Annual Revisions to the SUDAS Standard Specifications
2020 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	1010	ALL	Replace ENTIRE SECTION with enclosed pages. Added abbreviation and definition for MAPLE.
	1090, 1.05, B	1-2	Deleted reference to an Iowa Code section that has been repealed.
2	2010, 3.06	15-16	Clarified moisture and density elements should be used for compaction in subgrade cut section compaction.
3	Figure 3010.104	1	Deleted column for AWWA C905 reference since it no longer exists.
4	Table of Contents	ALL	Updated the table of contents based on revisions made to Division 4.
	4010, 1.08	1-4	Updated the “includes” items to create consistency among underground utility items.
	4010, 2.04, D	9-10	Updated reference to Section 4050.
	Figure 4010.201	1-2	Minor revision.
	Figure 4010.202	1	Minor revision.
	4020	ALL	Replace ENTIRE SECTION with enclosed pages (excluding figures). Updated the “includes” items to create consistency among underground utility items. Added new item for linear trench drain and renumbered items that followed.
	4030, 1.08, A-C	1-2	Updated the “includes” items to create consistency among underground utility items.
	Figure 4040.232	1	Minor revision.
	4050	ALL	Replace ENTIRE SECTION with enclosed pages. Revised the section based on current practices/products.
	4060, 3.05, A	7-8	Minor revision.
5	5010	ALL	Replace ENTIRE SECTION with enclosed pages (excluding figures). Updated the “includes” items to create consistency among underground utility items. Added AWWA references for installation of DIP and PVC water main pipe.
6	Table of Contents	ALL	Updated the table of contents based on revisions made to Division 6.
	6010	ALL	Replace ENTIRE SECTION with enclosed pages (INCLUDING figures). Updated the “includes” items to create consistency among underground utility items. Added internal manhole drop, additional adjustable casting, rock subbase to all cast-in-place structures to match precast structures, and various new intakes. Changed the default to no steps in manholes and intakes because of the safety concerns.
	6020, Tables 6020.02-03	4	Updated tables to allow for more products.

7	7010, 3.02, I, 7 (new)	15-16	Added information for honeycomb repair of non-formed paving.
	Figure 7010.101	1-8	Revised to reflect Iowa DOT's new maximum of 12' longitudinal and 17' transverse joint spacing.
	Figure 7010.102	1-2	Resolved discrepancies in driveway drop curb heights.
	Figure 7010.103	1	Updated title block.
	Figure 7010.104	1	Updated title block
	Figure 7020.201	1	Expanded options for jointing when HMA is extended through the boxout to the casting.
	7021, 2.04-2.05	1-2	Modified binder grade to ensure adequate crack resistance properties. Changed film thickness to follow Iowa DOT Specifications.
	7030, 1.08, C & E	1-4	Clarified the “includes” item to be slope and smoothness testing and correction.
	7030, 2.03, B	5-6	Corrected error.
	Figure 7030.101	1	Resolved discrepancies in driveway drop curb heights and clarifications to Detail A.
	Figure 7030.102	1	Clarifications to Detail A.
	7080, 1.08, F, 3	3-4	Updated the “includes” item to clarify furnishing and placing/installing the items.
8	8010, 1.08, B	1-2	Expanded bid item for temporary traffic signal.
	8010, 3.06	21-22	Expanded removal process for temporary traffic signals.
	Figure 8010.102	1-4	*(Starts on the back of Figure 8010.101).* Fixed dimensional inconsistency with the conduit.
	8020, 3.02, H, 2, c	9-10	Minor revision.
9	Table of Contents	i-ii	Minor correction on the table of contents.
	9010, 3.10, A, 2, a	21	Corrected error.
	9020, 2.01; 3.04-3.06	3-6	Modified age, added cultivars, modified depth of cut, and added more details for watering.
	9040, 2.07, C, 2	11-12	Corrected reference error.
	9070, 2.01	3-4	Revised to reflect changes to Iowa DOT Specifications and I.M.s/MAPLE
	9071, 2.01	3-4	Revised to reflect changes to Iowa DOT Specifications and I.M.s/MAPLE

Contributors and Acknowledgments

In 2019, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2020 versions of the SUDAS manuals. These revisions would not have been possible without the efforts of the SUDAS technical committee members. The SUDAS program's success is also due to the dedication of the district committees and Board of Directors. Keeping the SUDAS manuals current is an ongoing, cooperative effort, involving hundreds of people who volunteer their time and expertise. It is not possible to acknowledge each of these volunteers individually, but we appreciate them all.

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* Denotes an officer

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
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
CPM - Critical Path Method
CRSI - Concrete Reinforcing Steel Institute
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
GRI - Geosynthetic Research Institute
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
MAPLE - Materials Approved Product List Enterprise
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

1.02 ABBREVIATIONS (Continued)

OSHA - Occupational Safety of Health Administration
PCC - Portland Cement Concrete
PLS - Pure Live Seed
RAP - Recycled Asphalt Pavement
SAE - Society of Automotive Engineers
SDR - Standard Dimension Ratio
SSPC - Steel Structures Painting Council
SUDAS - Statewide Urban Design and Specifications
UL - Underwriters' Laboratories, Inc.
US - United States
USC - United States Code

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.

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.

1.03 DEFINITIONS AND TERMS (Continued)

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.

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.

1.03 DEFINITIONS AND TERMS (Continued)

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.

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.

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.

1.03 DEFINITIONS AND TERMS (Continued)

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.

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.

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.

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.

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.

1.03 DEFINITIONS AND TERMS (Continued)

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.

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.

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

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.

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.

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

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.

1.03 DEFINITIONS AND TERMS (Continued)

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.

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

MEASUREMENT AND PAYMENT

1.01 MEASUREMENT

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

1.02 SCOPE OF PAYMENT

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

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

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

1.03 LUMP SUM BREAKDOWNS

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

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

1.04 PAYMENT FOR CHANGE ORDERS

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

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

1.04 PAYMENT FOR CHANGE ORDERS (Continued)

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

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

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

1.05 PROGRESS PAYMENTS

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

B. Retainage: The Jurisdiction shall retain from each monthly progress payment 5% of the amount determined to be due according to the estimate of the Engineer.

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

1.06 PAYMENT OF RETAINAGE

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

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

3.04 EMBANKMENT CONSTRUCTION (Continued)

C. Depositing Embankment Material:

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

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

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

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

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

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

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

3.04 EMBANKMENT CONSTRUCTION (Continued)

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

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

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

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

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

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

3.05 USE OF UNSUITABLE SOILS

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

3.06 SUBGRADE PREPARATION

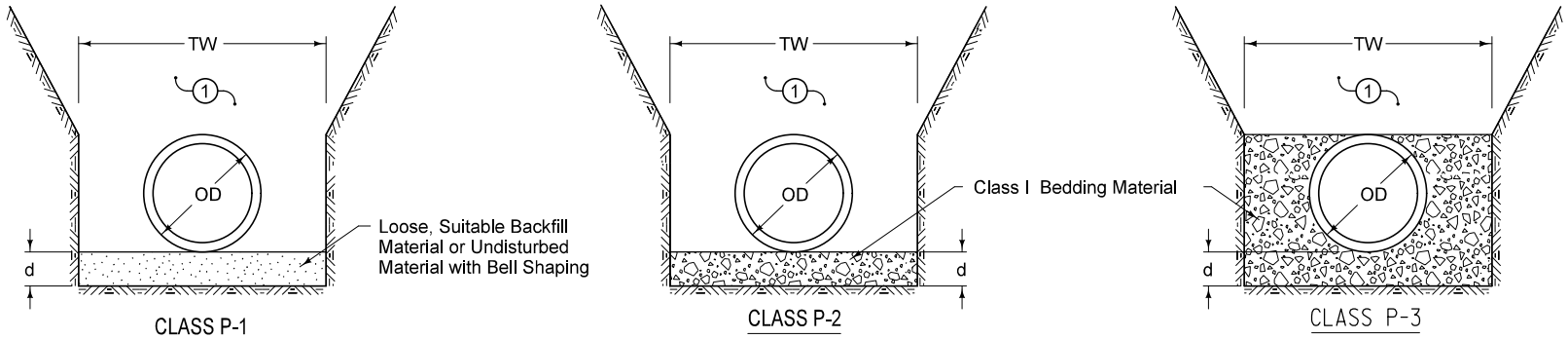
Shape and consolidate subgrade in preparation for the placement of pavement.

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

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

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

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)

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FIGURE 3010.104 | STANDARD ROAD PLAN | SW-104 | SHEET 1 of 1

REVISIONS: Modified PVC Table Title.

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

PRESSURE PIPE TRENCH BEDDING

FIGURE 3010.104 SHEET 1 OF 1

Table of Contents

Section 4030 - Pipe Culverts (Continued)

Section 4040 - Subdrains and Footing Drain Collectors **Page No.**

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; 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; 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; trench excavation; dewatering; furnishing, placing, and compacting bedding and backfill material; furnishing and installing annular space fill material; casing spacers; pipe connections; testing; and inspection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; 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.

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.

1.08 MEASUREMENT AND PAYMENT (Continued)

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.

2.04 SANITARY SEWER SERVICES (Continued)

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.

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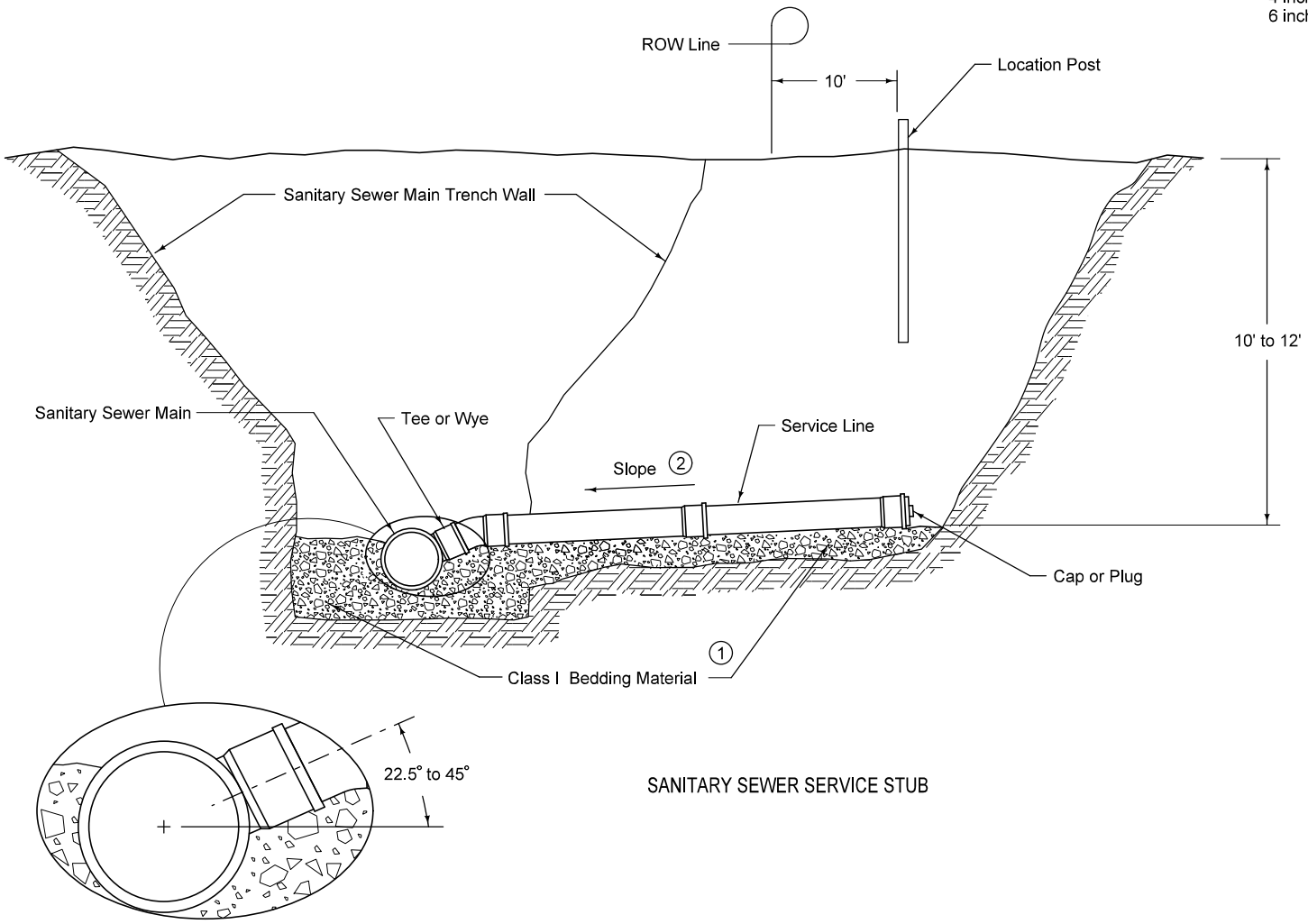
① Place bedding and backfill material as required for sewer main.

② Service Line Slope:
4 inch: 2% to 5%
6 inch and greater: 1% to 5%



SANITARY SEWER SERVICE STUB

FIGURE 4010.201 | SHEET 1OF 2

SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 4010.201	STANDARD ROAD PLAN	SW-201
		SHEET 1 of 2

REVISIONS: Changed 1 to I on Bedding Material

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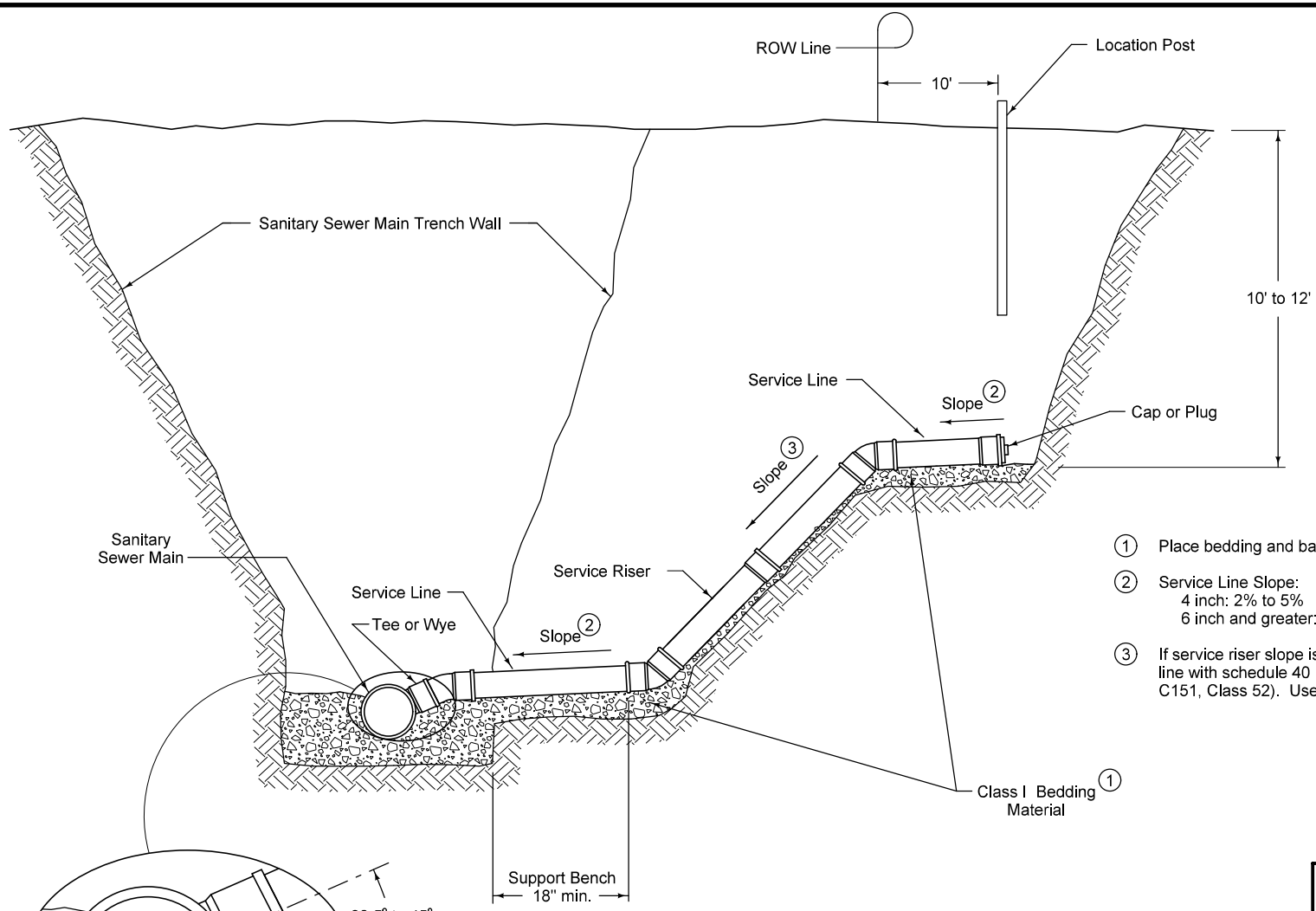
SANITARY SEWER SERVICE STUB



1. Place bedding and backfill material as required for sewer main.
2. Service Line Slope:
   4 inch: 2% to 5%
   6 inch and greater: 1% to 5%
3. If service riser slope is steeper than 1:1, construct riser of entire service line with schedule 40 PVC (ASTM D 1785) or ductile iron (AWWA C151, Class 52). Use single length of pipe for riser, if possible.

SANITARY SEWER SERVICE STUB WITH RISER

FIGURE 4010.201 SHEET 2 OF 2

SUDAS | IOWA DOT

REVISION	
2	04-21-20

FIGURE 4010.201 | STANDARD ROAD PLAN | SW-201 | SHEET 2 of 2

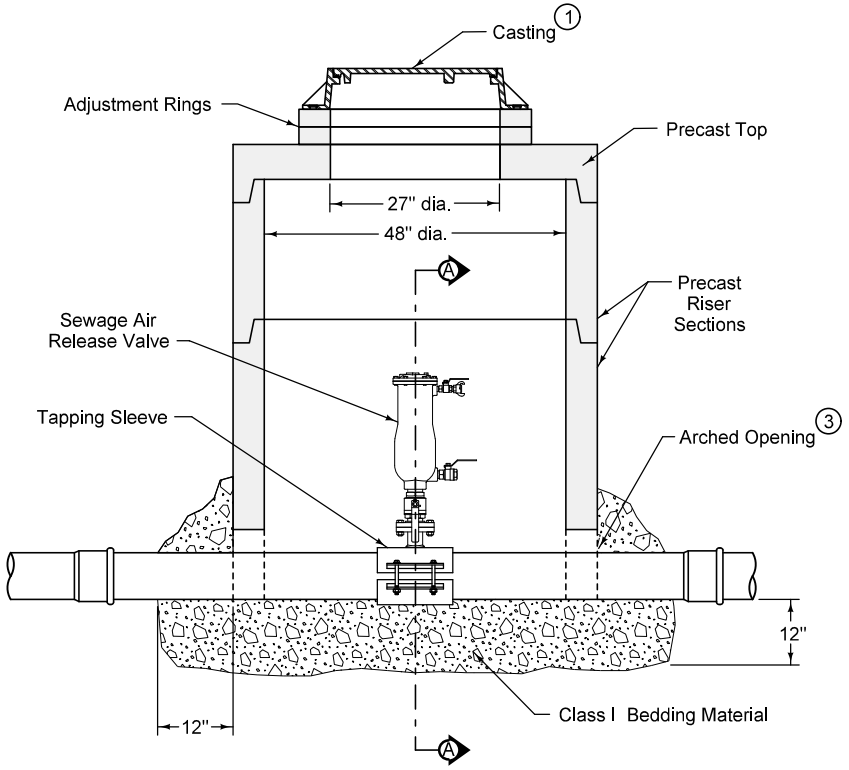
REVISIONS: Changed 1 to I on Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR

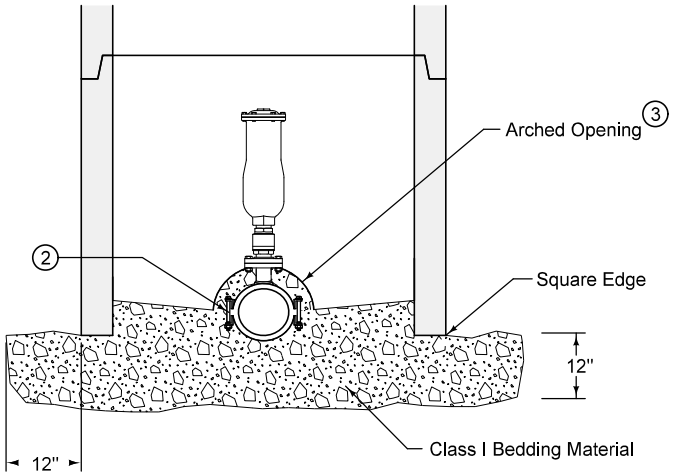
Stuart Nicholson, DESIGN METHODS ENGINEER

SANITARY SEWER SERVICE STUB

1. SW-601 Type A or SW-602 Type G casting.
2. Place bedding material to springline of pipe.
3. Prevent riser from bearing on pipe by providing an arched opening with a diameter up to 6 inches larger than pipe diameter.



TYPICAL SECTION



SECTION A-A

SUDAS	IOWADOT	REVISION 2 04-21-20
FIGURE 4010.202	STANDARD ROAD PLAN	SW-202 SHEET 1 of 1

REVISIONS: Changed 1 to I on Bedding Material.

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

SEWAGE AIR RELEASE VALVE PIT

FIGURE 4010.202 SHEET 1 OF 1

STORM SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Storm Sewers

B. Abandonment of Storm Sewers

1.02 DESCRIPTION OF WORK

A. Construct storm sewers.

B. Abandon storm sewers.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Storm Sewer:

1. Trenched:

a. Measurement: Each type and size of pipe installed in a trench will be measured in linear feet along the centerline of the pipe from center of intake or manhole to center of intake or manhole. Where the end of the pipe discharges to a ditch or waterway, measurement will be to the end of the pipe, exclusive of aprons. Lengths of elbows and tees will be included in the length of pipe measured.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; joint wrapping; wyes and other fittings; pipe joints; pipe connections; testing; and inspection.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; pipe connections; testing; and inspection.

B. Storm Sewer with Casing Pipe:

1. Trenched:

a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing, placing, and compacting bedding and backfill material; furnishing and installing annular space fill material; casing spacers; pipe connections; testing; and inspection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

C. Linear Trench Drain:

1. Measurement: Measurement will be in linear feet from end to end.

2. Payment: Payment will be at the unit price per linear feet of linear trench drain installed.

3. Includes: Price includes, but is not limited to, furnishing and installing the linear trench drain including all appurtenances; furnishing and placement of PCC transition; furnishing, excavation, and backfill of discharge pipe; connection to manhole or intake, if required; installation of apron, if required.

D. Removal of Storm Sewer:

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

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

3. Includes: Unit price includes, but is not limited to, removal, disposal, and capping (if specified) of pipe; and furnishing, placing, and compacting backfill material.

1.08 MEASUREMENT AND PAYMENT (Continued)

E. Connection to Existing Manhole or Intake: Comply with Section 6010, 1.08, G.

F. Storm Sewer Abandonment, Plug:

1. **Measurement:** Each plug will be counted.

2. **Payment:** Payment will be made at the unit price for each plug installed.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary), cutting pipe (if required), furnishing and placing plug materials, and placing and compacting backfill material.

G. Storm Sewer Abandonment, Fill and Plug:

1. **Measurement:** Each size of storm sewer to be abandoned by filling and plugging will be measured in linear feet.

2. **Payment:** Payment will be at the unit price per linear foot for each size of pipe filled and plugged.

