detection System and Processors:

a. Processor to be card rack mounted or located within camera. Compatible with NEMA TS-1, TS-2, and Type 170 controllers and cabinets.

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. 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.

b. Equipped with internal thermostatically controlled heater and external sunshield.

c. Meet NEMA-4 or NEMA-6P environmental standards.

d. Use camera cable(s) meeting the manufacturer's recommendations. Provide a continuous run, without splices, from the camera to the controller cabinet.

D. Microwave 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.

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.

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 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 high resolution 1/4 inch CCD imager. 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.

9. Provide all necessary rack support devices for video viewing and PTZ control.

10. Provide ability to control PTZ and view video remotely.

B. Fiber Optic Hub Cabinet: As specified in the contract documents.

C. Wireless Interconnect Network: Provides two-way data communication between the on-street master controller 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.
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.

2.03 COMMUNICATIONS (Continued)

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. NEMA Controller, Cabinet, and Auxiliary Equipment: Comply with the latest edition of NEMA TS1 or TS2 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. 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.
d. 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.
e. Heavy-duty clear plastic envelope attached to inside wall of cabinet or cabinet door, for cabinet wiring diagrams, 12 inches by 18 inches minimum.
f. GFI electrical outlet and lamp in accessible location near the front of the cabinet. GFI outlet fused separately from main AC circuit breaker. Fluorescent or LED cabinet lamp connected and fused with GFI outlet.
g. Back panel positions to accommodate phasing and expansibility specified in the contract documents.
h. 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.
i. 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.

2.04 CABINET AND CONTROLLER (Continued)

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.

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 capable of withstanding a 100 mph wind.
b. Provides 5 inches of black field around the assembly.

2.05 POLES, HEADS, AND SIGNS (Continued)

7. Mounting Hardware:
- **a. Fixed:** 1 1/2 inch aluminum pipe and fittings, natural aluminum finish for galvanized poles or match the pole color. 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.

8. LED Modules: Comply with current ITE standards.

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. Tunnel type visor attached to the housing door by stainless steel screws.
- 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.

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. 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. Fabricate poles from low carbon (maximum carbon 0.30%) steel of U.S. standard gauge.
- d. 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.

2.05 POLES, HEADS, AND SIGNS (Continued)

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. 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.

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 on all traffic signal pole mast arms over 60 feet in length as shown on the figures.

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.

2.05 POLES, HEADS, AND SIGNS (Continued)

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.
   - **c. Pedestal Base:** Cast aluminum, square in shape, with a handhole.
     - **1) Handhole:** Minimum of 6 inches by 6 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools.
     - **2) Base:** Minimum weight of 20 pounds with a four bolt pattern uniformly spaced on a 12 1/2 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.

2. **Anchor Bolts:** Four 3/4 inch by 15 inch steel, hot dip galvanized anchor bolts complying with ASTM F 1554, Grade 36, with right angle bend at the bottom end, complete with all hardware required for installation.

E. Pedestrian Push Button Post:

1. **Material:**
   - **a. Post:** Standard weight (Schedule 40) pipe complying with ASTM F 1083, galvanized inside and out; 2 1/2 inches in diameter.
   - **b. Cap:** Waterproof cap complying with ASTM F 626.
   - **c. Anchor Bolts:** Four 1/2 inch by 24 inch steel, hot dip galvanized anchor bolts complete with all hardware required for installation.
   - **d. Non-shrink Grout:** Comply 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 post base and the foundation.
   - **e. Base Plate:** Provide a 5 inch square, 1/2 inch thick galvanized steel base plate with a 4 1/2 inch bolt circle.

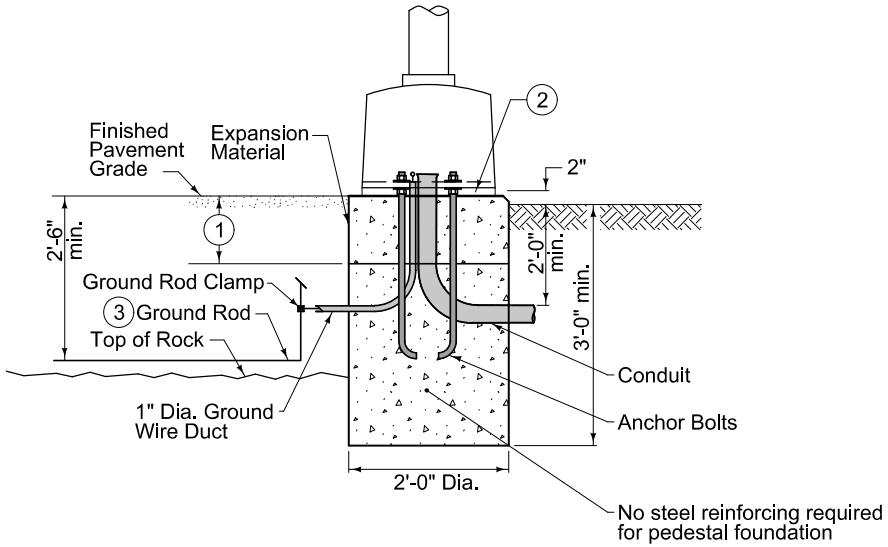
F. Traffic Signs:

1. Comply with Iowa DOT Section 4186.

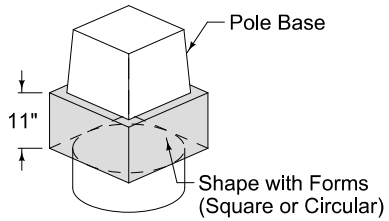
2. Use a universally adjustable mast arm mounted sign bracket.

3. Comply with MUTCD and the contract documents for the street name sign dimensions, letter height and font, and sheeting.

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.



PEDESTAL POLE FOUNDATION IN SOIL OR ROCK



DETAIL 'A'

FIGURE 8010.102 SHEET 4 OF 4

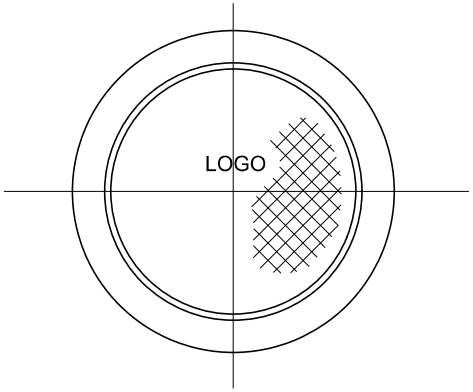
SUDAS | IOWADOT | REVISION 4 04-21-20

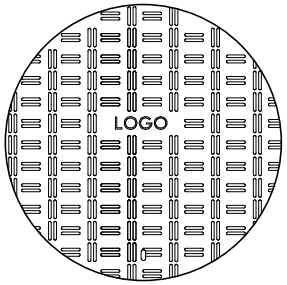
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 SHEET 4 of 4

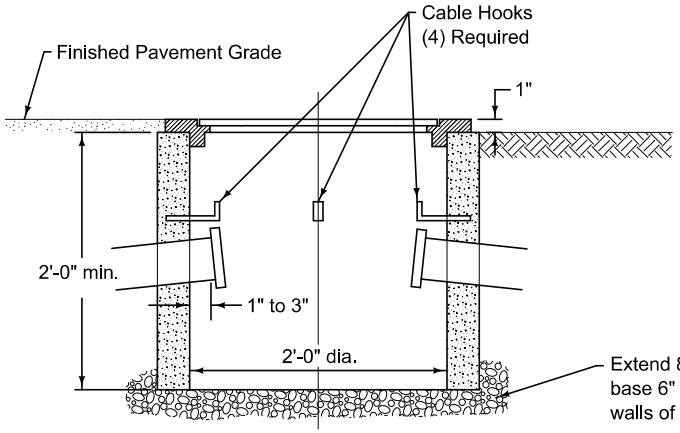
REVISIONS: Modified conduit details in MAST ARM POLE FOUNDATION drawings on Sheets 1, 2, and 3.

Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

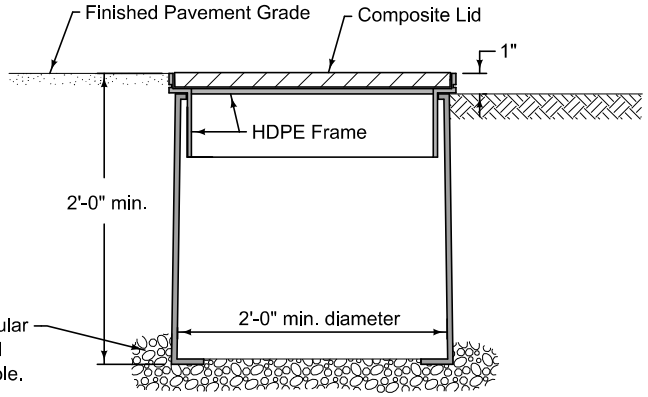
TRAFFIC SIGNAL POLE FOUNDATION







PRECAST CONCRETE HANDHOLE (TYPE I)