3. **Includes:** Unit price includes but is not limited to, trench excavation (if necessary), cutting pipe (if required), furnishing and placing pipe fill material, furnishing and placing plug materials, and placing and compacting backfill material.

H. Aprons: Comply with Section 4030 for pipe aprons, apron footings, and apron guards.

PART 2 - PRODUCTS

2.01 STORM SEWERS

A. Reinforced Concrete Pipe (RCP):

1. Comply with ASTM C 76.

2. Minimum Class III, Wall B (Iowa DOT Class 2000D).

3. Use tongue and groove joints wrapped with engineering fabric, unless a rubber O-ring or profile gasket complying with ASTM C 443 is specified.

B. Reinforced Concrete Arch Pipe (RCAP):

1. Comply with ASTM C 506.

2. Minimum Class A-III (Iowa DOT Class 2000D).

3. Use tongue and groove joints wrapped with engineering fabric, unless a rubber O-ring or profile gasket complying with ASTM C 443 is specified.

C. Reinforced Concrete Elliptical Pipe (RCEP):

1. Comply with ASTM C 507.

2. Minimum Class HE III (Iowa DOT Class 2000D) or Class VE III (Iowa DOT Class 2000D).

3. Use tongue and groove joints wrapped with engineering fabric, unless a rubber O-ring or profile gasket complying with ASTM C 443 is specified.

D. Reinforced Concrete Low Head Pressure Pipe (RCPP):

1. Comply with ASTM C 361; minimum Class C 25.

2. Use tongue and groove joints. Comply with ASTM C 361 for rubber O-rings or profile gaskets.

E. Polyvinyl Chloride Pipe (PVC):

1. Use pipe complying with the following:
   a. Types of PVC pipes:
      1) Corrugated exterior, smooth interior, ASTM F 949.
      2) Solid wall, ASTM D 3034 or ASTM F 679.
      3) Closed profile, ASTM F 1803.
      4) Composite, ASTM D 2680.
   b. PVC plastic meeting ASTM D 1784, Cell Classification 12454.
   c. Minimum pipe stiffness of 46 psi.
   d. Integral bell and spigot joints with elastomeric seals according to ASTM D 3212 and ASTM F 477.

2. Use of this pipe material requires specific approval by the Engineer.

2.01 STORM SEWERS (Continued)

F. High Density Polyethylene Pipe (HDPE):

1. Use pipe complying with the following:
   a. AASHTO M 294, Type S corrugated exterior and smooth interior.
   b. Minimum pipe stiffness at 5% deflection according to ASTM D 2412.
   c. Integral bell and spigot joints with elastomeric seals complying with ASTM F 477.
   d. Maximum 5% deflection of the average inside diameter by testing after installation according to Section 4060, 3.05.

2. Use of this pipe material requires specific approval by the Engineer.

G. Corrugated Metal Pipe (CMP):

1. Use pipe complying with the following:
   a. AASHTO M 36, Type I.
   b. Zinc coating complying with AASHTO M 218.
   c. Corrugated steel circular section with annular or helical corrugations.
   d. Gage of pipe according to Iowa DOT Standard Road Plan DR-104 or as specified in the contract documents.
   e. Coupling bands with annular or helical corrugations to match pipe ends.

2. Use of this pipe material requires specific approval by the Engineer.

H. Spiral Rib Pipe:

1. Use pipe complying with the following:
   a. ASTM A 760 Type 1R.
   b. Corrugation profile of 3/4 inch by 3/4 inch by 7 1/2 inches.
   c. Type 2 aluminized steel complying with ASTM A 929.
   d. Minimum thickness of 0.064 inch. Use gage of pipe according to manufacturer's requirements.
   e. Coupling bands complying with manufacturer's recommendations.

2. Use of this pipe material requires specific approval by the Engineer.

I. Coated Corrugated Metal Pipe:

1. Use in corrosive soil or effluent conditions, or where specified in the contract documents or required by the Engineer.

2. Comply with AASHTO M 274. Use gage of pipe according to Iowa DOT Standard Road Plan DR-104 or as specified in the contract documents.

3. Use of this pipe material requires specific approval by the Engineer.

J. Corrugated Metal Arch Pipe (CMAP):

1. Use pipe complying with the following:
   a. AASHTO M 36, Type II.
   b. Zinc coating complying with AASHTO M 218.
   c. Corrugated steel Type I pipe reformed into a pipe-arch having an approximately flat bottom.
   d. Coupling bands with annular corrugations or helical corrugations to match pipe ends.
   e. Gage of pipe according to Iowa DOT Standard Road Plan DR-104.

2. Use of this pipe material requires specific approval by the Engineer.

2.01 STORM SEWERS (Continued)

K. Spiral Rib Arch Pipe:

1. Use pipe complying with the following:
   a. ASTM A 760 Type IIR.
   b. Corrugation profile of 3/4 inch by 3/4 inch by 7 1/2 inch.
   c. Type 2 aluminized steel complying with ASTM A 929.
   d. Minimum thickness of 0.064 inch. Use gage of pipe complying with manufacturer's requirements.
   e. Coupling bands complying with the manufacturer's recommendations.

2. Use of this pipe material requires specific approval by the Engineer.

L. Polypropylene Pipe:

1. Comply with the following for 12 inch to 30 inch pipe:
   a. Double walled pipe meeting ASTM F 2764.
   b. Minimum pipe stiffness per ASTM D 2412, 46 psi.
   c. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.

2. Comply with the following for 30 inch to 60 inch pipe:
   a. Triple walled pipe meeting ASTM F 2764.
   b. Minimum pipe stiffness per ASTM D 2412, 46 psi.
   c. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F 477.

3. Use of this pipe material requires specific approval by the Engineer.

M. Bituminous Joint Primer: Material intended for use in priming concrete joints. Comply with the requirements of ASTM D 41.

N. Engineering Fabric: Comply with Iowa DOT Article 4196.01.

O. Non-Shrink Grout: Comply with Iowa DOT Materials I.M. 491.13.

2.02 LINEAR TRENCH DRAIN

Comply with approved manufacturer's requirements and Iowa DOT Materials I.M. 449 (MAPLE), as well as complying with Figure 6010.521. Provide certification indicating continuous trench drain meets AASHTO M 306 for 40,000 pound proof load.

2.03 CASING PIPE

Comply with Section 3020, 2.02 for casing pipe requirements.

2.04 PIPE APRONS

Comply with the requirements of Section 4020, 2.01 and Section 4030, 2.01 for the pipe material of which the apron is constructed. Supply concrete pipe aprons according to Figure 4030.222 and Figure 4030.223. Supply CMP pipe aprons according to Figure 4030.225.

2.05 APRON FOOTINGS

Comply with the requirements of Section 6010 for reinforcing steel and structural concrete used in apron footings.

2.06 APRON GUARD

Use smooth or deformed steel bars, ASTM A 615, Grade 40 or merchant quality, in the construction of the apron guard. Hot dip galvanize the apron guard according to ASTM A 123.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify measurements at site; make necessary field measurements to accurately determine pipe makeup lengths or closures.

B. Examine site conditions to ensure construction operations do not pose hazards to adjacent structures or facilities.

3.02 PIPE INSTALLATION

A. General:

1. Clean pipe interior and joints prior to lowering into trench. Keep pipe clean during construction.

2. Begin at the lowest point in the line. Lay groove or bell end pointing upstream unless otherwise specified.

3. Place pipe with lifting holes at the top of the pipe and fill lift hole with non-shrink grout or manufactured plugs.

4. Assemble joints as specified by the pipe manufacturer.

5. Use a saw to cut ends of pipe flush with inside wall of manholes, intakes, and structures. Do not use hammer or other means to break pipe.

6. Provide manholes and intakes as specified in the contract documents.

7. Use watertight stopper, plug, or other approved means to protect the exposed upstream ends of the pipe and prevent soil sediment from entering the storm sewer system.

B. Trenched:

1. Excavate trench and provide pipe bedding and backfill material as specified in Section 3010.

2. Prepare trench bottom to design line and grade so that only minor movement of the pipe is necessary after installation.

3. Lay pipe to design line and grade. Set field grades to invert of pipe.

4. Provide uniform bearing for full pipe barrel length. Excavate bell holes as necessary for uniform support of pipe barrel on bedding material.

5. Do not lay pipe in water or on saturated soil or bedding, or allow water to rise in trench around pipe prior to placing backfill material.

6. Do not disturb installed pipe and bedding when using movable trench boxes and shields. Block or anchor pipe as necessary to prevent joint displacement.

C. Trenchless: Comply with Section 3020.

3.03 STORM SEWER INSTALLED WITHIN A CASING PIPE

Comply with Section 3020, 3.04 for installation of storm sewer within casing pipe.

3.04 LINEAR TRENCH DRAIN

A. Install according to the manufacturer's requirements and the contract documents.

B. Use duct tape or wood block to prevent intrusion of concrete during installation and paving.

C. Connect to existing intake or manhole according to Section 6010, 3.05 or discharge to an open drainageway/ditch.

3.05 PIPE JOINTING

A. General:

1. Clean joint surfaces to remove soil or foreign material prior to jointing pipe.

2. Assemble joints according to pipe manufacturer's recommendations. Use equipment that does not apply damaging forces to pipe joints.

B. Reinforced Concrete Pipe (RCP), Reinforced Concrete Arch Pipe (RCAP), and Reinforced Concrete Elliptical Pipe (RCEP):

1. Comply with Figure 4020.211 for pipe joint wrapping. Secure engineering fabric in place to prevent displacement while placing backfill material.

2. If a rubber O-ring or profile gasket is specified for RCP, coat the rubber gasket and joint with soap-based lubricant immediately prior to closing the joint.

3. Place pipe such that joint openings on the outside or inside of the pipe do not exceed 1/8 inch at the bottom and 5/8 inch at the top.

C. Reinforced Concrete Low Head Pressure Pipe (RCPP); Polyvinyl Chloride Pipe (PVC) and Corrugated PVC Pipe; Polypropylene Pipe; and High Density Polyethylene Pipe (HDPE): Coat gasket and joint with soap-based lubricant immediately prior to closing the joint.

D. Corrugated Metal Pipe (CMP) and Corrugated Metal Arch Pipe (CMAP): Lap coupling bands to form a tightly closed joint upon installation.

E. Connections between Dissimilar Pipes:

1. Use manufactured adapters or couplings approved by the Engineer.

2. Where adapters or couplings are not available, the Engineer may authorize use of a concrete collar as shown in Figure 4020.211.

3.06 APRONS

A. Install pipe aprons where specified in the contract documents. Use the same installation methods as used on the pipe to which the apron is being attached. Dewater area as necessary to prevent installing the apron in water or on saturated soil or bedding. Do not allow water to rise around the apron prior to backfilling the area.

B. Install apron footings where specified in the contract documents. Construct according to Section 6010 and the contract documents. Dewater area as necessary to prevent installing the apron footing in water or on saturated soil or bedding. Do not allow water to rise around the apron footing prior to backfilling the area.

3.06 APRONS (Continued)

C. Anchor the last three concrete pipe sections and the apron together with two pipe connections per joint. Comply with Iowa DOT Standard Road Plan DR-121.

D. Attach corrugated metal aprons to the pipe with a manufacturer's approved bolt, weld, or clamp to fasten directly to the pipe.

E. Install apron guard where specified in the contract documents. Construct according to Figure 4030.224 or 4030.225. Repair any damage to the galvanized coating that occurs due to storage, handling, or installation.

3.07 TOLERANCES

The following tolerances apply to utilities installed by open trench construction. For trenchless construction, comply with Section 3020.

A. Do not allow horizontal and vertical alignment to vary from design line and grade at any structure by more than 1% of the inside diameter of the pipe or 1/4 inch, whichever is larger.

B. Do not allow the horizontal alignment of the pipe to vary from design line at any point along the pipe by more than 1% of the inside diameter of the pipe.

C. Low spots holding water exceeding the following depths for each pipe size will be considered unacceptable and must be removed and reinstalled to proper grade.

Pipe Diameter	Maximum Low Spot Depth
8"	1/2"
10"	1/2"
12"	3/4"
15"	3/4"
18" and Larger	5% of Pipe Diameter*

* Measured to the nearest 1/2"

3.08 CONFLICTS

A. Horizontal Separation of Gravity Sewers from Water Mains:

1. Separate gravity storm 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 storm sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

1. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of Section 5010, 2.01 and

2. The sewer force main is laid at least 4 linear feet from the water main.

3.08 CONFLICTS (Continued)

C. Separation of Sewer and Water Main Crossovers:

1. Vertical separation of 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 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.

3.09 STORM SEWER ABANDONMENT

A. Plug:

1. Prior to placing the sewer plug, the Engineer will verify the sewer line is not in use.

2. Construct sewer plug by completely filling the end of the pipe with concrete. Force concrete into the end of the pipe for a distance of 16 inches, or one-half the pipe diameter, whichever is greater.

B. Fill:

1. Prior to filling the sewer, the Engineer will verify the sewer line is not in use.

2. If specified in the contract documents, fill the line to be abandoned with flowable mortar, foamed cellular concrete, or CLSM (comply with Section 3010) by gravity flow or pumping.

3. Batching, mixing, and placing may be started when temperature is 34°F and rising. Cease mixing and placing when temperature is 38°F or less and falling.

3.10 CONNECTION TO EXISTING MANHOLE OR INTAKE

Comply with Section 6010, 3.05.

3.11 CLEANING, INSPECTION, AND TESTING

Clean, inspect, and test according to Section 4060.

END OF SECTION

PIPE CULVERTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe Culverts

B. Pipe Aprons and Beveled Ends

C. Footings for Concrete Pipe Aprons

D. Pipe Apron Guards

1.02 DESCRIPTION OF WORK

Construct pipe culverts, beveled ends, pipe aprons, and associated appurtenances.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Pipe Culverts:

1. Trenched:

a. Measurement: Each type and size of pipe installed in a trench will be measured in linear feet from end of pipe to end of pipe along the centerline of pipe, exclusive of aprons. Lengths of elbows and tees will be included in length of pipe measured.

b. Payment: Payment will be made at the unit price of each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; connectors; testing; and inspection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the casing pipe.

b. Payment: Payment will be made at the unit price for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing and compacting backfill material; pipe connections; testing; and inspection.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Pipe Aprons:

1. **Measurement:** Each type and size of pipe apron will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of pipe apron.

3. **Includes:** Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; connectors; and other appurtenances.

C. Footings for Concrete Pipe Aprons:

1. **Measurement:** Each footing installed on a concrete pipe apron will be counted.

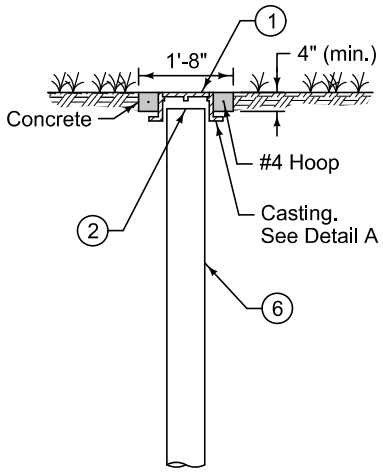
2. **Payment:** Payment will be made at the unit price for each footing.

3. **Includes:** Unit price includes, but is not limited to, excavation; dewatering; reinforcing steel; concrete; furnishing and installing apron; furnishing, placing and compacting bedding and backfill material.

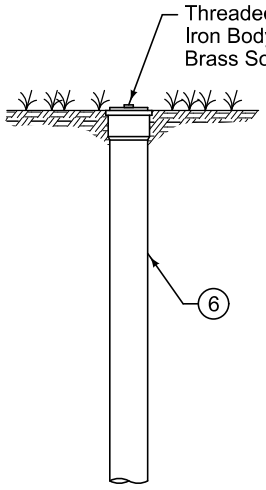
D. Pipe Apron Guards:

1. **Measurement:** Each pipe apron guard will be counted.

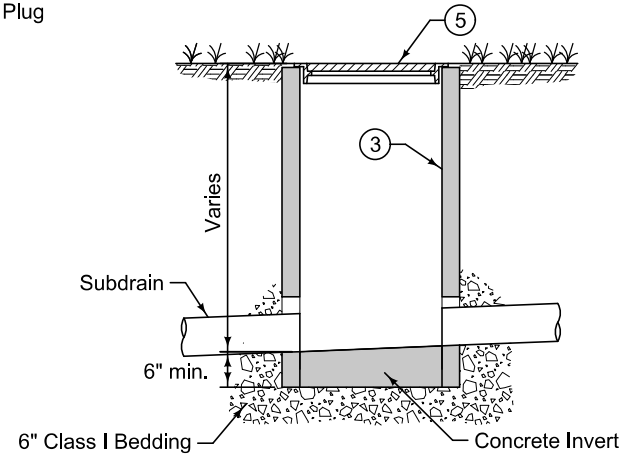
2. **Payment:** Payment will be made at the unit price for each pipe apron guard.



TYPE A-1 CLEANOUT



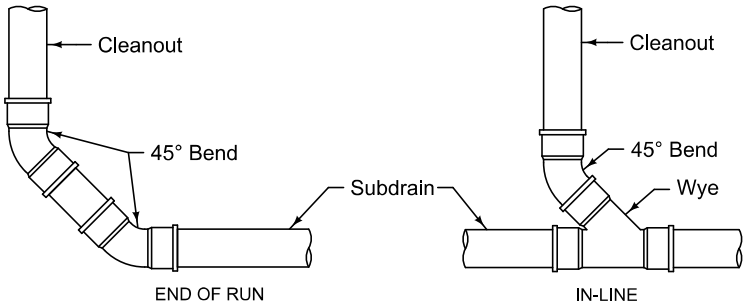
TYPE A-2 CLEANOUT



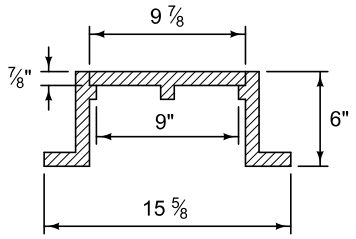
TYPE B CLEANOUT

Use in non-traffic areas.

1. Light duty casting. Label lid with "Storm" or "Storm C.O."
2. Do not allow casting to bear on top of riser pipe; provide 2 inch clearance, minimum.
3. A manufactured cleanout may be used in lieu of a Type B cleanout, if approved by the Engineer.
4. Design is intended for use in conjunction with 8 inch PVC riser pipe. Other sized caps may be used with smaller pipe, as approved by the Engineer.
5. Provide Type G casting, as required to fit pipe size.
6. PVC riser pipe; match diameter of subdrain (8 inches maximum).



TYPE A CLEANOUT CONNECTIONS



DETAIL A (1)(4)
(Dimensions are nominal)

FIGURE 4040.232 | SHEET 1 OF 1

SUDAS

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3 | 2020 Edition

4040.232

SHEET 1 of 1

SUDAS Standard Specifications

SUBDRAIN CLEANOUTS

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: When required in the contract documents, submit documentation of National Institute of Occupational Safety and Health (NIOSH) testing, health hazard evaluation, and recommended safety procedures for CIPP workers and public.

B. Grouting Sewer Joints and Service Connections:

1. Grout: Description of chemical grout materials to be used.

2. Additives: Description of additives to be used including strengthening agents, shrinkage reducers, dye, viscosity modifiers, gel time modifier, freeze/thaw inhibiter, or others.

3. Root Inhibitor: Description of chemical root deterrent.

4. Procedures: Manufacturer's published recommendations for storing, mixing, testing, and handling chemical grouts.

C. Installer Information: When requested by the Contracting Authority, submit the following prior to the preconstruction meeting.

1. Installer name.

2. Completed project list for last five years including for each project and year completed, client name/address/contact person/phone number, footages installed by pipe diameter, and number of lateral reinstatements.

3. Detailed installation procedures, including estimated times for each task, lateral reinstatement methods, number of required excavations, and other items unique to each product.

4. Video of installation process, if available.

5. Evidence of properly trained personnel.

6. Related ASTM standards or any nationally recognized standards for product installation.

7. Available equipment list.

8. Detailed procedures for repairing the product in the event of future damage or failure and for tapping future service connections, including and required specialized equipment or training.

9. Videos of two rehabilitated sewer sections showing before and after conditions.

10. Additional information may be required. The submittal of prequalification information in no way implies that the product, manufacturer, or installer will be deemed to be qualified. The Contracting Authority, in its sole discretion, will determine whether a product, manufacturer, or installer does or does not qualify as an approved equal.

1.04 SUBSTITUTIONS

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

Provide, as a minimum, the following information for evaluation.

A. Product Information:

1. Product name.
2. Year product first available in the United States.
3. Total footage or number of line segments installed in the United States.
4. Results of all available product testing, including but not limited to leakage, physical properties, pipe stiffness, chemical resistance, strain-corrosion, external loading, flow characteristics, infiltration/inflow reductions, structural capacity, and external hydrostatic loading capacity.
5. Samples of before and after product.
6. Design method.
7. Typical lining thickness for pipe sizes included in the project.

B. Manufacturer Information:

1. Manufacturer name.
2. Years of experience manufacturing the product.
3. Country of manufacture of all product components.
4. Quality control procedures for product manufacture, including inspection requirements, testing procedures, and allowable tolerance levels.
5. Related ASTM standards, or other nationally recognized standards for product manufacturing.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

A. Prior to start of work, notify all affected parties 24 hours in advance as to the length of time their service will be blocked.

B. Unless otherwise specified, the Jurisdiction will provide water at no cost for cleaning and installation of cured-in-place pipe. Utilize an approved double check backflow assembly or open gap.

1.07 SPECIAL REQUIREMENTS (Continued)

C. Establish a Public Information and Notification Program for contacting each home or business connected to the affected sanitary sewer, informing them of the work to be done and when the sewer will be off-line. The following specific steps are part of the Public Information and Notification Program.

1. Provide written notice to be delivered to each affected home or business describing work, schedule, how the work affects them, and a local telephone number of the Contractor they can call to discuss the project or their problems.

2. Personally contact each home or business on the day lateral verifications using closed circuit video inspection are to be performed. The homeowner or business will be asked to run water down their drain to verify each lateral. If the homeowner is unavailable, attempt other arrangements (cleanouts) to drain water through the lateral to verify each connection.

3. Provide written notice and personally contact the home or business the day prior to beginning inversion of the section of sewer to which they are connected.

4. Personally contact all homes or businesses that cannot be reconnected within the time stated in the written notice.

5. Furnish and service portable toilets for use by the home or business occupants if so required by any affected served business or homeowner.

1.08 MEASUREMENT AND PAYMENT

A. Pipe Cleaning and Inspection for Rehabilitation:

1. Pre-Rehabilitation Cleaning and Inspection:

a. Measurement: Measurement will be made for each diameter range of sewer main cleaned and inspected prior to rehabilitation. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.

b. Payment: Payment will be made at the unit price per linear foot for each diameter of pre-lining cleaning and inspection.

c. Includes: Unit price includes, but is not limited to, pre-cleaning CCTV inspection, light sewer cleaning, debris removal and transport, post cleaning CCTV inspection for Engineer review, and identification and logging of active service taps. If specified in the contract documents, unit price also includes disposal and associated costs for all debris removed from sewer.

2. Additional Sewer Cleaning:

a. Measurement: Measurement will be made on an hourly basis for additional pipe cleaning for each diameter range. Hours will start with the initial cleaning work following the Engineer's approval to proceed and will extend until mechanical cleaning ceases. Time for removal, transporting, and disposal of debris is not included. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.

b. Payment: Payment will be made at the unit price per hour for additional pipe cleaning.

c. Includes: Unit price includes, but is not limited to, heavy sewer cleaning; root cutting; deposit cutting; and removing, transporting, disposing, paying associated costs for all debris removed from sewer, and post cleaning CCTV inspection for Engineer review.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Remove Protruding Service Connections:

1. **Measurement:** Each protruding service connection removed will be counted. Quantity will be based on number of protruding service connections identified in the pre-rehabilitation CCTV inspection and removed from the post-rehabilitation CCTV inspection.

2. **Payment:** Payment will be made at the unit price for each protruding service connection removed.

3. **Includes:** Unit price includes, but is not limited to, removal of protruding service connections and debris removal.

C. CIPP Lining:

1. **CIPP Main Lining:**
   a. **Measurement:** Each diameter of main pipe lining will be measured in linear feet along the centerline of the pipe lining from center of manhole to center of manhole.
   b. **Payment:** Payment will be made at the unit price per linear foot for each diameter of pipe lining.
   c. **Includes:** Unit price includes, but is not limited to, furnishing and installing the liner and appurtenances, CCTV inspection immediately prior to lining, bypass pumping unless otherwise specified, sliding foil, post-lining CCTV inspection, and all costs associated with the public information and notification program.

2. **Building Sanitary Sewer Service Reinstatement:**
   a. **Measurement:** Each active sanitary sewer service reinstated, including those reinstated by excavation, will be counted.
   b. **Payment:** Payment will be made at the unit price for each active sewer service reinstated.
   c. **Includes:** Unit price includes, but is not limited to, reinstating sanitary sewer service connections, removal of debris, and coordination with service owners.

3. **CIPP End Seal:**
   a. **Measurement:** Each size of CIPP end seal installed will be counted.
   b. **Payment:** Payment will be made at the unit price for each CIPP end seal installed.
   c. **Includes:** Unit price includes, but is not limited to, end seal and installation.

D. CIPP Point Repair:

1. **Measurement:** Each diameter of CIPP point repair will be counted. Repairs in excess of 10 feet in length will be counted as multiple repairs.

2. **Payment:** Payment will be made at the unit price for each diameter of CIPP point repair.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing point repair liner, bypass pumping unless otherwise specified, sewer cleaning, removal of obstructions, debris removal, pipe preparation, and pre and post repair CCTV inspection.

1.08 MEASUREMENT AND PAYMENT (Continued)

E. CIPP Service Repair:

1. **CIPP Service Pipe, Connection:**
   - **a. Measurement:** Each size combination of main and service connection diameters repaired will be counted.
   - **b. Payment:** Payment will be made at the unit price for each size combination of CIPP service pipe, connection.
   - **c. Includes:** Unit price includes, but is not limited to, furnishing and placing service connection liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.

2. **CIPP Service Repair, Partial Pipe:**
   - **a. Measurement:** Each size combination of main and service diameters and specified service length lined will be counted.
   - **b. Payment:** Payment will be made at the unit price for each size combination of CIPP service repair, partial pipe.
   - **c. Includes:** Unit price includes, but is not limited to, furnishing and installing service repair liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.

F. Pressure Testing and Grouting of Sewer Joints and Service Connections:

1. **Pressure Testing of Mainline Sewer Joints:**
   - **a. Measurement:** Each mainline sewer joint tested will be counted. Separate measurement will be made for each diameter of sewer main. Visually leaking joints, whether tested or not, will be counted if they are grouted.
   - **b. Payment:** Payment will be made at the unit price for each sewer joint tested.
   - **c. Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, control testing, and documentation.

2. **Injection Grouting of Mainline Sewer Joints:**
   - **a. Measurement:** Each mainline sewer joint grouted will be counted. Separate measurement will be made for each diameter of sewer main.
   - **b. Payment:** Payment will be made at the unit price for each sewer joint grouted.
   - **c. Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, material testing, pressure testing after grouting, re-grouting of failed joints, and documentation. Unit price does not include the quantity of chemical grout used.

3. **Pressure Testing of Service Connections:**
   - **a. Measurement:** Each sewer service connection tested will be counted. Separate measurement will be made for service connections on each diameter of sewer main.
   - **b. Payment:** Payment will be made at the unit price for each service connection tested.
   - **c. Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, and documentation.

4. **Injection Grouting of Service Connections:**
   - **a. Measurement:** Each service connection grouted will be counted. Separate measurement will be made for service connections on each diameter of sewer main.
   - **b. Payment:** Payment will be made at the unit price for each service connection grouted.
   - **c. Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, material testing, pressure testing after grouting, and documentation. Unit price does not include the quantity of chemical grout used.

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 1219 for heat cure or ASTM F 2019 and D 5813 for UV light cure.

B. CIPP Lining Dimensions:

1. Use nominal internal diameter and length such that CIPP forms to internal circumference and length of original pipe.

2. Field verify diameter and length.

3. Use one continuous length without joints.

C. Structural Requirements:

1. Design the CIPP liner according to ASTM F 1216.

2. Unless otherwise specified in the contract documents, assume fully deteriorated conditions and the following properties for design at each location:

Table 4050.01: CIPP Main Lining Design Values

Design Criteria	Value
Factor of safety, N	2.0
Soil modulus, E'_s	1,000 psi
Soil density, ω	120 lb/ft^3
Live load, W_s	H20
Ovality reduction factor, C	As specified for each location
Height of soil above pipe, H	As specified for each location
Height of water above top of pipe, H_w	1/2 depth of cover
Long term flexural strength, σ_L	Use value for 50 year design

3. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.

4. Design for internal pressure or vacuum is not required.

D. CIPP Lubricant: Provide a non-toxic, oil based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

E. CIPP End Seal:

1. Hydrophilic Gasket Sleeve: Provide a seamlessly molded gasket and retaining ring system complying with ASTM F 3240.

2. Expansion Band System:
a. Provide a one-piece rubber gasket and a pair of stainless-steel expansion bands in a system manufactured specifically for CIPP end seal applications.
b. Provide bands with positive locking mechanism permanently securing the bands in their expanded position after tightening.
c. Comply with material requirements of ASTM C 923 for rubber gasket and stainless steel.

2.02 CIPP POINT REPAIR

A. General: Utilize a repair system that complies with the following requirements.

1. Meet or exceed the material requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.

2. Provides a full wrap section sized to create a circular liner equal to the inner diameter of the pipe. Ensure one end of the CIPP point repair sheet overlaps the second end by a minimum of 10% to allow for variation in pipe diameter.

3. Sufficient strength to bridge missing pipe segments and ability to stretch to fit irregular pipe sizes.

4. Uniform thickness and 10% extra resin.

5. Utilizes a thermoset resin system comprised of a base resin and hardener that cure at ambient temperatures.

6. Has a shrinkage value of less than 0.5% when measured according to ISO 2577 or ASTM D 6289.

7. Designed against corrosion and typical chemicals found in domestic sewage.

B. Liner Length: Minimum length as specified in the contract documents. Lengths beyond 10 feet may be completed with multiple liners.

C. Structural Requirements: Design the CIPP point repair according to the structural requirements for CIPP main lining described herein. Assume an ovality of 2% unless otherwise specified in the contract documents.

2.03 CIPP SERVICE REPAIR

A. General: Utilize a repair system that provides the following.

1. Full circumferential CIPP liner inside the main pipe and a tube that extends continuously from the sewer main into the service for the distance specified in the contract documents.

2. Installation of system from within the sewer main without the need for excavation or access through a clean out.

3. The ability to seal a combination of tees and wyes of varying angles.

4. The ability to seal the connection of the service to the mainline in a continuous, tight fitting, watertight pipe within a pipe that eliminates infiltration and root intrusion between the liner and host pipe.

B. Liner Length:

1. CIPP Service Connection Repair: Provide service liner with a length of 12 to 24 inches to seal the connection between the main line and the wye or tee.

2. Partial Service Pipe: Provide service liner with a length between 12 and 24 inches, as specified in the contract documents, to seal the connection from the main line to the first service pipe joint.

3. Main Pipe Liner Length: Provide main pipe liner with a length of 18 inches minimum.

2.03 CIPP SERVICE REPAIR (Continued)

C. Fabric Tube:

1. Provide a fabric tube consisting of one or more layers of absorbent non-woven felt fabric, felt/fiberglass, or fiberglass complying with the requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.

2. Provide nominal fabric tube wall thickness to the nearest 0.5 mm increment as required by the thickness design. Ensure the wet-out fabric tube has a uniform thickness that, when compressed at installation pressures, meets or exceeds the design thickness after cure.

3. Coat inside (after installation) of fabric tube with an impermeable, flexible membrane that will contain the resin and facilitate vacuum impregnation.

4. Mark the fabric tube with the name of the lining system manufacturer and manufacturing lot or production footage. Ensure print is visible during final CCTV inspection.

D. Resin:

1. Provide a chemical-resistant thermoset (heat or UV light) resin and catalyst system or epoxy resin and catalyst / hardener system that, when cured within the fabric tube, complies with requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.

2. Method of cure may be by heat source, UV light, or ambient temperature.

3. Provide resin to tube ratio as recommended by the manufacturer.

E. Structural Requirements:

1. Design the cured-in-place service liner according to ASTM F 1216 utilizing the following assumptions, unless otherwise specified in the contract documents:

Table 4050.02: CIPP Service Design Values

Design Criteria	Value
Factor of safety	2.0
Soil modulus	1,000 psi
Soil density	120 pcf
Live load	H20
Depth of cover	As specified for each location
Groundwater	1/2 depth of cover
Ovality	2%

2. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.

2.03 CIPP SERVICE REPAIR (Continued)

3. Comply with the following minimum structural properties:

Table 4050.03: Minimum Structural Properties for CIPP Service

Property	Test Method	Minimum Value
Flexural modulus of elasticity	ASTM D 790	250,000 psi
Flexural strength	ASTM D 790	4,500 psi

4. Do not consider the bond to the existing pipe in determining the structural performance of the lining system.

2.04 CHEMICAL GROUT

A. Grout: Provide a chemical grout (chemical sealing material) complying with ASTM F 2304 or ASTM F 2454.

B. Additives: Strengthening agents, shrinkage reducers, dyes, viscosity modifiers, gel time modifiers, and freeze/thaw inhibiters, are allowed at the Contractor's discretion. Provide additives compatible with the chemical grout and complying with chemical grout manufacturer's requirements.

C. Root Inhibiter: When specified in the contract documents, provide a root deterrent chemical to control root regrowth. Ensure root inhibitor is compatible with chemical grout and additives and complies with grout manufacturer's requirements.

2.05 SEWER DYE

Provide tracer dye complying with NSF/ANSI 60.

2.06 PIPE REPAIR COUPLINGS FOR SPOT REPAIRS BY PIPE REPLACEMENT

A. Style: Full circle, fully lined, bolted.

B. Length: As recommended by the manufacturer for pipe diameter; 12 inches, minimum.

C. Materials and Manufacturer:

1. Shells, armors, side bars, lugs, Turner lifting bars; complying with ASTM A 240, Type 304 stainless steel.

2. MIG welds, fully passivated.

3. Rubber gasket complying with ASTM D 2000, AA415 with full coverage and a grid pattern.

4. Stainless steel armor bonded to gasket to bridge lug area.

D. Nuts and Bolts: 1/2 inch or 5/8 inch diameter, complying with ASTM A 240, Type 304 stainless steel, and Teflon coated threads.

2.07 SEWER MAIN PIPE (FOR SPOT REPAIRS)

A. Comply with Section 4010.

B. Use materials for pipe replacement as specified in the contract documents or approved by the Engineer.

PART 3 - EXECUTION

3.01 SEWER CLEANING AND INSPECTION FOR REHABILITATION

A. General:

1. Provide equipment specifically designed and constructed for sewer cleaning and inspection.

2. Use sewer cleaning equipment manufacturer's recommended size tools for various pipe sizes.

3. Utilize equipment recommended by the manufacturer to protect the manhole and pipe during cleaning and inspection operations.

4. Perform all cleaning and removal operations under CCTV observation to monitor the progress of the work and to monitor the sewer line for damage. Continue until the condition of the host pipe meets the requirements of the liner manufacturer.

5. Flush all debris to downstream manhole. Screen, collect, and remove debris from sewer.

6. Dispose of all sanitary sewer debris and material at a location directed by the Owner. If specified in the contract documents, pay for all disposal fees.

B. Pre-Cleaning Inspection:

1. Complete CCTV inspection of sewer prior to initiating cleaning.

2. Inspect each pipe segment between manholes or access points in a single, continuous run where possible.

3. If line is impassable due to debris or obstructions, reverse setup and inspect from opposite manhole or access point.

C. Pre-Rehabilitation Sewer Pipe Cleaning:

1. Perform light cleaning with hydraulic flusher or high velocity cleaning equipment to remove loose debris.

2. Complete up to three passes in an attempt to remove all debris from line.

4. If the pre-rehabilitation light cleaning fails to leave the sewer line in a condition ready for lining, contact Engineer for authorization to proceed with additional sewer cleaning.

D. Additional Sewer Cleaning:

1. Notifying Engineer prior to performing heavy cleaning as required to remove obstructions, grease, rock, sticks, deposits settled (DS), deposits attached grease (DAGS), deposits attached encrustation (DAE), and roots, so the sewer is ready for lining. This item does not include cutting/grinding protruding service lines.

2. Utilize rotating nozzles, saws or cutters, or high velocity hydro-cleaning equipment.

3. Notify Engineer prior to use of mechanical/hydraulic spinner nozzle, chain flail, or other devices that may damage pipe or service connections.

4. If deposits and obstructions cannot be removed by tools normally used in the sewer cleaning industry, notify Engineer immediately.

3.01 SEWER CLEANING AND INSPECTION FOR REHABILITATION (Continued)

5. Maintain a log of time spent performing additional pipe cleaning on each line segment.

E. Remove Protruding Service Connection:

1. Grind or cut services that protrude more than 1/2 inch into the sewer main.

2. Utilize a remote grinding/cutting device specifically designed to remove concrete, vitrified clay, PVC, and other types of pipe materials.

3. Notify Engineer if ductile iron, steel, cast iron, or other non-typical service materials are encountered to review the ability and risks of removing the protruding services.

4. Grind or cut protruding service flush to the main sewer pipe without scouring or damaging the main sewer or service connection.

5. Notify the Engineer immediately if the sewer main or service pipe are not structurally sound.

F. Post-Cleaning CCTV Inspection:

1. Complete CCTV inspection of sewer upon completion of all sewer cleaning, obstruction removal, and protruding service removal activities.

2. Inspect each pipe segment between manholes or access points in a single, continuous run.

3. Inspect all service connections at right angles utilizing pan and tilt capabilities of the camera.

4. Identify active and inactive service connections by the following:
   a. Observe each service connection and identify active connections by active sewage flow or evidence of recent sewage flow.
   b. If the status of the connection is inconclusive, run water down adjacent services to verify the location of each service.
   c. Dye test connections if necessary to verify active status.
   b. Accurately measure and log the location and clockwise position of all active service connections.

G. Groundwater: If significant groundwater infiltration is present, which could result in resin loss, resin contamination, reduction in CIPP thickness, or inadequate curing, notify the Engineer prior to installing CIPP liner.

H. Inspection Reporting:

1. Provide a copy of the pre-cleaning and post-cleaning video inspections. Include on-screen continuous footage, pipe diameter, direction of viewing, manhole number, and street location reference in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.

2. Provide a written report of the inspections. Include true to scale drawings of all sewer defects and observation locations. Reference the time stamp on each line item entry on the written report.

3.02 BYPASSING SEWAGE

A. Submit a bypassing plan to the Engineer for review.

B. When sewer line flows exceed the values in Table 4050.04, or the depth recommended by the manufacturer of the sewer rehabilitation practice being implemented, reduce flows to acceptable levels.

1. Plug the line at a point upstream of pipe to be rehabilitated if bypassing is required.

2. Pump flow to a downstream point or adjacent system as directed by the Engineer.
   a. Provide pump and bypass lines of adequate capacity to handle all flows.
   b. Provide adequate reserve pumps on-site for emergency use and for storm flows.

C. Rehabilitation and inspection work may be completed without bypassing in certain situations including low flow conditions, adequate upstream storage, use of a flow-through packer, or other situations approved by the Engineer. If proposed work will be completed without bypassing, have equipment and plan of action available to implement bypass pumping in the event the work is delayed or sewage levels in the upstream line are in danger of causing backups.

Table 4050.04: Maximum Depth of Flow During Inspection, Testing, and Rehabilitation

Main Diameter	CCTV Inspection	Joint Testing/Sealing
6” to 10”	20% of pipe diameter	25% of pipe diameter
12” to 24”	25% of pipe diameter	30% of pipe diameter
27” and up	30% of pipe diameter	35% of pipe diameter

3.03 CIPP MAIN LINING

A. General:

1. Clean, prepare, and inspect the repair point according to Section 4050, 3.01

2. Install liner according to the manufacturer′s published recommendations, ASTM F 1216, and ASTM F 2019.

B. Resin Impregnation:

1. Vacuum impregnate tube with resin (wet-out) at manufacturer’s plant under quality controlled conditions or on-site in mobile wet-out unit.

2. Fill all voids in the tube material, adding 5% to 10% excess resin to allow for migration of resin into the voids and cracks.

C. Insertion:

1. General:
   a. Perform pre-lining video inspection immediately prior to insertion of the wet-out tube.
   b. Insert the wet-out tube through an existing manhole or approved access.
   c. Ensure the tube is continuous between manholes with no joints. A single tube may span several manhole reaches as allowed by the equipment, properties of the CIPP, and time limits imposed by sewage flows to the host pipe.
   d. Insertion of CIPP indicates acceptance of the host pipe conditions and the suitability of the liner inserted into the host pipe. Repair any failure of CIPP liner due to inadequate cleaning, groundwater infiltration, or defects in the liner system at no additional cost to the Contracting Authority.

3.03 CIPP MAIN LINING (Continued)

2. Inverted Heat-Cured Liner:

a. Prior to installation of the liner, place a temperature sensor on the bottom of the host pipe to monitor the temperature of the outside of the liner during the curing process. Place sensor at the termination point or location most distant from the heat source.
b. Insert the wet-out tube into the inversion device or standpipe with the impermeable plastic liner on the outside of the tube.
c. Turn back the end of the liner to form a cuff and secure the cuff to the inversion device or standpipe.
d. Apply air pressure or hydrostatic head as required to invert the tube into the host pipe with the impermeable liner on the inside of the pipe.
e. Apply lubricant directly to the tube or pour lubricant into the standpipe during the inversion process to reduce friction.
f. Maintain and adjust pressure as necessary to invert the tube from the point of insertion to the point of termination and to hold the tube tight against the wall, producing dimples at service connections.

3. Pull-In UV Light Cured Liner:

a. If CIPP manufacturer recommends the use of a sliding foil for the existing pipe conditions, provide sliding foil which covers the lower third to lower half of the pipe circumference. Pull sliding foil into place.
b. Fold the wet-out liner in half and pull into place through an existing manhole. Monitor pulling speed and tension to avoid exceeding the manufacturer's recommendations.
c. Pull 1 to 2 feet of excess liner into the termination manhole.
d. If the product is sensitive to elongation, measure the overall elongation of the tube after pull-in. Ensure the elongation of the tube is less than 2% of the overall length of the segment specified by the manufacturer.
e. Expand the resin-impregnated tube as necessary to hold the tube tight against the wall, producing dimples at service connections.
f. Perform CCTV inspection of the inflated liner prior to initiating cure. Confirm alignment and fit prior to initiating cure. Make corrections as necessary to provide a finished liner free of wrinkles and defects.

D. Curing:

1. Heat Cured:

a. Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete. Increase pressures to compensate for external ground water, if present.
b. Cure liner using circulating heated water or steam. Ensure the temperature is sufficient to affect a cure in all sections of the pipe.
c. Monitor and log the temperature from the sensor placed between the impregnated tube and the host pipe.
d. Initial cure will occur during heat up and is achieved when exposed portions of the new pipe appear to be hard and sound and the temperature sensor indicates the liner has reached the temperature necessary to effect a cure in the resin.
e. After initial cure is reached, raise the temperature to post-cure temperatures and hold for a period of time as recommended by the resin manufacturer.
f. Cool the new pipe to a temperature of 100°F for water cure and 113°F for steam cure before relieving the internal pressure within the section.

2. UV Light Cured:

a. Automatically record the time, rate of travel of the ultraviolet assembly, pressures, and amount of lamps in operation for each CIPP segment as documentation of correct curing of the fabric tube.
b. Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete.

3.03 CIPP MAIN LINING (Continued)

c. Draw the multi-lamp ultraviolet curing assembly through the pipe at a consistent, predetermined, speed that allows for cross-linking/polymerization of the CIPP resin.
d. Adjust air pressure during curing as necessary to hold liner tight to the wall. Maintain pressure by adjustment of the outlet valve.
e. Remove the temporary internal calibration hose installed by the manufacturer after curing is complete.

G. 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.

H. 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)

I. 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.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS

A. General:

1. Clean, prepare, and inspect the repair point according to Section 4050, 3.01

2. Complete sewer joint and service connection testing and grouting according to the grout supplier and equipment manufacturer′s published recommendations, ASTM F 2304, and ASTM F 2454.

B. Equipment:

1. Joint Testing Device: Provide a joint testing device (packer), with means for introducing air under pressure into the void area created by the expanded ends of the packer against the host pipe and a means of continuously measuring, viewing, and recording the static pressure of the test medium and grout within the void area only. Provide packer constructed in a manner to allow a limited amount of sewage to flow through at all times.

2. Service Connection Testing Device: Provide a service connection testing device with inflatable mainline end elements and a service line grouting plug that creates a void area extending beyond the main connection. Use a service line grouting plug sized to match the diameter of the service being grouted with an effective sealing length of at least 18 inches, unless otherwise specified in the contract documents.

3. Pumping Equipment:
   a. Provide positive displacement metering grout pump and hose delivery system capable of supplying a mixed volume of grout at a minimum of 3 gallons per minute and 30 gallons of uninterrupted flow within 10 minutes.
   b. Ensure pump system has sufficient discharge pressure (in excess of system pressure losses and groundwater) to deliver grout volume to fill void space within the gel set time of the chemical grout.

4. Grout Tanks: When using non-soluble additives, ensure grout tanks have mechanical mixing devices to keep additives in suspension.

5. Measuring Equipment: Provide means of measuring and recording the volume of mixed grout pumped for each grouted joint or service connection.

C. Control Tests:

1. Prior to beginning testing and grouting, perform a demonstration test in an above ground 8 inch nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. For service line testing, provide an 8 inch test cylinder with 6 inch service tee to receive the lateral bladder.

2. Equip the test cylinder with a pressure gauge to monitor internal pressure and a release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions.
   a. With the void release valve closed, inflate the packer and air test the void at 7 to 10 psi. Ensure the observed void pressure at the test cylinder pressure gauge is within $\pm$ 1/2 psi of the test monitoring equipment.
   b. Crack open the release valve to simulate a small leak. Ensure the pressure drop of the cylinder gauge is within $\pm$ 1/2 psi of the test monitoring equipment.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

2. After entering each pipeline segment, but prior to commencement of joint testing, position the packer on a section of sound and clean sewer between two consecutive pipe joints and perform a pressure test. Pressurize packer to between 7 and 10 psi and hold for a period of 15 seconds with a pressure drop of less than 1.0 psi. Deflate packer and ensure that void pressure monitoring equipment drops $\pm$ 1/2 psi of initial reading.

3. If any of the control tests are unsuccessful, clean equipment of excess grout or make necessary repairs and retest.

D. Sewer Main Joint Pressure Testing:

1. Test joints at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).

2. Position the packer within the pipe so the packer straddles the pipe joint to be tested. Verify location via CCTV monitoring.