HDPE HANDHOLE (TYPE V)

FIGURE 8010.103 | SHEET 1 OF 2

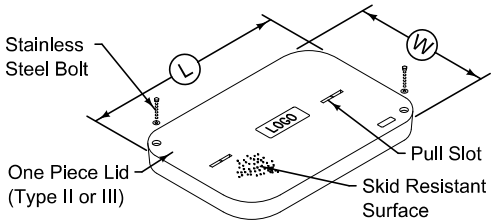
SUDAS	IOWA DOT	REVISION 1 04-20-21
FIGURE 8010.103	STANDARD ROAD PLAN	LI-103
		SHEET 1 of 2

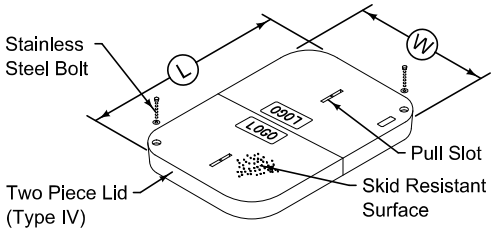
REVISIONS: Added the HDPE handhole to the precast concrete and composite ones.

Paul D. Wigand — SUDAS DIRECTOR

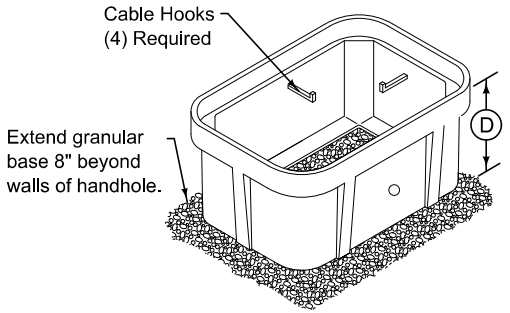
Stuart Nicholson — DESIGN METHODS ENGINEER

CONDUIT AND PRECAST HANDHOLES

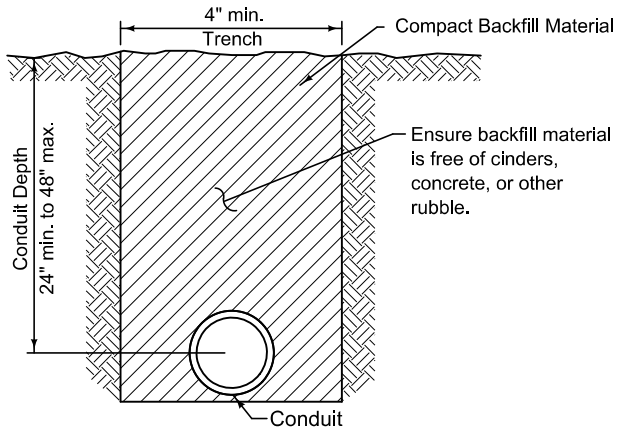




HANDHOLE DIMENSIONS TABLE (NOMINAL)			
TYPE	(L)	(W)	(D)
II	30"	17"	24"
III	36"	24"	30"
IV	48"	30"	36"



PRECAST CONCRETE COMPOSITE HANDHOLE



CONDUIT IN TRENCH

FIGURE 8010.103 | SHEET 2 OF 2

SUDAS | IOWA DOT

REVISION: 1 — 04-20-21

FIGURE 8010.103 | STANDARD ROAD PLAN | LI-103

SHEET 2 of 2

REVISIONS: Added the HDPE handhole to the precast concrete and composite ones.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

CONDUIT AND PRECAST HANDHOLES

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.

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

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.

2.07 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 green 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) Contain a minimum of 90% organic material according to ASTM D 2974.
      5) Have a rainfall event (R-factor) of $140 < R$ according to ASTM D 6459.
      6) Have a cover factor of $C \leq 0.03$ according to ASTM D 6459.
      7) Vegetation Establishment of 400% minimum according to ASTM D 7322.
      8) Water Holding Capacity 600% minimum according to ASTM D 7367.

3. Mechanically-Bonded Fiber Matrix (MBFM):
   a. Manufactured to be applied hydraulically.
   b. Dyed green 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) Contain a minimum of 90% organic material according to ASTM D 2974.
   5) Have a rainfall event (R-factor) of 175 < R according to ASTM D 6459.
   6) Have a cover factor of C ≤ 0.01 according to ASTM D 6459.
   7) Vegetation establishment of 500% minimum according to ASTM D 7322.
   8) 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.