3. Expand the packer ends to isolate the joint from the remainder of the pipe and to create a void area between the pipe joint and testing device.

4. Pump air into void space until the pressure reaches the required test pressure.

5. Stop the flow of air into the void space and observe the void pressure for 15 seconds.

6. If the pressure is maintained with a drop of less than 1 psi, the joint will be considered as having passed the test.

7. If the pressure drops more than 1 psi during the test period, the joint will be considered as having failed and sealing will be required.

8. Deflate packer and verify the void pressure monitor drops to within $\pm$ 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

E. Service Line Pressure Testing:

1. Test service lines at a target pressure equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).

2. Position the testing device within the line segment to straddle the service connection. Verify location via CCTV.

3. Align the service bladder with the service connection.

4. Apply air pressure to invert or inflate the bladder from the mainline assembly into the service pipe.

5. Expand the packer ends to isolate the section of the service connection to be tested.

6. Introduce air into the void area until a pressure equal to or up to 10% greater than the required test pressure is observed.

7. Stop the flow of air into the void space and observe the void pressure for 15 seconds.

8. If the pressure is maintained, with a pressure drop of less than 2 psi, the connection will be considered as having passed the test.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

9. If the pressure drops more than 2 psi during the test period, the connection will be considered as having failed and sealing will be required.

10. Deflate packer and bladder and verify the void pressure monitor drops to within ± 1/2 psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

F. Sewer Main Joint Sealing by Injection Grouting: Perform joint sealing according to ASTM F 2304, equipment manufacturer, grout supplier, and the following:

1. Position packer over the faulty joint and expand packer ends, isolating the joint with a tight seal.

2. Pump two-part chemical sealant material into the ratio specified by the grout supplier.

3. Continue to pump grout, in stages if necessary, until "refusal" is achieved.
   a. Refusal indicates the grout has flowed throughout the void, into the surrounding soil, forming a cohesive seal stopping further flow of grout.
   b. Under pumping conditions, void pressure will slowly rise as grout is forced into the surrounding soil and begins to set. When void pressure spikes an additional 8 psi or more in a short pumping period of 1 to 5 seconds, the point of refusal is achieved.
   c. If a quantity of grout equal to 1/2 gallon per inch diameter of pipe size is pumped without reaching the point of refusal, staging may be required. Staging is accomplished by repetitive cycles of pumping and curing until refusal is achieved. Notify Engineer for approval before staging is attempted.
   d. If joint cannot be sealed by staging, abandon sealing operations at that joint and notify Engineer.

4. Upon reaching refusal, stop grout pumps and allow grout to cure for 30 to 40 seconds.

5. Deflate packer to break away the ring of gel formed in the void and move at least one packer length away from the joint in either direction.

6. Ensure pressure gauge reads zero pressure ± 1/2 psi. If gauge does not return to zero clean equipment.

7. Reposition packer over joint and retest at a pressure equal to the initial test pressure.

8. If joint fails pressure test, repeat grouting and pressure testing procedure until the joint is sealed or Engineer determines grout consumption is too high and continued attempts to seal joint are abandoned.

9. Remove residual sealing materials that extend into the pipe or restrict the flow. Ensure sealed joint surfaces are left flush with existing pipe surface. Remove residual grout material from manhole; do not allow grout to be flushed down the sewer.

G. Service Connection Sealing by Injection Grouting: Perform service sealing according to ASTM F 2454, equipment manufacturer, grout supplier, and the following requirements.

1. Pump two-part chemical sealant material at the ratio specified by the grout supplier.

2. Continue to pump grout, in stages if necessary, until refusal is achieved.
   a. Under initial pumping conditions, the void pressure will slowly rise to a range of approximately 2 to 4 psi.
   b. Continue pumping until there is a sudden increase to over 8 psi in a few seconds, indicating refusal.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

c. If a quantity of grout equal to 1 gallon per foot of service line bladder plus 3 gallons is pumped without reaching the point of refusal, staging may be required.
d. Stage grouting by pumping additional grout equivalent to 1 gallon plus 0.25 gallons per foot of bladder, waiting 1 full minute and retesting. Do not exceed two stages unless approved by Engineer

3. Upon reaching refusal, stop grout pumps and allow grout to cure for 1 full minute.

4. Deflate service packer, re-inflate, and repeat service line pressure testing.

5. If the service connection test fails, repeat injection grouting and pressure testing procedures until service is sealed or Engineer determines grout consumption is too high and continued attempts to seal service are abandoned.

6. Confirm flow after sealing of each service. If a grout blockage exists, immediately clear the service of the blockage.

7. A thin film of residual grout inside the service, which does not significantly impede flow, is a normal result of sealing and is not considered a blockage.

H. Inspection and Reporting: Comply with ASTM F 2304 Section 12.9 as noted below.

1. Inspection:
a. Perform CCTV observation and recording of initial pressure testing, sealing operations (if required), and final pressure testing (if required) for each joint or service.
b. Perform final CCTV video inspection of sewer main rehabilitated by injection grouting after all grouting work is completed. Provide copy of video to the Jurisdiction.

2. Reporting: Upon completion of each pipe segment, submit a report showing the following information for each joint and service connection tested, grouted or both.
a. Identification of sewer pipe section tested.
b. Type of pipe material, diameter, and depth of pipe to surface at manholes.
c. Length of pipe sections between joints.
d. Test pressure used before and after sealing and duration of test.
e. Location of each joint or service connection tested and any joints or service connections not tested with and explanation for not testing.
f. Pass/fail results for each joint or service connection tested.
g. Volume of grout material used on each joint or service connection.
h. Grout mix record of the batches mixed including amount of grout and catalyst, additives, temperature of the grout solution in the tanks, and gel set time used.

3.07 SPOT REPAIRS BY PIPE REPLACEMENT

A. Excavate trench according to Section 3010.

B. Remove existing pipe to the extent required and disconnect affected sewer services.

C. Install replacement pipe of the same nominal size as the existing pipe.

1. Use the materials as specified in the contract documents that comply with Section 4010.

2. Place bedding material according to Section 3010.

3.07 SPOT REPAIRS BY PIPE REPLACEMENT (Continued)

D. Install pipe repair coupling.

1. Cut pipes to length required allowing no more than a 1/2 inch gap between butted pipe ends at coupling location. Cut pipes perpendicular to centerline.

2. Clean the outside surface of the existing and replacement pipes as required to provide a positive seal with the pipe repair coupling.

3. Wrap coupling around pipes, centered on butt joint, and tighten bolts according to manufacturer's recommendations.

E. Reconnect sewer services.

F. Place backfill in trench according to Section 3010.

3.08 CLEANUP AND CLOSEOUT

A. Verify that the services are reconnected and fully operable, with at least 90% of original capacity.

B. Submit initial and final recordings in a digital format and on a device approved by the Engineer.

C. Remove all equipment and debris.

END OF SECTION

3.05 DEFLECTION TESTING

A. Perform deflection tests on all flexible sanitary sewer mains, excluding ductile iron pipe. Also perform deflection tests on all flexible storm sewer or culvert pipe 12 inches in diameter or greater.

B. Perform deflection tests after backfill has been in place at least 30 calendar days and before paving activity takes place, or as per appropriate sections of these specifications.

C. Pull 9 arm deflection mandrel, complying with applicable ASTM Standards, through sewer by hand.

D. Ensure pipe deflection does not exceed 5% of average inside diameter as established by ASTM Standards.

E. Remove and replace pipe exceeding deflection limits.

F. Handle and divert existing flows during deflection testing.

3.06 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

3.06 FORCE MAIN TESTING (Continued)

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

PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe

B. Fittings

C. Special Fittings

D. Pipeline Accessories

1.02 DESCRIPTION OF WORK

Construct water mains and building service pipes.

1.03 SUBMITTALS

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

Submit product information sheet for joint restraint system to be used.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

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

Remove pipe and fittings contaminated with mud and surface water from the site; do not use in construction unless thoroughly cleaned, inspected, and approved by the Engineer.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Water Main:

1. Trenched:

a. Measurement: Each type and size of pipe installed in an open trench will be measured in linear feet along the centerline of the pipe, including the length through the fittings.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; tracer system; testing; disinfection; and polyethylene wrap for ductile iron pipe and for fittings.

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; tracer system; testing; and disinfection.

B. Water Main with Casing Pipe:

1. Trenched:

a. Measurement: Each type and size of pipe with a casing pipe installed in an open trench, will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

2. Trenchless:

a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe.

b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation; dewatering; placing and compacting backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

C. Fittings: One of the following methods will be specified for measurement and payment of water main fittings.

1. Fittings by Count:

a. Measurement: Each type and size of fitting installed as specified in the contract documents or as required for proper installation of the water main will be counted.

b. Payment: Payment will be made at the unit price for each type and size of fitting.

c. Includes: Unit price includes, but is not limited to, restrained joints and thrust blocks.

2. Fittings by Weight:

a. Measurement: Each type and size of fitting installed as specified in the contract documents or as required for proper installation of the water main will be counted. Determine the total weight of fittings counted, in pounds, based on the standard fitting weights published in AWWA C153 for ductile iron compact fittings.

b. Payment: Payment will be made at the unit price per pound for each type and size of fitting.

c. Includes: Unit price includes, but is not limited to, restrained joints and thrust blocks.

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Water Service Stubs by Each:

1. **Measurement:** Each type and size of water service stub from the water main to the stop box will be counted.

2. **Payment:** Payment will be made at the unit price for each type and size of water service stub.

3. **Includes:** Unit price includes, but is not limited to, water service corporation; service pipe; curb stop; stop box; trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; and installation of tracer wire system for non-metallic service pipe.

E. Water Service Stubs by Length:

1. **Water Service Pipe:**
   a. **Measurement:** Each type and size of water service pipe will be measured in linear feet along the centerline of the pipe.
   b. **Payment:** Payment will be made at the unit price per linear foot of each type and size of water service pipe.
   c. **Includes:** Unit price includes, but is not limited to, trench excavation; dewatering; furnishing and installing pipe; furnishing, placing, and compacting bedding and backfill material; and installation of tracer wire system for non-metallic service pipe.

2. **Water Service Corporation:**
   a. **Measurement:** Each type and size of water service corporation will be counted.
   b. **Payment:** Payment will be made at the unit price for each type and size of water service corporation.

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 gray 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 asphalt seal coat.

3. **External Coating:** Asphalt 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.
   - **e. Flanged:** According to AWWA C111.
   - **f. Grooved:** 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.

2.01 WATER MAIN (Continued)

C. Prestressed Concrete Cylinder Pipe: Design and manufactured according to AWWA C301 and AWWA C304.

1. Minimum Conditions:
- **a. Internal Pressure:** 150 psi.
- **b. Earth Loads:** Actual trench depth, but not less than 6 feet.
- **c. Live Loads:** HS 20 vehicle over trench.
- **d. Surge Pressure:** Allowance 60 psi.
- **e. Bedding:** Type R2, AWWA C304, Figure 9.
- **f. Safety Factor:** 2.5.

2. Joints:
- **a. Rings:** Steel joint rings with rubber gaskets according to AWWA C301.
- **b. External Joint Filler:** Cement mortar with diapers.
- **c. Outlets:** Flanged, according to ANSI B16.1, Class 125, with 1/8 inch minimum thickness rubber gaskets.

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 asphalt coating.

2.03 FITTINGS (Continued)

3. Wall Thickness: Comply with AWWA C153.

4. Gaskets: Comply with AWWA C111.

B. For Prestressed Concrete Cylinder Pipe: As required for prestressed concrete cylinder pipe.

C. 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.

D. 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

2.05 PIPELINE ACCESSORIES (Continued)

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%
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.

2.07 WATER SERVICE PIPE AND APPURTENANCES (CONTINUED)

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, 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 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 C600, except as modified herein.

3.04 ADDITIONAL REQUIREMENTS FOR PRESTRESSED CONCRETE CYLINDER PIPE INSTALLATION

A. Install according to AWWA M9.

B. Relieve gasket tension by inserting a small rod between the gasket and the gasket groove and running the tool around the pipe twice.

C. Check gasket position using a metal feeler gauge after the joint has been assembled.

D. Complete joint exterior grouting after pipe has been properly positioned using non-shrink grout.

3.05 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.

3.06 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.

3.06 TRACER SYSTEM INSTALLATION (Continued)

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.

3.07 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.

3.07 CONFLICTS (Continued)

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.

3.08 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.

3.09 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.

3.10 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.

3.11 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

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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; 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 2375.
   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. Do not install steps in manholes or intakes unless otherwise specified in the contract documents.

B. If specified, comply with the following:

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.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS FOR INSTALLATION OF MANHOLES AND INTAKES

A. Excavation: Excavate according to Section 3010.

B. Subgrade Preparation:

1. **Cut Sections (Undisturbed Soil):** Prepare subgrade to accurate elevation required to place subbase.

2. **Fill Sections:** Compact to 95% of maximum Standard Proctor Density and hand grade to accurate elevation required to place subbase, or install stabilization material as directed by the Engineer.

3. **Unstable Soil:** Install stabilization material as directed by the Engineer.

C. Subbase: Install 8 inch thick pad of Class I bedding material a minimum of 12 inches outside footprint of the structure.

D. Installation of Manhole or Intake Structure: When necessary, adjust wall height and depth of base to provide a minimum of 48 inches between form grade elevation and top of base. Form walls and construction joints for cast-in-place intakes or install precast intake boxes to ensure intake lids are set to match the longitudinal slope of the adjacent street unless otherwise specified in the contract documents.

1. **Cast-in-place:** Comply with Section 6010, 3.02.

2. **Precast:** Comply with Section 6010, 3.03.

E. Pipes: Install and bed pipes and connect to manhole or intake. Install pipe flush with inside wall of structure. Place bedding and pipe embedment material according to Section 3010.

1. **Cast-in-place Structures:**
   a. **Storm:** Form structure walls around pipe.
   b. **Sanitary:** Form or core circular opening and install flexible, watertight gasket according to Section 6010, 2.08. Keep void between pipe and manhole section free of debris and concrete.

2. **Precast Storm Sewer Manholes or Intakes:** If annular space between pipe and structure is less than 2 inches, fill with non-shrink grout. If annular space is 2 inches or greater, construct a concrete collar around the pipe according to Section 6010, 3.05.

3. **Precast Sanitary Sewer Manholes:** Connect to structure with flexible, watertight gasket according to Section 6010, 2.08. Keep void between pipe and manhole section free of debris and concrete.

4. **Sanitary Sewer Manholes on Existing Pipe:** Install waterstop according to Section 6010, 2.08.

F. Joint Sealant:

1. **Sanitary Sewer Manholes:**
   a. Install rubber O-ring or profile gasket (precast structures).
   b. Apply bituminous jointing material or butyl sealant wrap to exterior of all sanitary sewer manhole joints.

3.01 GENERAL REQUIREMENTS FOR INSTALLATION OF MANHOLES AND INTAKES (Continued)

2. Storm Sewer Manhole and Intakes:
a. Apply bituminous jointing material or install rubber rope gasket.
b. If indicated in the contract documents, apply engineering fabric wrap to joints.

G. Fillet:

1. Construct manhole or intake fillet up to one-half of pipe diameter to produce a smooth half-pipe shape between pipe inverts.

2. Slope fillet top toward pipe 1/2 inch per foot perpendicular to flow line.

3. For sanitary sewer, keep void between pipe and structure wall free of debris and concrete.

4. For precast fillets, remove any projections and repair any voids to provide a hydraulically smooth channel between ends of pipes.

H. Top Sections: Install manhole eccentric cone or flat top section or install intake top.

I. Adjustment Ring(s):

1. Bed each concrete ring with bituminous jointing material in trowelable or rope form.

2. Bed each polyethylene or expanded polypropylene ring with manufacturer's approved product and according to manufacturer's recommended installation procedure.

3. Construct manholes and intakes with the following adjustment ring stack heights:
a. Minimum: 4 inches for new manholes and intakes. No minimum for rehabilitation projects.
b. Maximum: 12 inches for new manholes and intakes; 16 inches for existing manholes and intakes.

4. For greater adjustment, modify lower riser section(s).

J. Casting:

1. Install the type of casting specified in the contract documents and adjust to proper grade.

2. Where a manhole or intake is to be in a paved area, adjust the casting to match the slope of the finished surface.

3. Three-piece Castings:
a. Attach the frame to the structure with four anchor bolts.
b. Set initial position of movable portion of the casting in the center of the adjustment range.
c. Remove height-adjustment bolts or mechanism after the paving is completed.

3.01 GENERAL REQUIREMENTS FOR INSTALLATION OF MANHOLES AND INTAKES (Continued)

K. Infiltration Barrier: Install on sanitary sewer manholes.

1. Internal or External Chimney Seal:

a. Do not use external chimney seal if seal will be permanently exposed to sunlight.
b. Extend seal 3 inches below the lowest adjustment ring.
c. Extend seal to 2 inches above the flange of the casting for a standard two-piece casting, or 2 inches above the top of the base section of the casting for an adjustable three-piece casting.
d. Use multiple seals, if necessary.
e. Install compression bands (external chimney seal) or expansion bands (internal chimney seal) to lock the rubber sleeve or extension into place and to provide a positive watertight seal. Once tightened, lock the bands into place. Use only manufacturer recommended installation tools and sealants.

2. Molded Shield:

a. Clean surface of structure cone section.
b. Apply sealant to the top surface of the cone section. Use sufficient sealant to accommodate flaws in the surface of the cone section.
c. Cut molded shield to height by adding the dimensions of the adjustment rings and casting height. Be sure not to interfere with seating of the lid into the casting frame.
d. Seat the molded shield against the sealant on the cone section.
e. Add adjustment rings and casting to meet final grade.

3. Heat Shrink Sleeve:

a. Ensure all surfaces are clean, dry, and free of foreign objects and sharp edges.
b. Warm the surface to drive off any moisture.
c. Cut sleeve to required length per manufacturer's requirements.
d. Apply primer to manhole and casting surface.
e. Place sleeve according to manufacturer's requirements.
f. Apply heat to the sleeve, smooth out wrinkles, and remove trapped air.
g. Cut the sleeve at the casting gussets. Reheat to place the sleeve onto the casting.
h. Trim off any excess material.

L. Backfill and Compaction:

1. Place suitable backfill material after concrete in structure has reached at least 3,000 psi compressive strength or 550 psi flexural strength. If concrete strength is not determined, place backfill at least 14 calendar days after initial concrete placement.

2. Place backfill material simultaneously on all sides of walls and structures so the fill is kept at approximately the same elevation at all times.

3. Compact the 3 feet closest to all walls using pneumatic or hand tampers only. Ensure proper and uniform compaction of backfill around structure.

3.02 ADDITIONAL REQUIREMENTS FOR CAST-IN-PLACE CONCRETE STRUCTURES

A. Forms:

1. Comply with Iowa DOT Article 2403.03, B.

2. Form all cast-in-place manholes and intakes on both the inside and the outside face above the base. Do not form against excavated earthen surface.

3.02 ADDITIONAL REQUIREMENTS FOR CAST-IN-PLACE CONCRETE STRUCTURES (Continued)

B. Reinforcing Steel:

1. Comply with Iowa DOT Section 2404.

2. Lap bars a minimum of 36 diameters, unless otherwise specified in the contract documents.

3. Provide a minimum of 3 inches of clearance for structure bases and 2 inches of clearance for walls and tops.

C. Concrete Mixing:

1. Comply with Iowa DOT Article 2403.02, D.

2. When using ready-mixed concrete, comply with ASTM C 94.

D. Concrete Placing:

1. Comply with Iowa DOT Article 2403.03, C.

2. Do not place concrete when the air temperature is less than 40°F without the approval of the Engineer. When placement of concrete below 40°F is allowed, comply with Iowa DOT Article 2403.03, F.

3. Place concrete continuously in each section until complete. Do not allow more than 30 minutes to elapse between depositing adjacent layers of concrete within each section.

4. Comply with Iowa DOT Article 2403.03, D for concrete vibration.

5. Form 1 1/2 inch by 3 inch keyed construction joints at locations shown in the contract documents.

6. Provide a broom finish on portions of structure that are to become part of exposed pavement.

E. Stripping and Cleaning:

1. Remove forms for manhole and intake walls and tops according to Iowa DOT Article 2403.03, M. References to culverts include all sanitary and storm structures. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used in determining concrete strength of structure tops.

2. Finish surfaces according to Iowa DOT Article 2403.03, P. Give exposed surfaces a Class 2 finish.

F. Curing:

1. Comply with Iowa DOT Article 2403.03, E.

2. For surfaces visible to the public, use only curing compounds complying with ASTM C 309, Type 1-D or Type 2.

3.02 ADDITIONAL REQUIREMENTS FOR CAST-IN-PLACE CONCRETE STRUCTURES (Continued)

G. Exterior Loading:

1. Restrict exterior loads on concrete according to Iowa DOT Article 2403.03, N.

2. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used.

H. Repairs: After visual inspection of the completed manhole or intake, repair honeycomb areas, visible leaks, tie holes, or other damaged areas. Remove concrete webs or protrusions.

I. Concrete Testing: The Engineer will conduct testing.

3.03 ADDITIONAL REQUIREMENTS FOR PRECAST CONCRETE STRUCTURES

A. Substitutions: If approved by the Engineer, precast structures may be substituted for designated cast-in-place structures. Comply with the requirements of Section 6010, 3.02 or Iowa DOT Materials I.M. 445.

B. Cast-in-place Base:

1. Comply with Section 6010, 3.02 for placement of concrete.

2. Ensure proper vertical and horizontal alignment of base riser section.

C. Precast Base or Base with Integral Riser Section: Place base or base with integral riser section and ensure proper vertical and horizontal alignment.

D. Additional Riser Sections: Install additional riser sections as required.

E. Lift Holes: Install rubber plug in lift holes. Cover plug and hole with non-shrink grout.

3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE

A. Casting Extension Rings:

1. Install casting extension rings only when specified in the contract documents, and only in conjunction with pavement overlays.

2. Install according to the manufacturer's recommendation and adjust for proper alignment.

B. Minor Adjustment (Adding or Removing Adjustment Rings):

1. Remove casting.

2. Modify adjustment ring stack height by one of the following methods:
   a. Add adjustment rings as necessary to adjust existing manhole or intake to finished pavement grade or finished topsoil grade, to a maximum ring stack height of 16 inches. Bed each concrete ring with bituminous jointing material. Bed each polyethylene ring with manufacturer's approved product.
   b. Remove one or more adjustment rings, as appropriate, to reduce casting elevation.

3. Install new casting on modified adjustment ring stack. Existing casting may be reinstalled when specified in the contract documents.

3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE (Continued)

4. Replace infiltration barrier for sanitary sewer manhole using only new materials.

C. Major Adjustment (Adding, Removing, or Modifying Riser or Cone Section): When adjustment is greater than can be accomplished through adding or removing adjustment rings, a major adjustment will be required.

1. Remove casting.

2. Remove top.

3. Remove and replace or modify existing riser section and/or top section according to the method approved by the Engineer.

4. Install new frame and cover or grate. Existing casting may be reinstalled when specified in the contract documents.

5. Replace infiltration barrier for sanitary sewer manhole using only new materials.

3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE

A. General:

1. Remove existing fillet as necessary to install pipe at required elevation and develop hydraulic channel.

2. Insert pipe into structure and trim end flush with inside wall of structure.

3. Place backfill material according to Section 3010.

B. Concrete Collar:

1. For new pipes 12 inches or smaller, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to a minimum thickness and width of 6 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.

2. For new pipes larger than 12 inches, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to minimum thickness and width of 9 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.

C. Sanitary Sewer:

1. General:
a. Core new openings in existing manholes unless otherwise specified in the contract documents.
b. Divert flow as necessary. Obtain approval of the diversion plan from the Engineer. Maintain sanitary sewer service at all times unless otherwise specified in the contract documents.

2. Cored Opening:
a. Insert flexible watertight connector into new opening.
b. Install and tighten internal expansion sleeve to hold flexible connector in place.
c. Insert pipe through flexible connector and tighten external compression ring.
d. Do not install grout or concrete collar for cored opening with flexible connector.

3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE (Continued)

3. Cut and Chipped Opening (Knock-out): Use only when specified or allowed.
a. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
b. Remove concrete and expand opening to a diameter at least 6 inches larger than the outside diameter of the new pipe.
c. Cut off all reinforcing steel protruding from the structure wall.
d. Install waterstop around new pipe centered within structure wall.
e. Fill opening between structure and pipe with non-shrink grout.
f. Construct concrete collar around pipe and exterior manhole opening.
g. Provide pipe joint, non-shear coupling, or other approved flexible coupling within 2 feet of structure wall to allow for differential settlement between the new sewer and the structure.

D. Storm Sewer:

1. Cut and Chipped Opening:
a. Use for pipe sizes 12 inches in diameter or larger.
b. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
c. Remove concrete and expand opening to a diameter at no more than 4 inches larger than the outside diameter of the new pipe.
d. Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.
e. Cut off all reinforcing steel protruding from the structure wall.

2. Cored Opening:
a. Core new openings in existing manholes or intakes for all pipes less than 12 inches in diameter.
b. Opening to be no greater than 2 inches larger than the outside diameter of the pipe.
c. Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.

3. Fill Opening: Fill opening between manhole or intake wall and outside of pipe with non-shrink grout or construct a concrete collar around the pipe according to Section 6010, 3.05, B.

3.06 DROP CONNECTION TO SANITARY SEWER MANHOLE

A. Internal:

1. Core opening in existing manhole wall and install flexible watertight connector.

2. Cut incoming pipe so a maximum of 2 inches extends into the manhole.

3. Allow 1 inch clearance between bottom of incoming pipe and top of the receiving bowl. Connect receiving bowl to manhole with stainless steel anchor bolts as recommended by the manufacturer.

4. Install flexible coupler connecting the receiving bowl and the drop pipe.

5. Mount drop pipe on the side of the manhole with stainless steel brackets spaced a maximum of 4 feet apart. Provide a minimum of two brackets per pipe segment.

6. Remove existing concrete fillet as required to accommodate bottom elbow.

3.06 DROP CONNECTION TO SANITARY SEWER MANHOLE (Continued)

7. Install elbow at bottom of drop pipe to match concrete fillet and create a smooth flow transition. Align elbow so discharge is directed at outlet pipe or at 45 degrees to manhole flow.

8. Repair fillet according to 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.

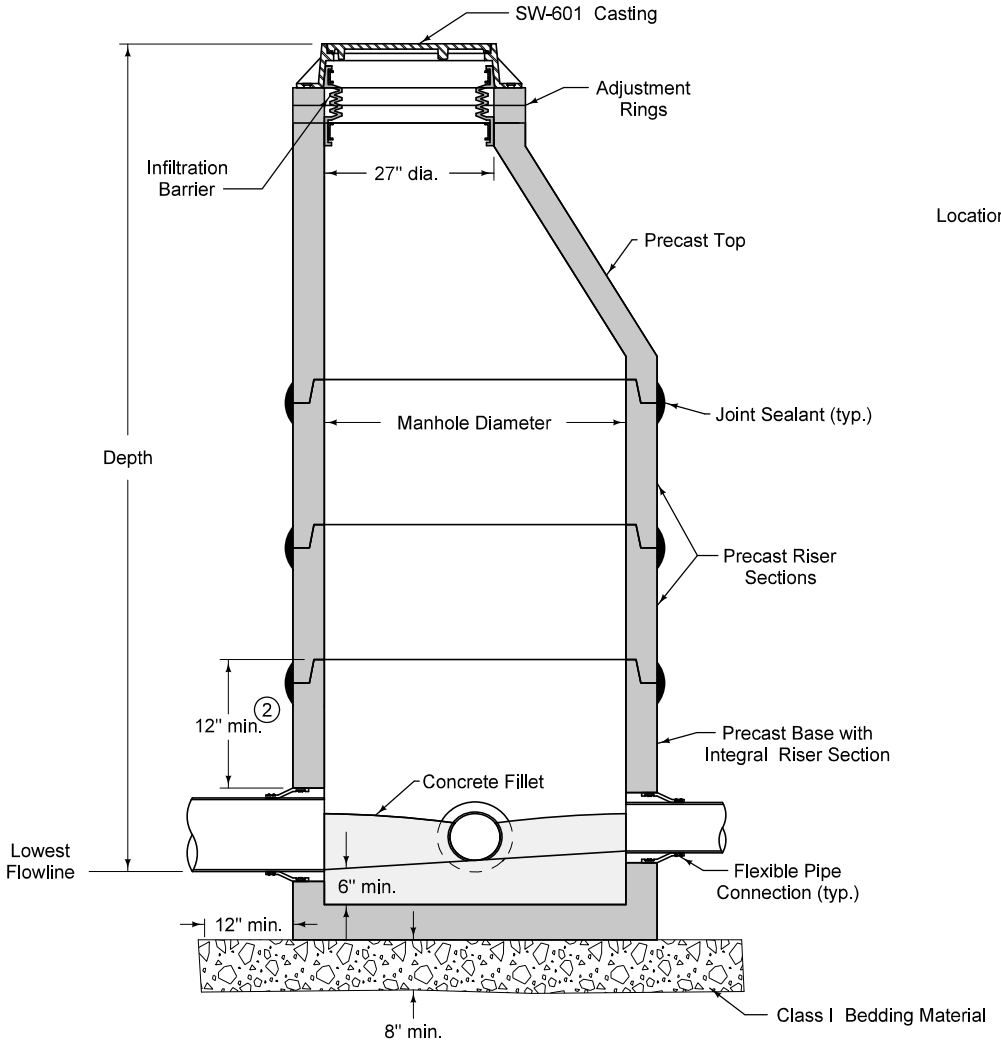
3.08 CLEANING, INSPECTION, AND TESTING

Clean, inspect, and test structures according to Section 6030.

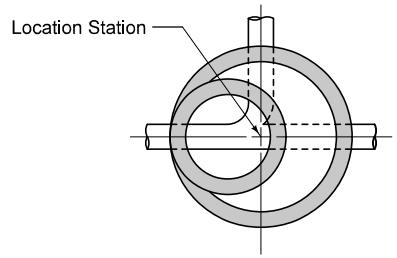
END OF SECTION

(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

	Maximum Pipe Diameter (1) (inches) for 2 Pipes	
	At 180° Separation	At 90° Separation
48	24	18
60	36	24
72	42	30
84	48	36
96	60	42

SUDAS | IOWA DOT | REVISION 3 04-21-20

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

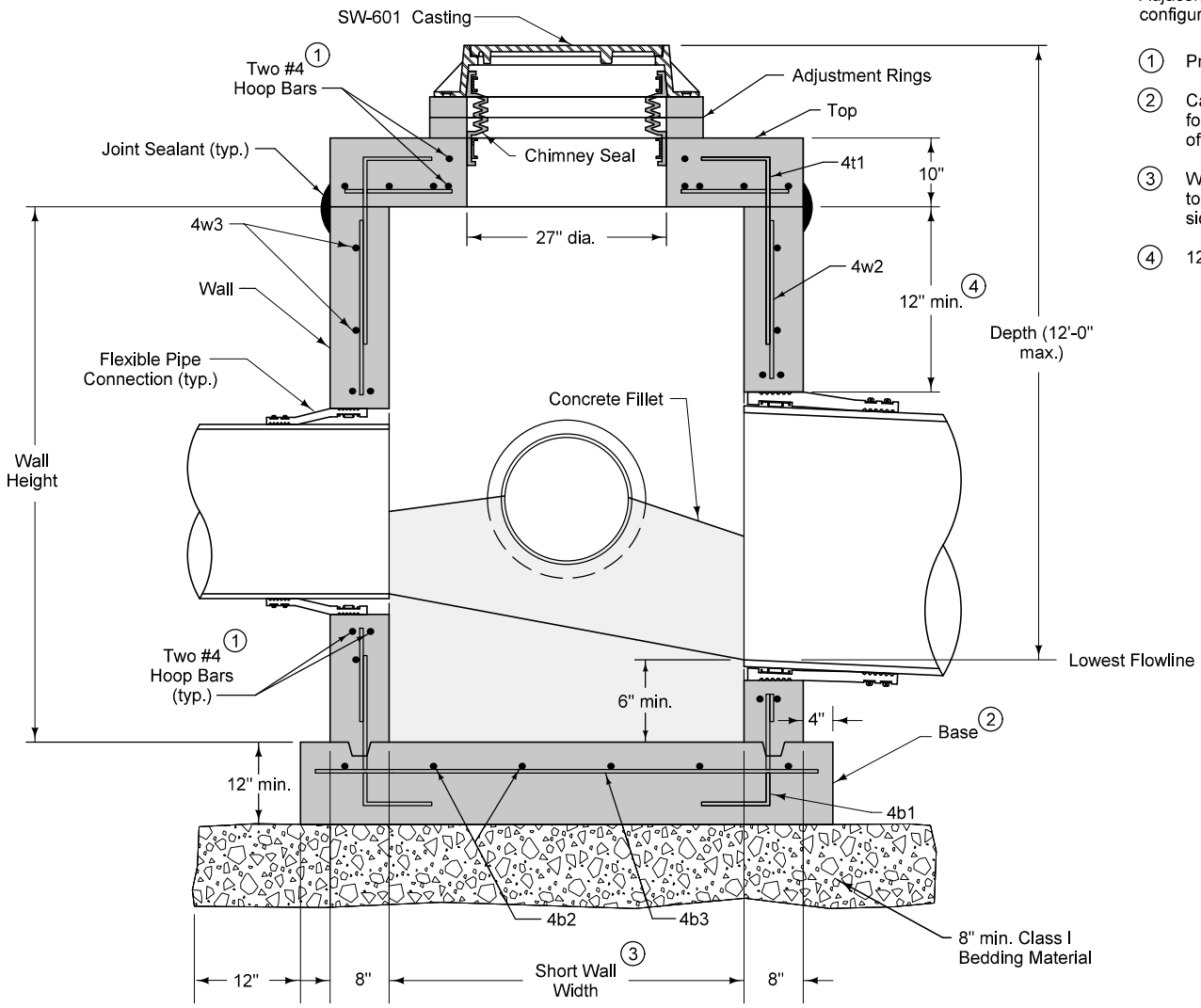
REVISIONS: Changed 1 to I on Bedding Material and removed steps.

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.

(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.

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

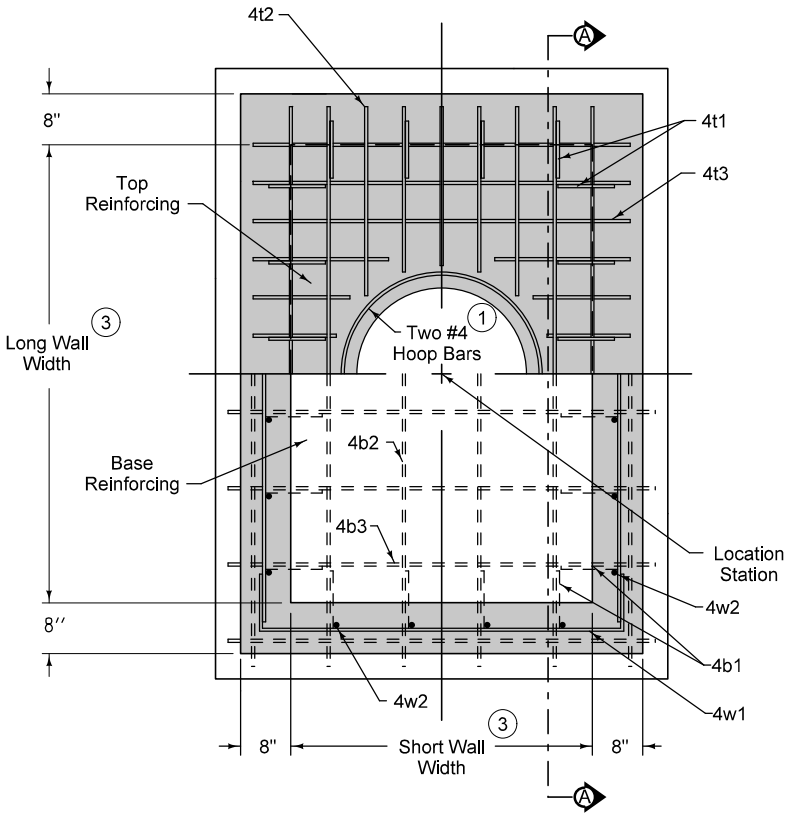
REVISIONS: Added Class I Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

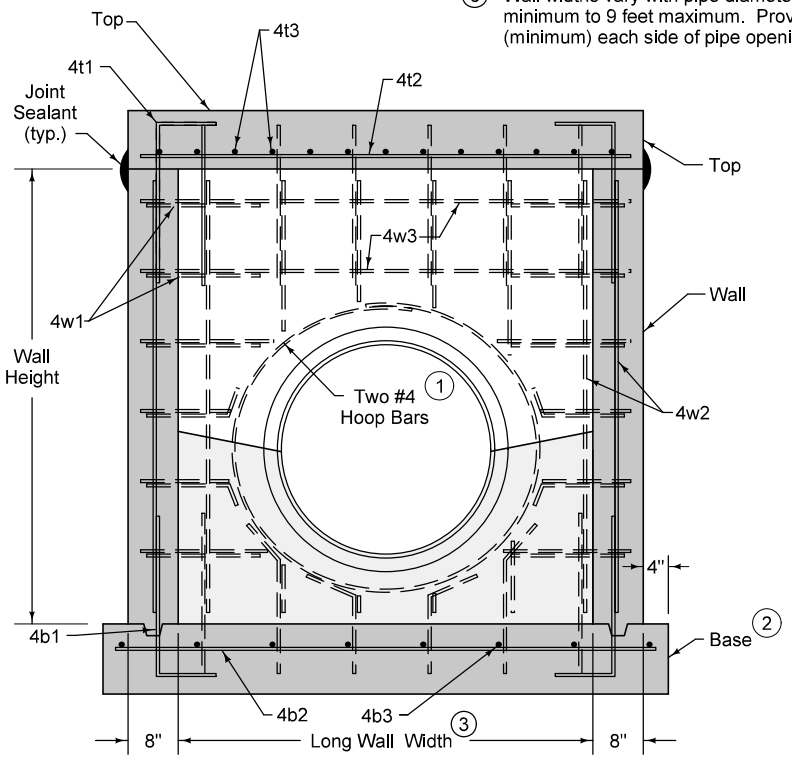
RECTANGULAR SANITARY SEWER MANHOLE

FIGURE 6010.302 | 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 the walls.
3. Wall widths vary with pipe diameter and range from 4 feet minimum to 9 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.



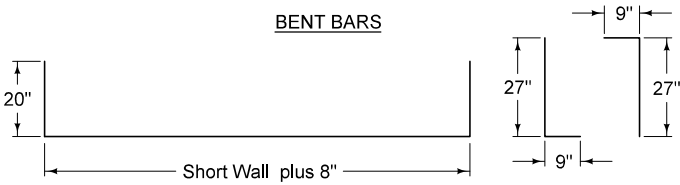
PLAN



SECTION A-A

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
4b1	4	Base	⌟	36"	12"
4b2	4	Base	—	Long Wall plus 18"	12"
4b3	4	Base	—	Short Wall plus 18"	12"
4t1	4	Top	⌜	36"	12"
4t2	4	Top	—	Long Wall plus 12"	6"
4t3	4	Top	—	Short Wall plus 12"	6"
4w1	4	Wall	⌐¬	Short Wall plus 48"	12"
4w2	4	Wall	—	Wall Height minus 4"	12"
4w3	4	Wall	—	Long Wall plus 12"	12"

BENT BARS



SUDAS | IOWADOT | REVISION 2 04-21-20

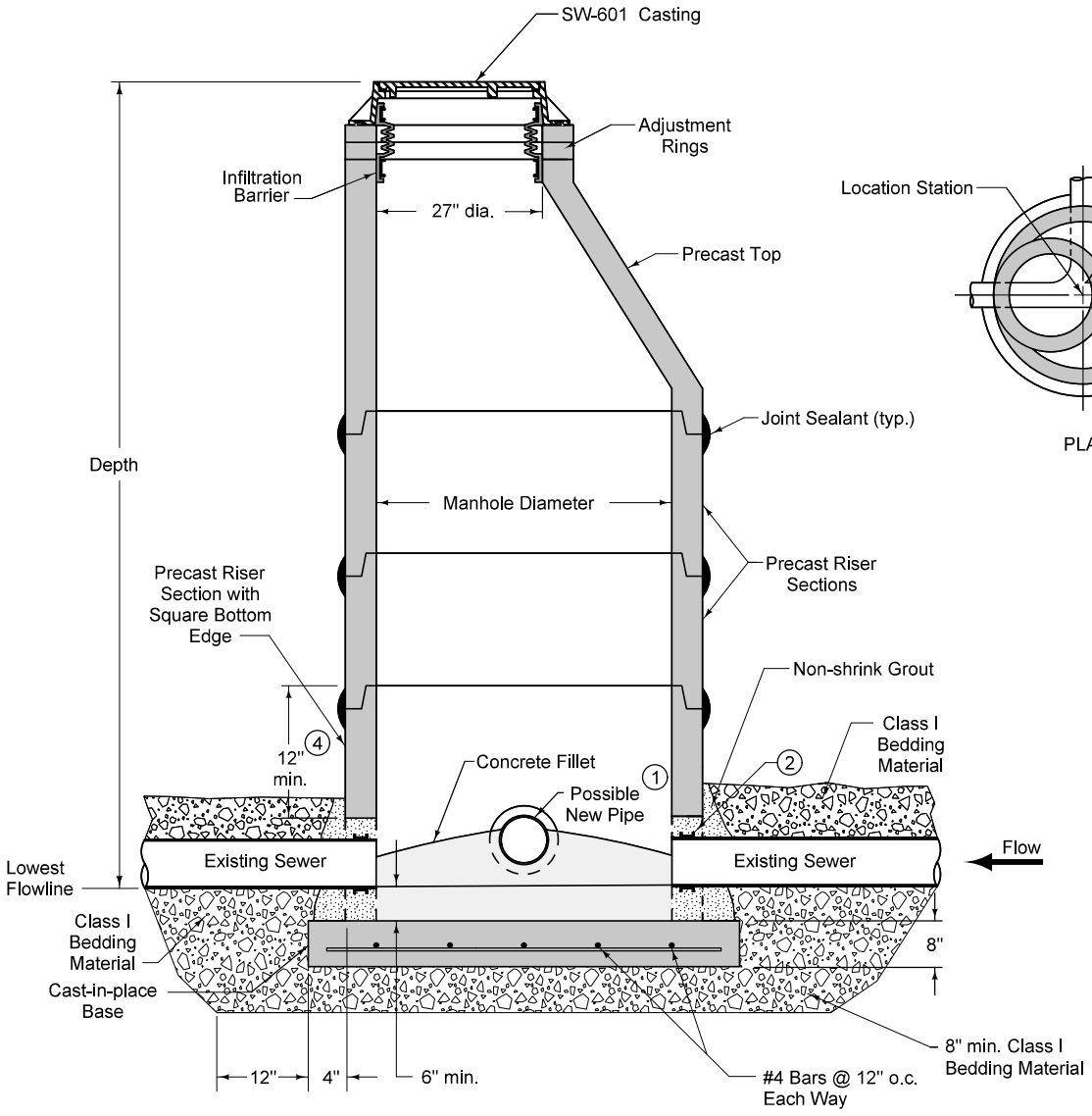
FIGURE 6010.302 | STANDARD ROAD PLAN | SW-302 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

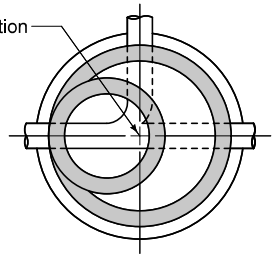
Paul D. Wigand, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

RECTANGULAR SANITARY SEWER MANHOLE

FIGURE 6010.302 SHEET 2 OF 2



TYPICAL SECTION



PLAN

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

SUDAS | IOWA DOT

REVISION: 3 | 04-21-20

FIGURE 6010.303 | STANDARD ROAD PLAN | SW-303

SHEET 1 of 1

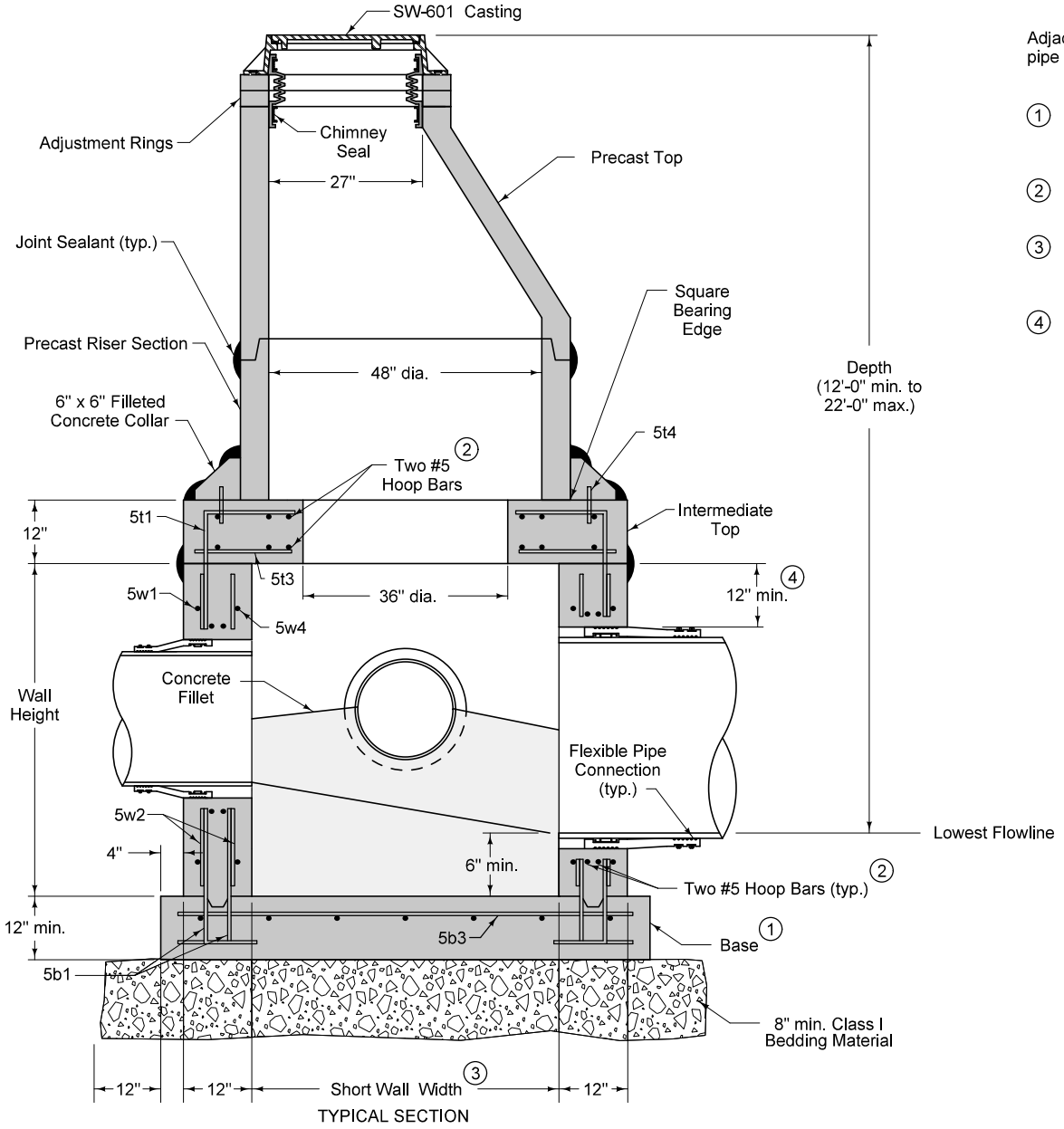
REVISIONS: Added Class I Bedding Material and removed steps.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

SANITARY SEWER MANHOLE OVER EXISTING SEWER

FIGURE 6010.303 SHEET 1 OF 1



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. 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

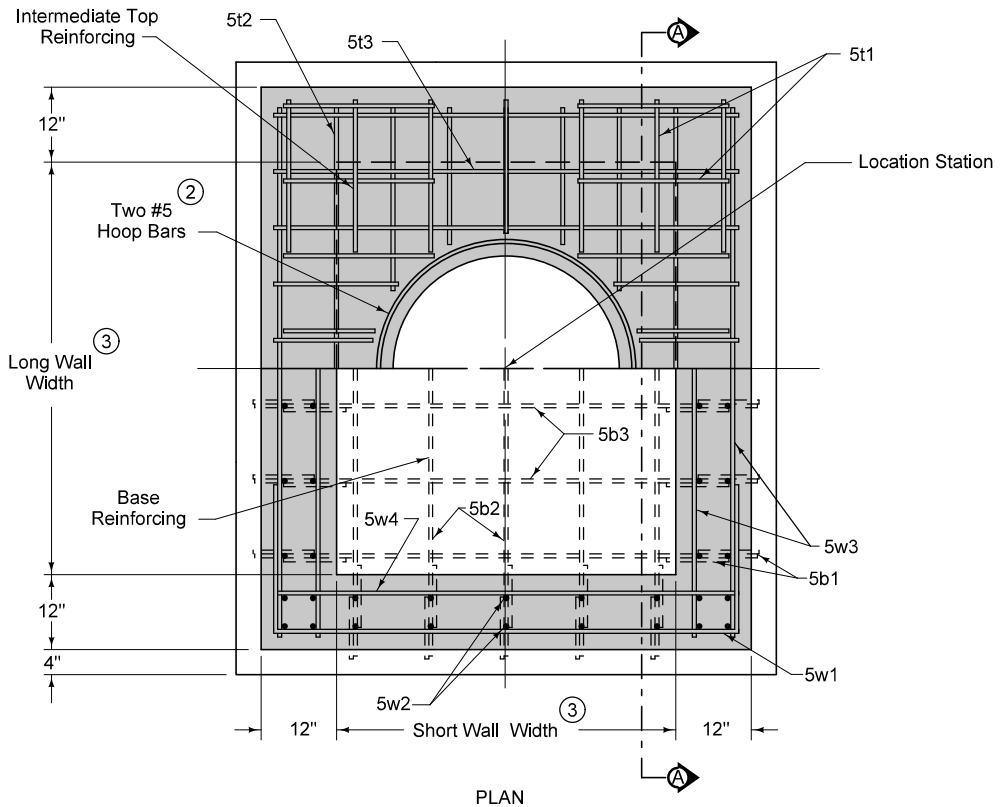
SUDAS	IOWADOT	REVISION 3 04-21-20
FIGURE 6010.304	STANDARD ROAD PLAN	SW-304 SHEET 1 of 2

REVISIONS: Added Class I Bedding Material and removed steps.

Paul D. Wigand — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

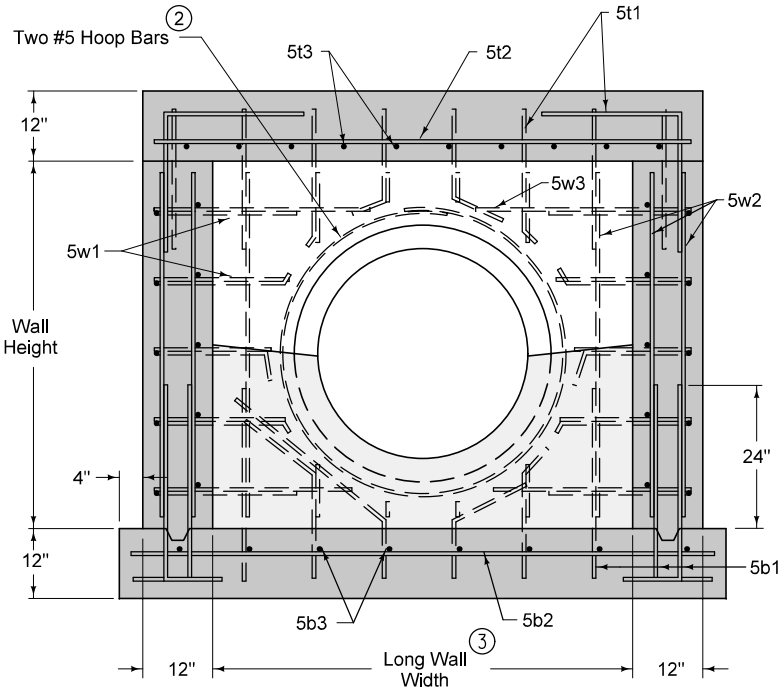
RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE



PLAN

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

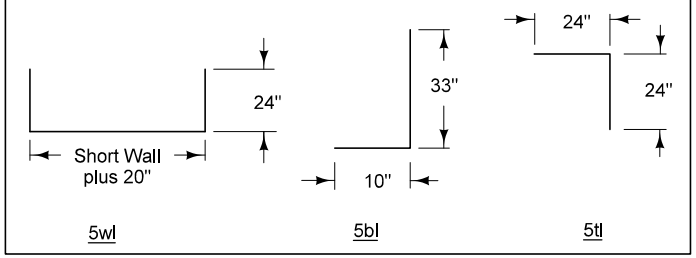
3 Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall opening (minimum) each side of pipe opening.



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 3 04-21-20

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

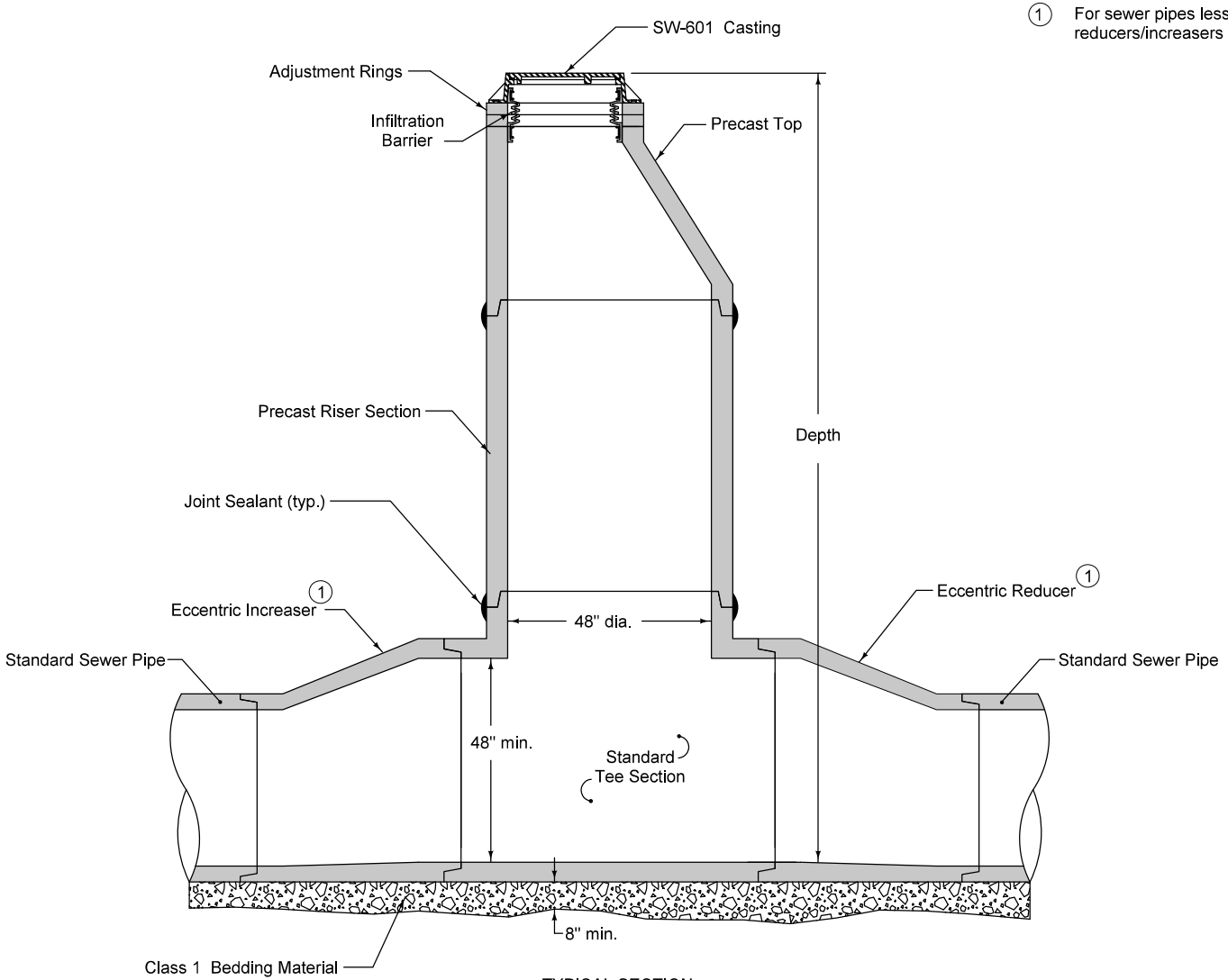
REVISIONS: Added Class I Bedding Material and removed steps.

Paul D. Wigand, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE

FIGURE 6010.304 SHEET 2 OF 2

① For sewer pipes less than 48 inches in diameter, install eccentric reducers/increasers with a standard tee or utilize a composite tee.



TYPICAL SECTION

STANDARD TEE ①

FIGURE 6010.305 SHEET 1 OF 2

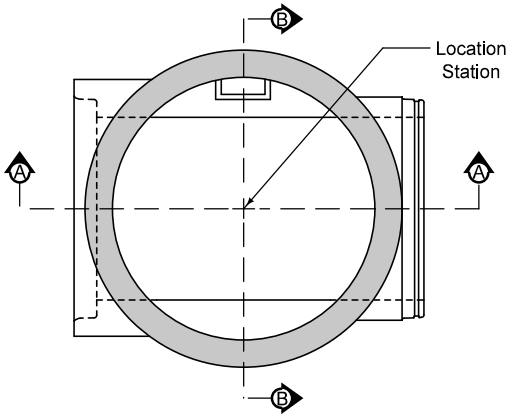
SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 6010.305	STANDARD ROAD PLAN	SW-305
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material and removed steps.

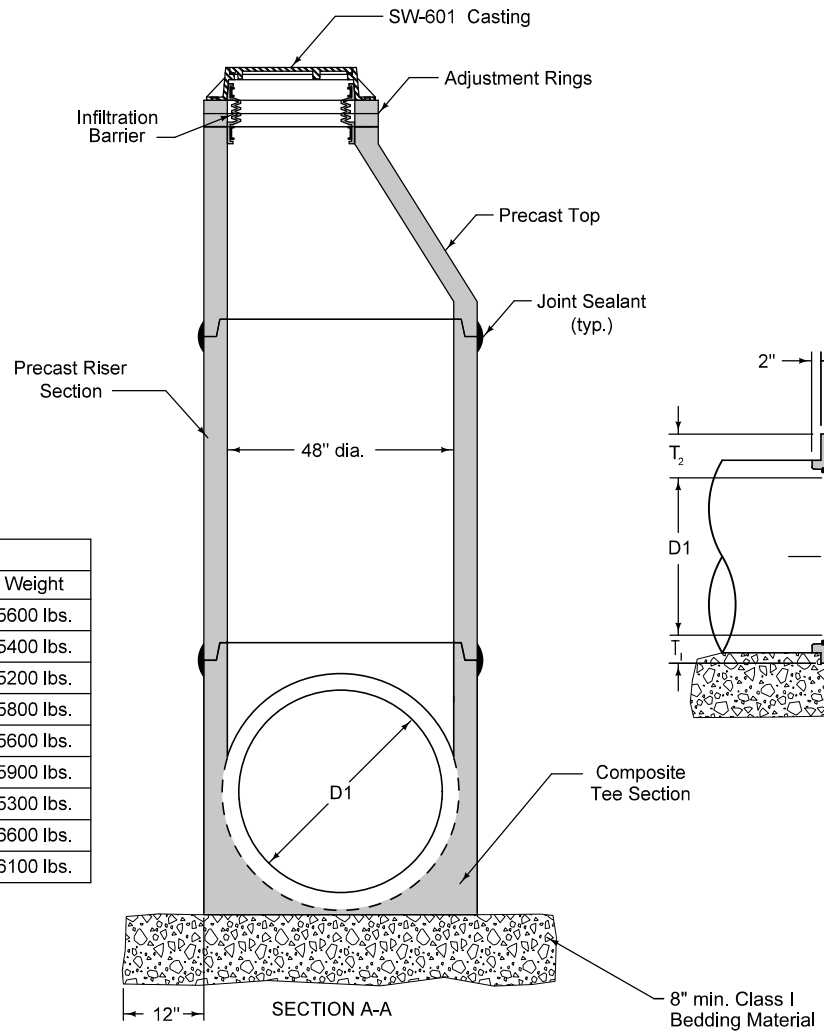
Paul D. Wigard — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

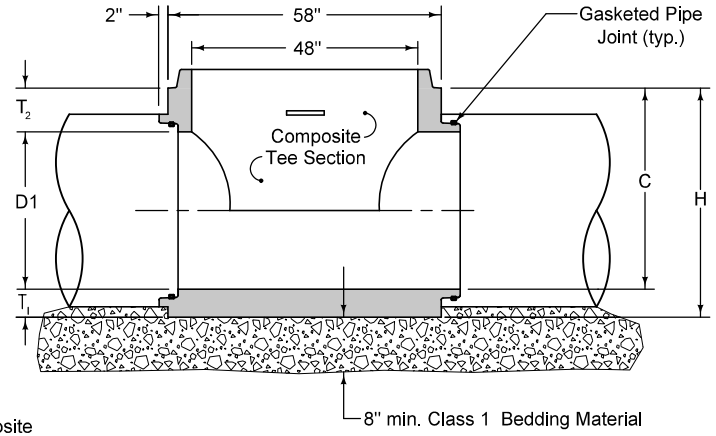
TEE-SECTION
SANITARY SEWER MANHOLE



PLAN



SECTION A-A



SECTION B-B

COMPOSITE TEE DIMENSIONS						
Size	D1	H	T_1	T_2	C	Weight
48" on 12"	12"	50"	$8\frac{1}{2}$"	$29\frac{1}{2}$"	$41\frac{1}{2}$"	5600 lbs.
48" on 15"	15"	50"	7"	28"	43"	5400 lbs.
48" on 18"	18"	50"	$5\frac{1}{2}$"	$26\frac{1}{2}$"	$44\frac{1}{2}$"	5200 lbs.
48" on 21"	21"	48"	$9\frac{1}{2}$"	$17\frac{1}{2}$"	$38\frac{1}{2}$"	5800 lbs.
48" on 24"	24"	48"	8"	16"	40"	5600 lbs.
48" on 27"	27"	48"	$9\frac{1}{2}$"	$11\frac{1}{2}$"	$38\frac{1}{2}$"	5900 lbs.
48" on 30"	30"	48"	8"	10"	40"	5300 lbs.
48" on 33"	33"	54"	$9\frac{1}{2}$"	$11\frac{1}{2}$"	$44\frac{1}{2}$"	6600 lbs.
48" on 36"	36"	54"	8"	10"	46"	6100 lbs.

COMPOSITE TEE

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

FIGURE 6010.305 SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 2 4-21-20

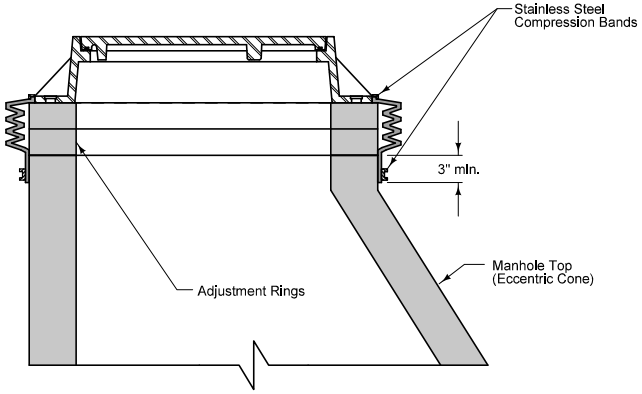
FIGURE 6010.305 | STANDARD ROAD PLAN | SW-305 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material and removed steps.

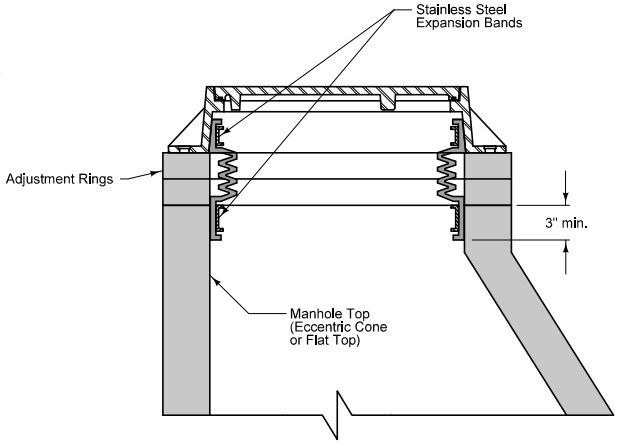
Paul D. Wigant, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

TEE-SECTION
SANITARY SEWER MANHOLE

CHIMNEY SEALS FOR 2-PIECE CASTINGS

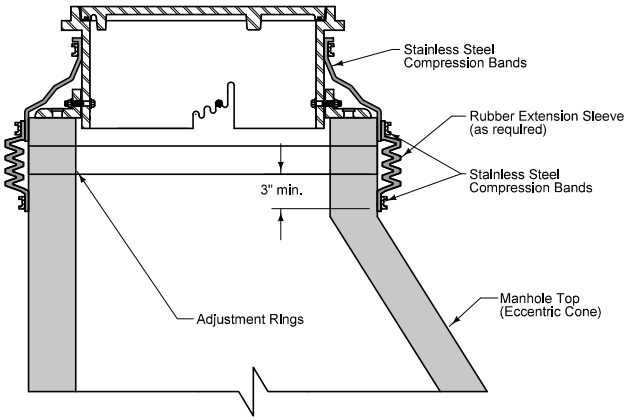


EXTERNAL SEAL

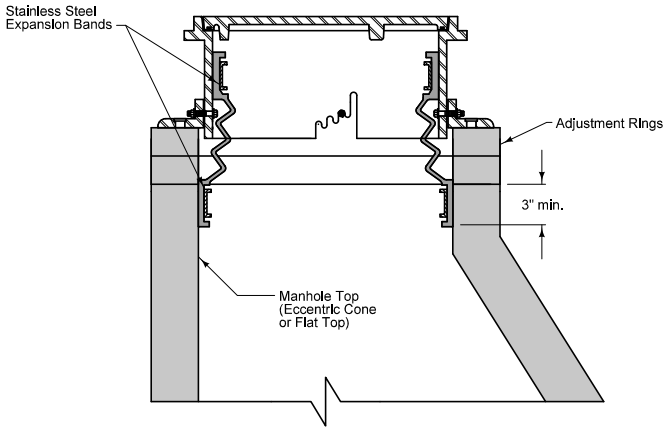


INTERNAL SEAL

CHIMNEY SEALS FOR 3-PIECE CASTINGS



EXTERNAL SEAL



INTERNAL SEAL

FIGURE 6010.306 SHEET 1 OF 1

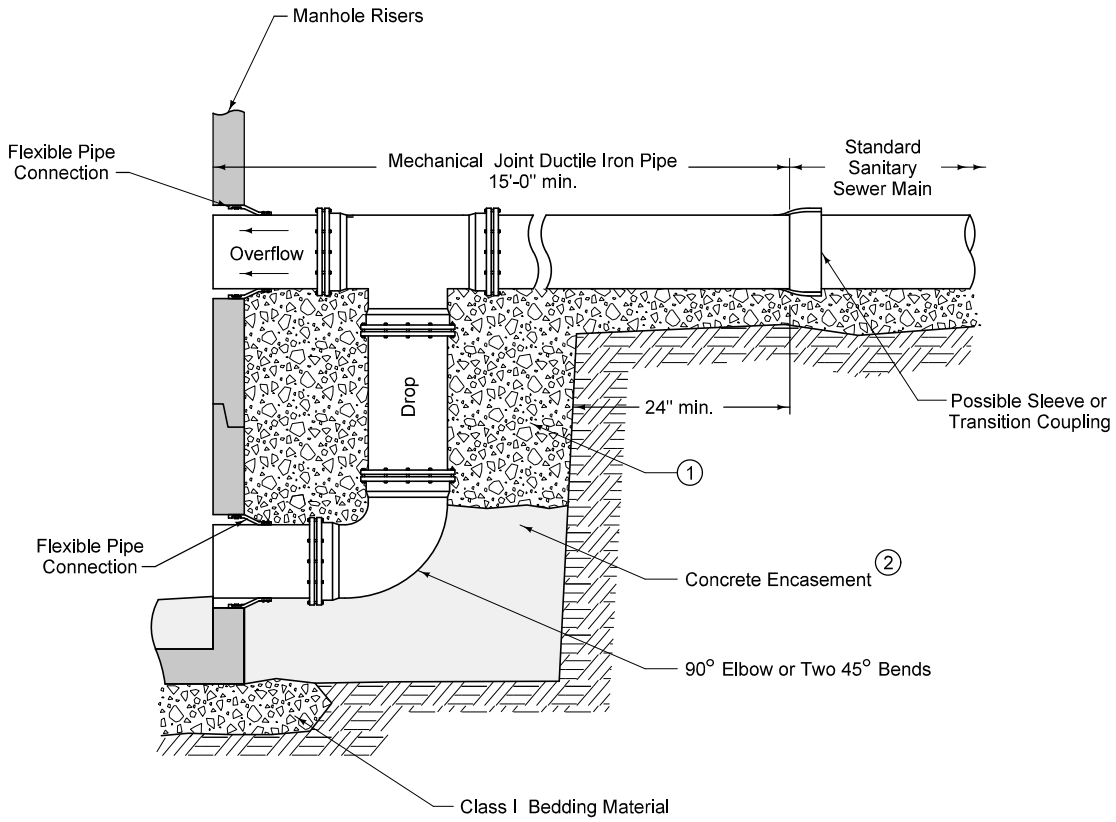
SUDAS	IOWA DOT	REVISION 1 04-21-15
FIGURE 6010.306	STANDARD ROAD PLAN	SW-306
		SHEET 1 of 1

REVISIONS: Revised 3-piece casting configuration.

Paul D. Wigand
SUDAS DIRECTOR

Brian Smith
DESIGN METHODS ENGINEER

CHIMNEY SEALS FOR SANITARY SEWER MANHOLES



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

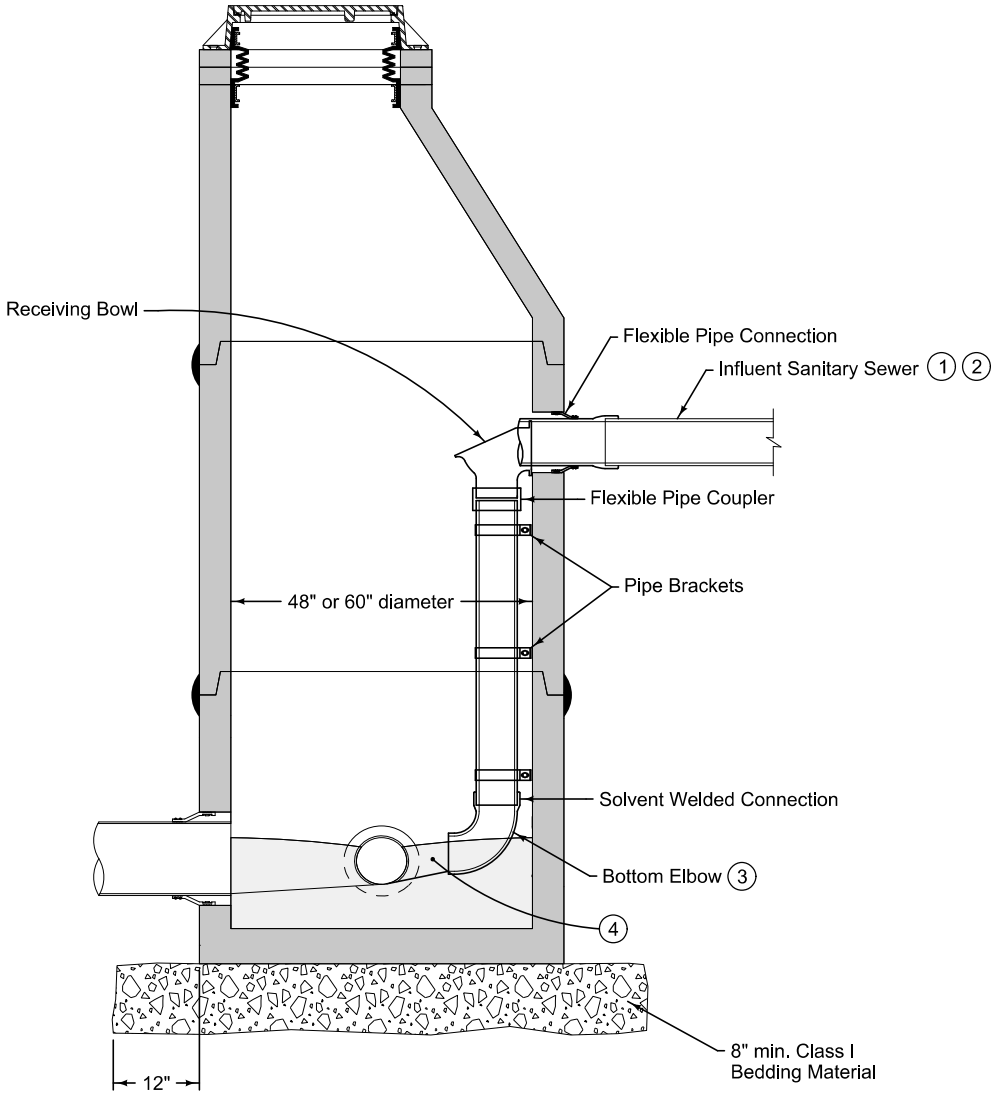
SUDAS | IOWADOT | REVISION 2 04-21-20

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

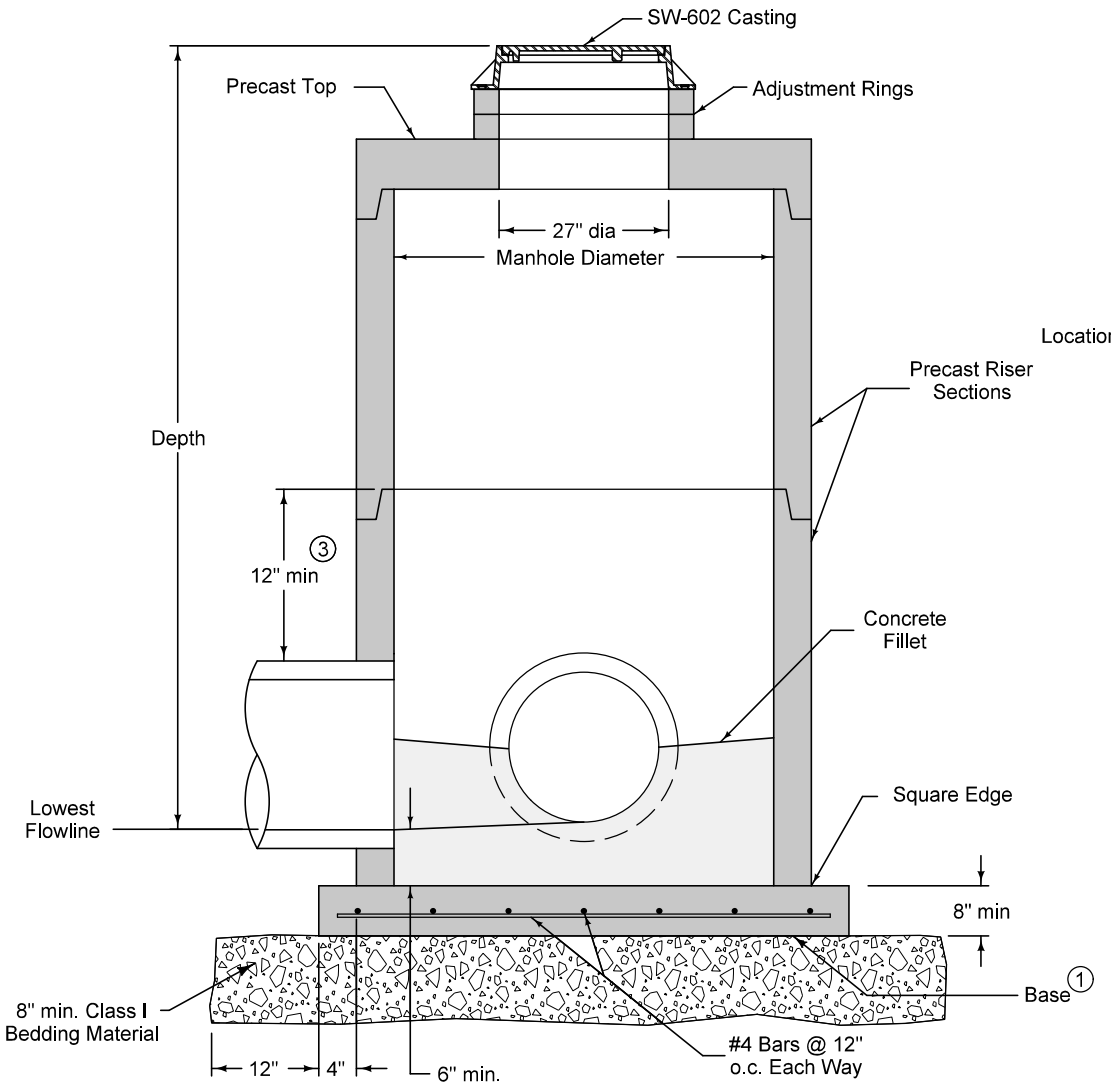
REVISION	
New	04-21-20

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

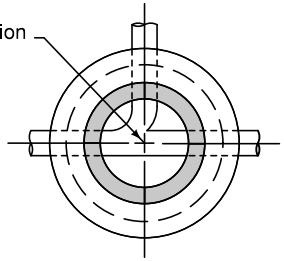
REVISIONS: New.

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

INTERNAL DROP CONNECTION FOR SANITARY SEWER MANHOLE



TYPICAL SECTION



PLAN

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 Diameter ② (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 1 OF 1

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

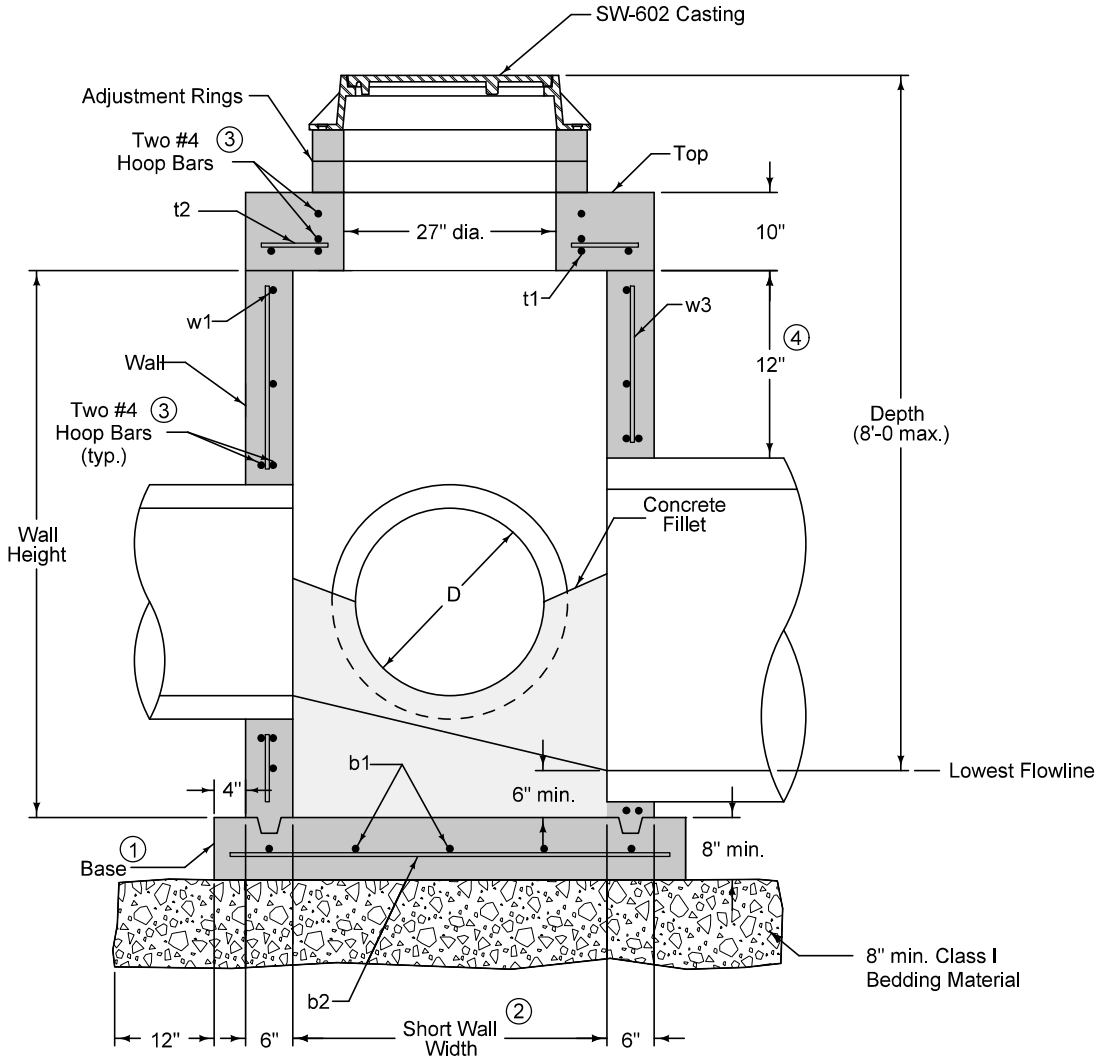
FIGURE 6010.401 | STANDARD ROAD PLAN | SW-401 | SHEET 1 of 1

REVISIONS: Added Class I Bedding Material and removed steps.

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.

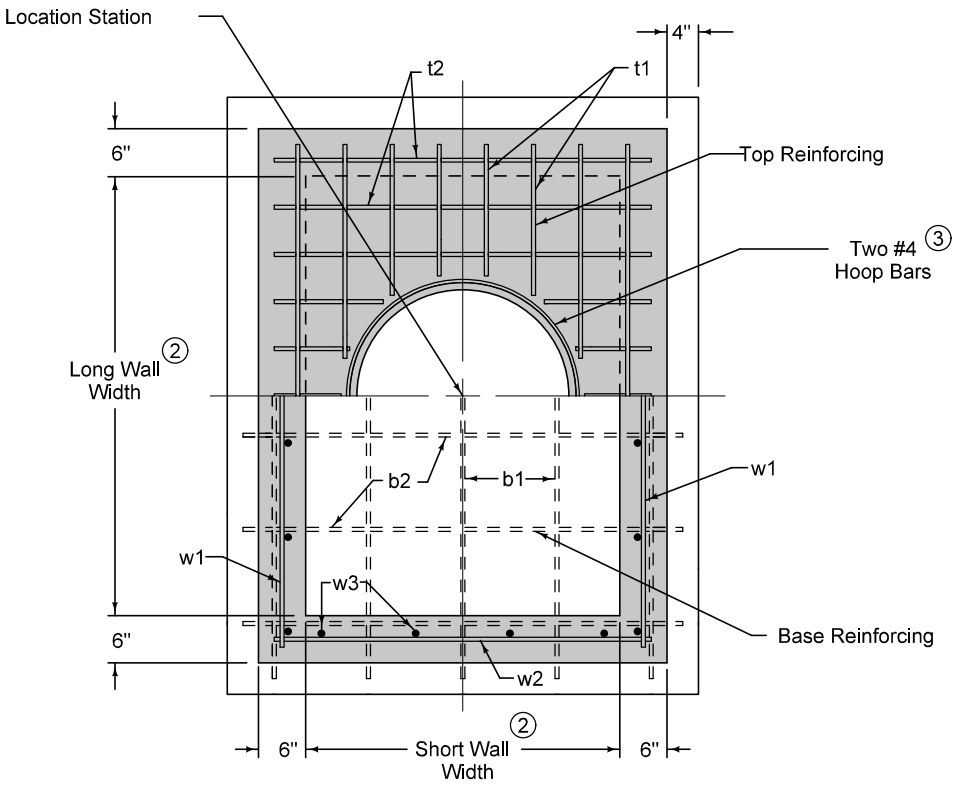
FIGURE 6010.402 | SHEET 1 OF 2

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

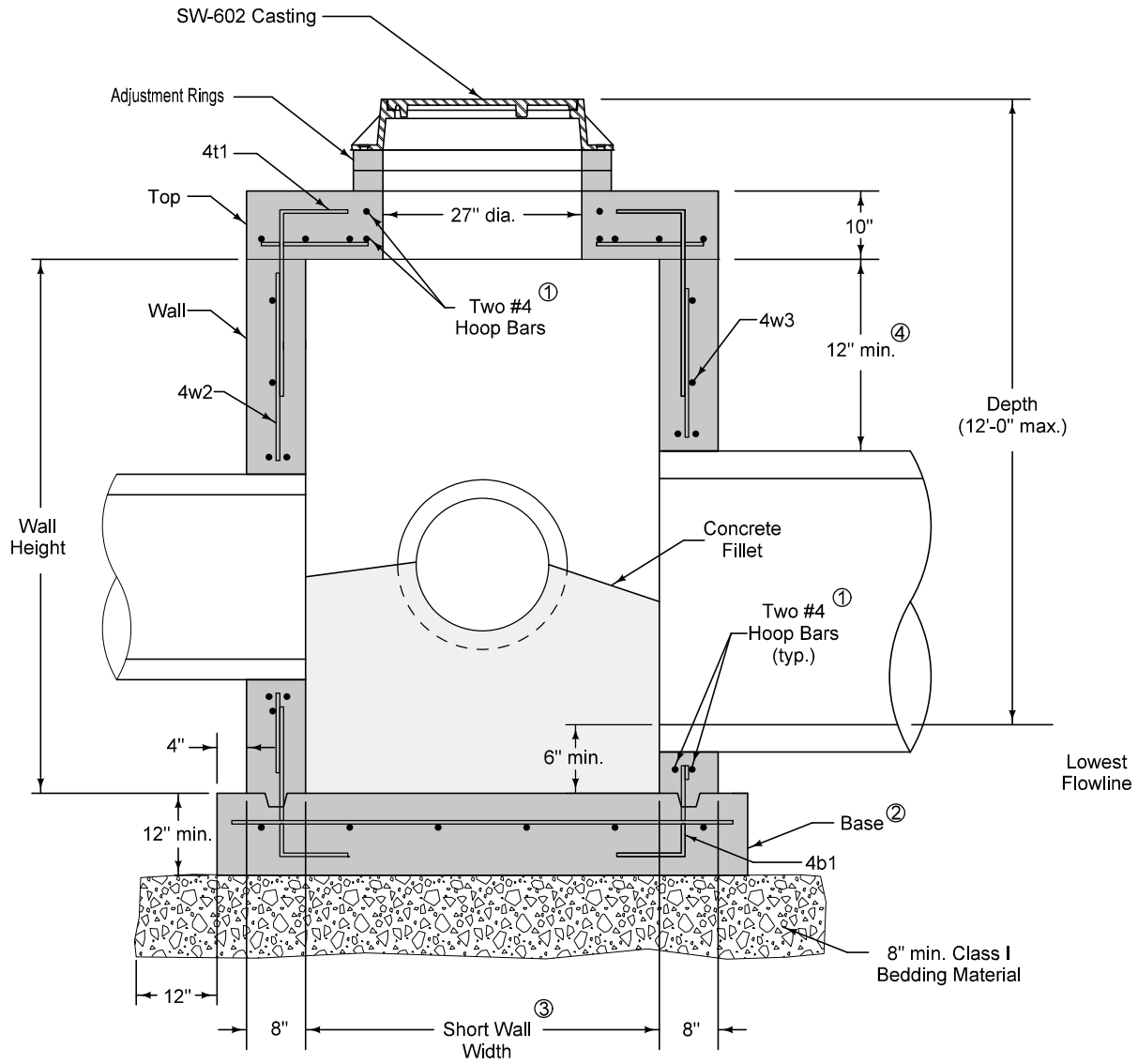
FIGURE 6010.402 | STANDARD ROAD PLAN | SW-402 | SHEET 2 of 2

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

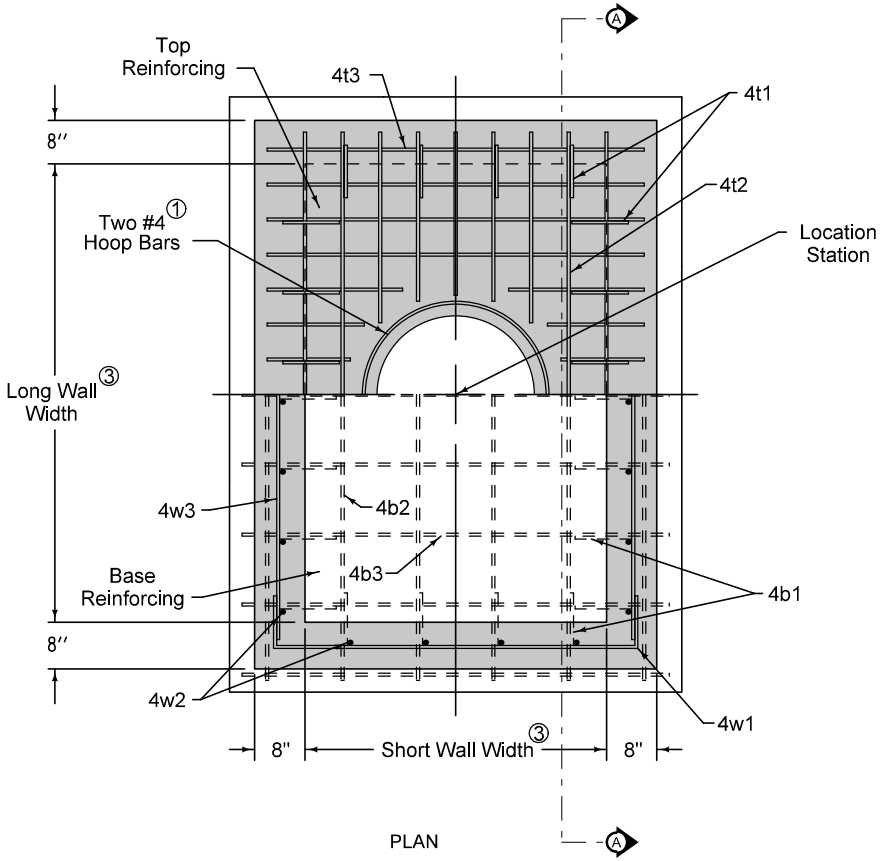
DEEP WELL RECTANGULAR STORM SEWER MANHOLE

FIGURE 6010.403 SHEET 1 OF 2

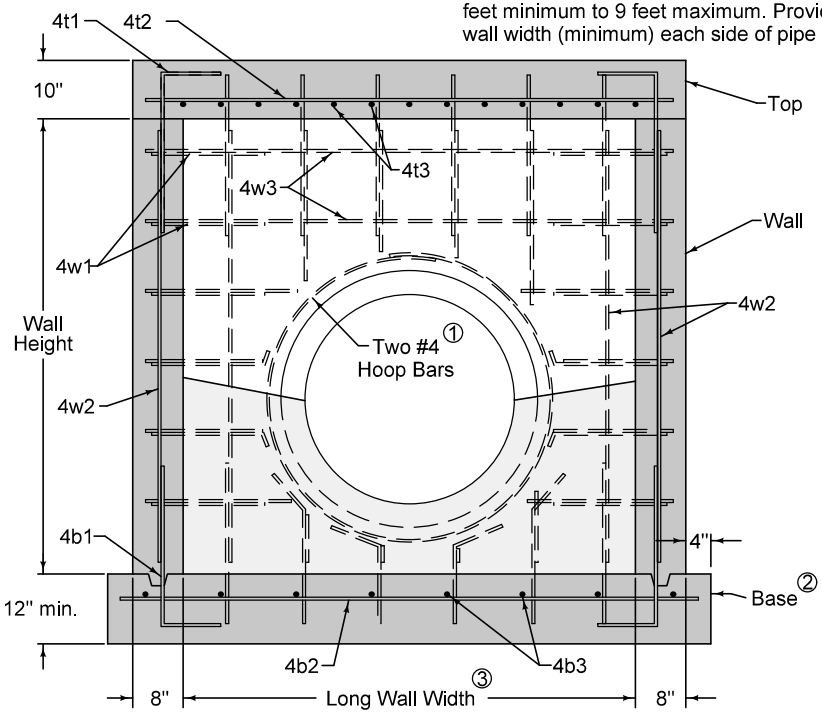
① Provide two #4 hoop bars at top opening and at all pipe openings.

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.



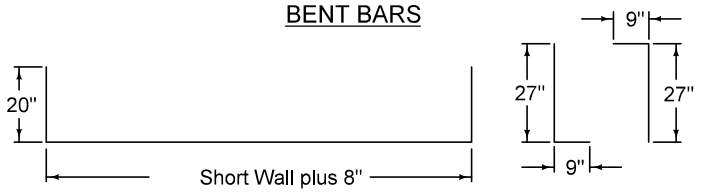
PLAN



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

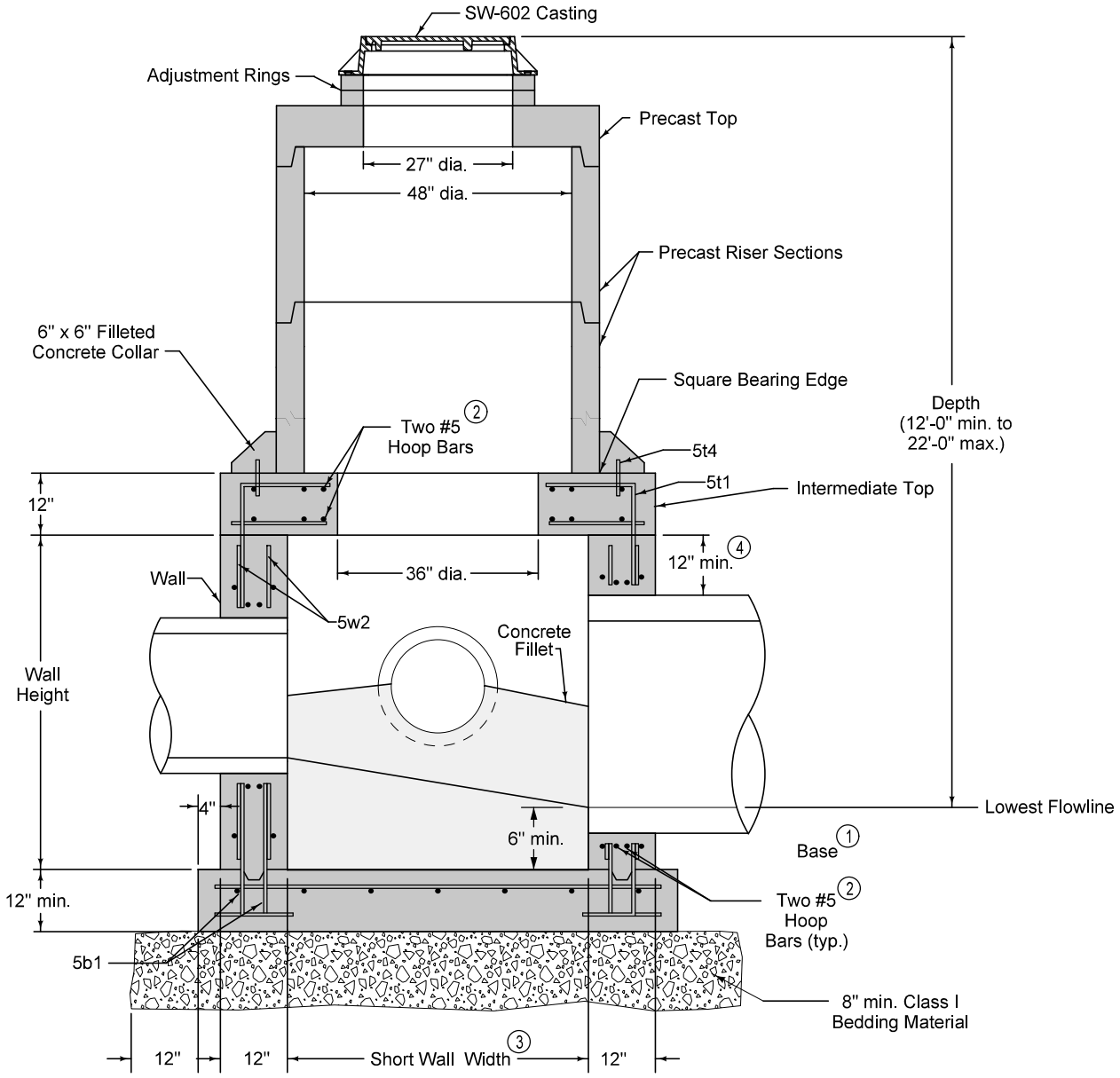
FIGURE 6010.403 | STANDARD ROAD PLAN | SW-403 | SHEET 2 of 2

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



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 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	IOWA DOT	REVISION 3	04-21-20
FIGURE 6010.404	STANDARD ROAD PLAN	SW-404	SHEET 1 of 2

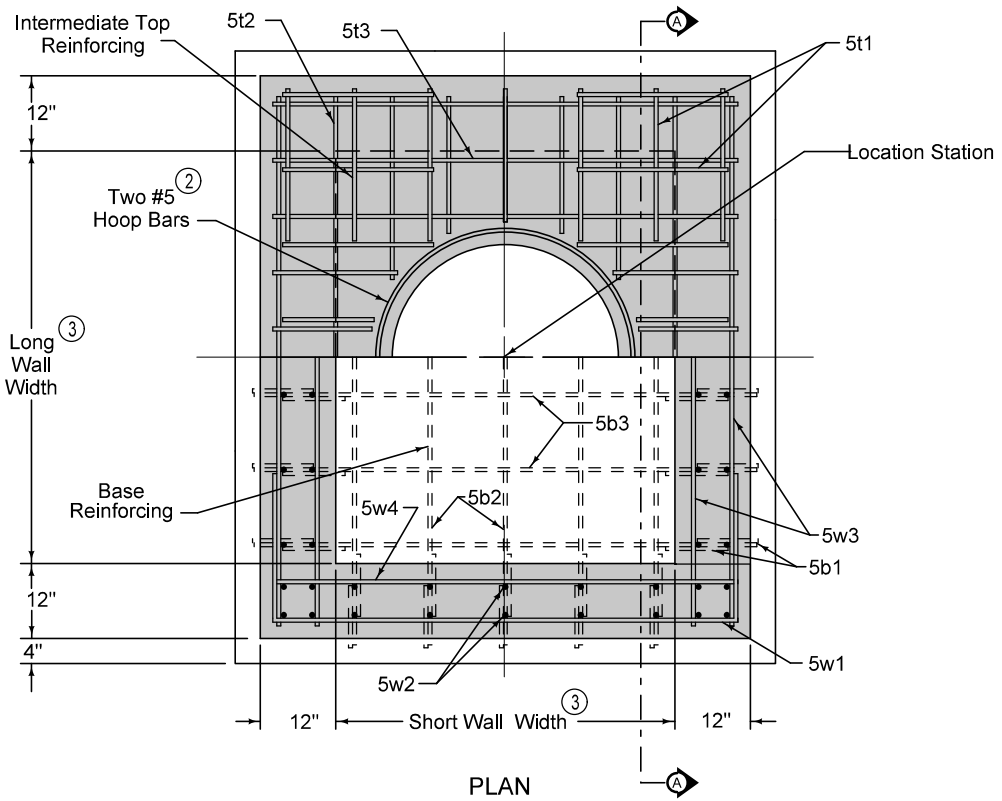
REVISIONS: Added Class I Bedding Material and removed steps.

Paul D. Wigand — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE

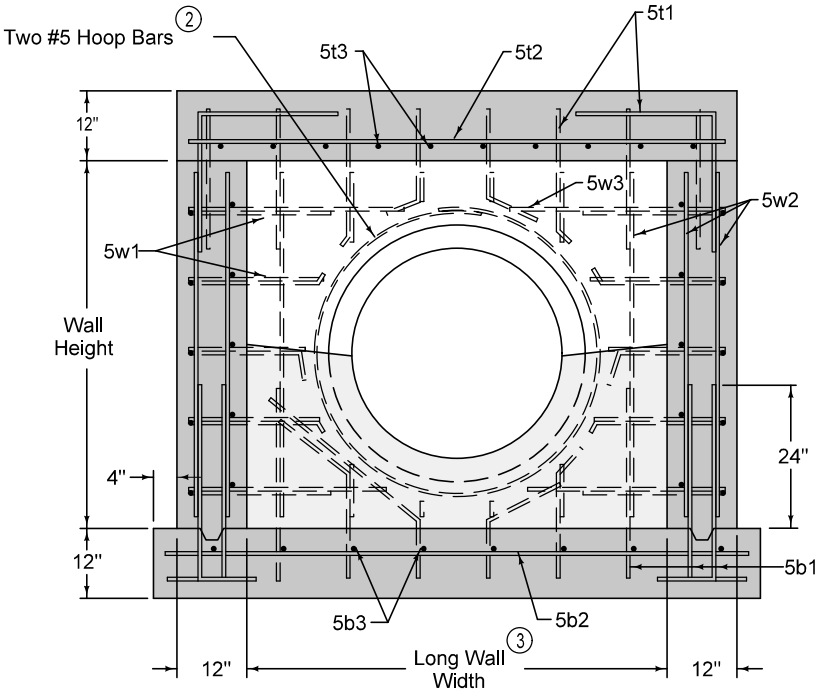
FIGURE 6010.404 SHEET 1 OF 2



PLAN

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

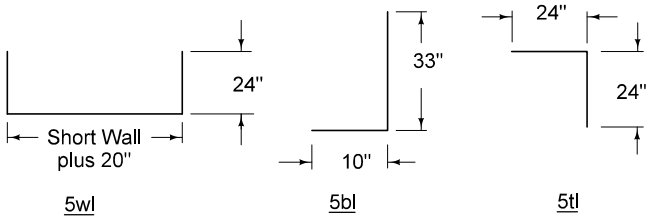
③ Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.



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



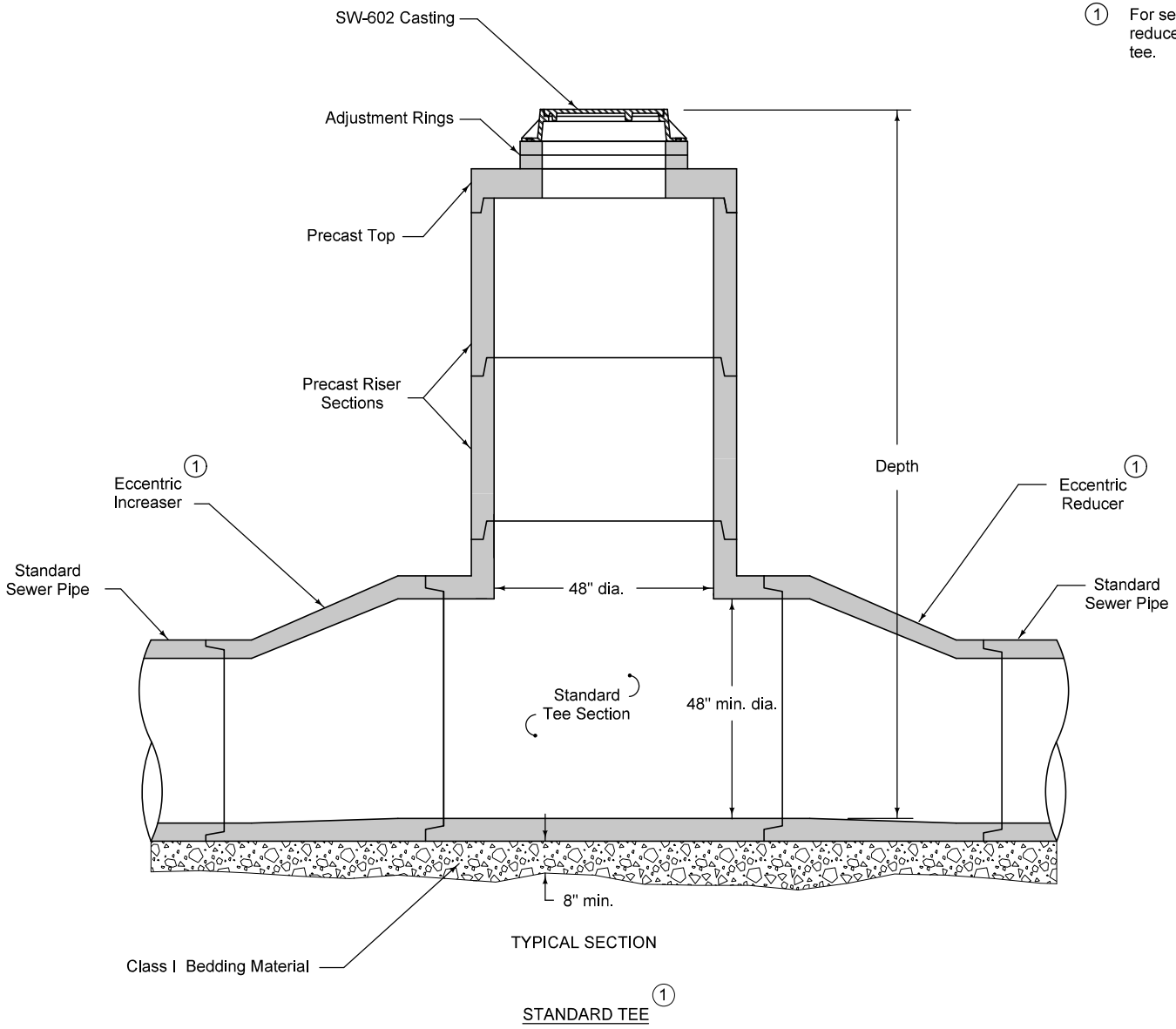
SUDAS | IOWADOT | REVISION 3 04-21-20

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

REVISIONS: Added Class I Bedding Material and removed steps.

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

RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE



TYPICAL SECTION

STANDARD TEE (1)

(1) For sewer pipes less than 48 inch diameter, install eccentric reducers/increasers with a standard tee or utilize a composite tee.

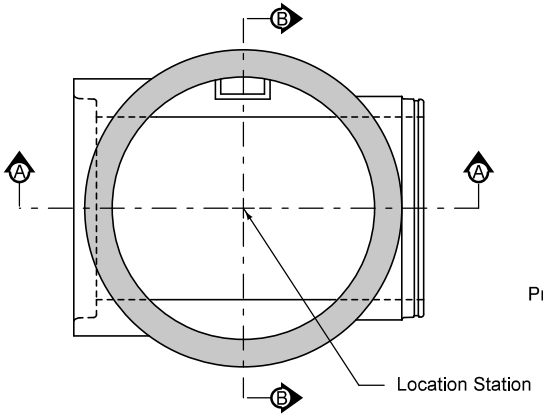
FIGURE 6010.405 SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 3 04-21-20
FIGURE 6010.405	STANDARD ROAD PLAN	SW-405
		SHEET 1 of 2

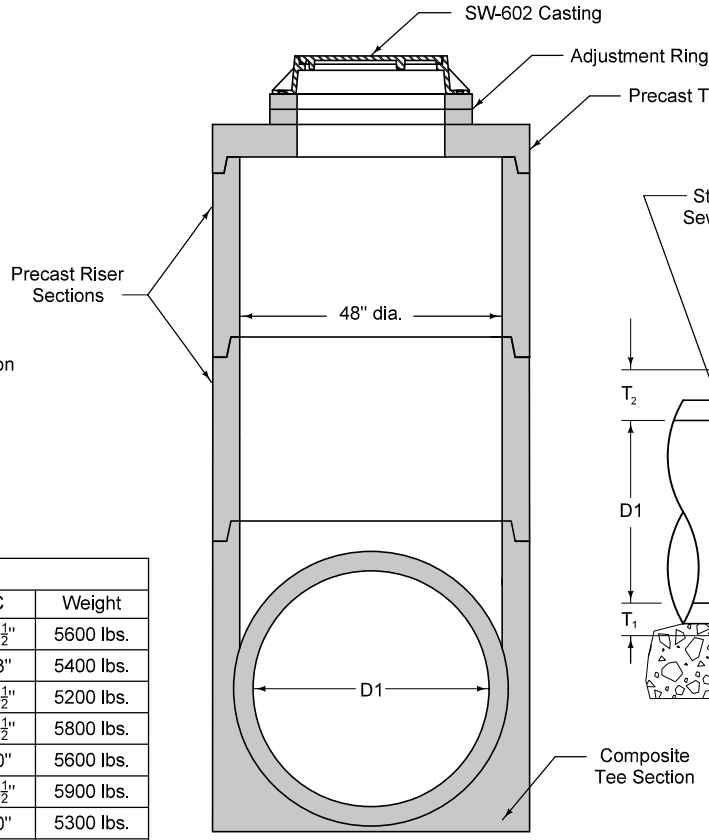
REVISIONS: Changed 1 to I on Bedding Material and removed steps.

Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

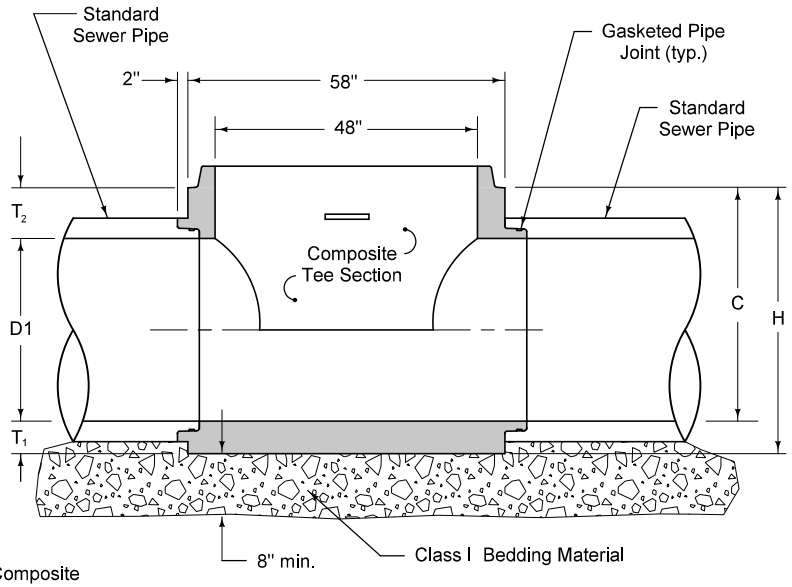
TEE-SECTION
STORM SEWER MANHOLE



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 3 04-21-20

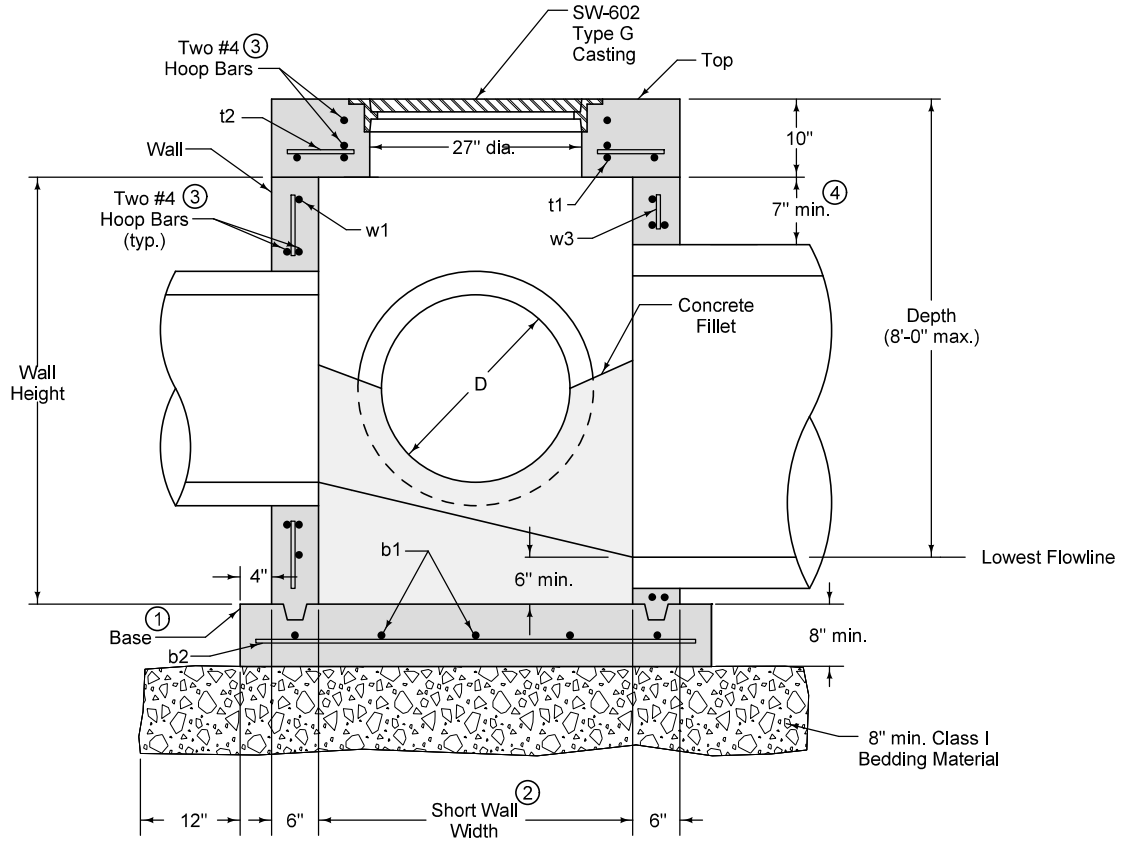
FIGURE 6010.405 | STANDARD ROAD PLAN | SW-405 | SHEET 2 of 2

REVISIONS: Changed 1 to I on Bedding Material and removed steps.

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

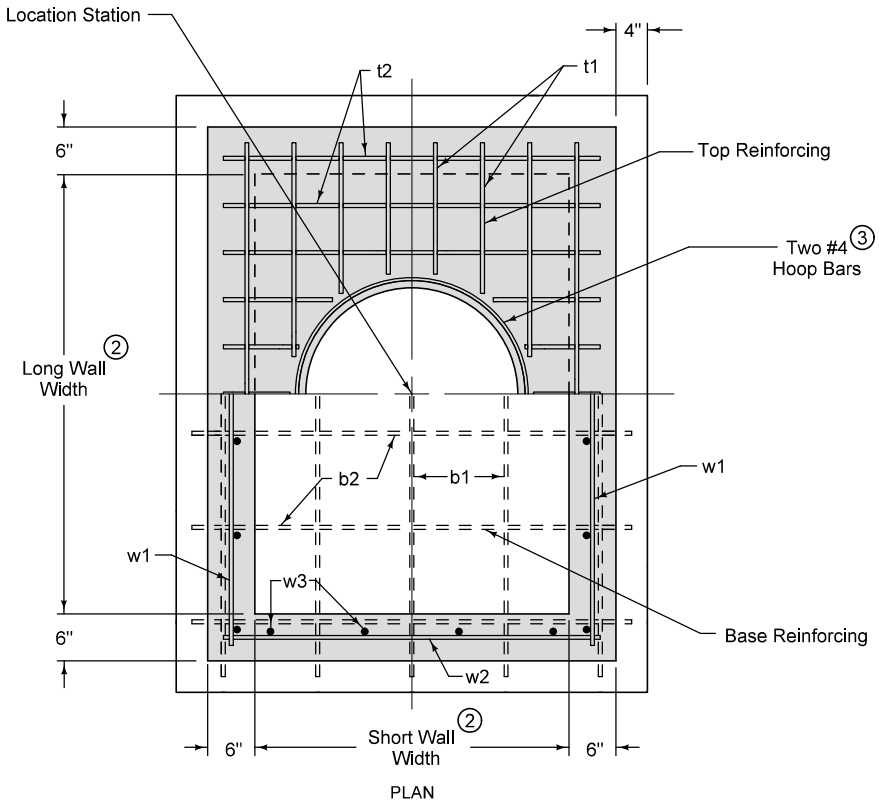
SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 6010.406	STANDARD ROAD PLAN	SW-406
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

SHALLOW RECTANGULAR STORM SEWER MANHOLE



PLAN

② Wall widths vary with pipe diameter and range from 40 inches minimum to 77 inches maximum. Provide 6 inches of wall width (minimum) each side of pipe opening.

③ Provide two #4 hoop bars at top opening and at all pipe openings.

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
t1	See Table	Top	——	Long Wall plus 8"	6"
t2	See Table	Top	——	Short Wall plus 8"	6"
b1	See Table	Base	——	Long Wall plus 14"	12"
b2	See Table	Base	——	Short Wall plus 14"	12"
w1	See Table	Walls	——	Long Wall plus 8"	12"*
w2	See Table	Walls	——	Short Wall plus 8"	12"
w3	See Table	Walls	——	Wall Height minus 4"	12"

*Place a minimum of one w1 bar above each pipe opening

Diameter of Largest Pipe, D	Minimum Bar Size
48" or 54"	6
33" to 42"	5
30" or smaller	4

FIGURE 6010.406 SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 2 04-21-20

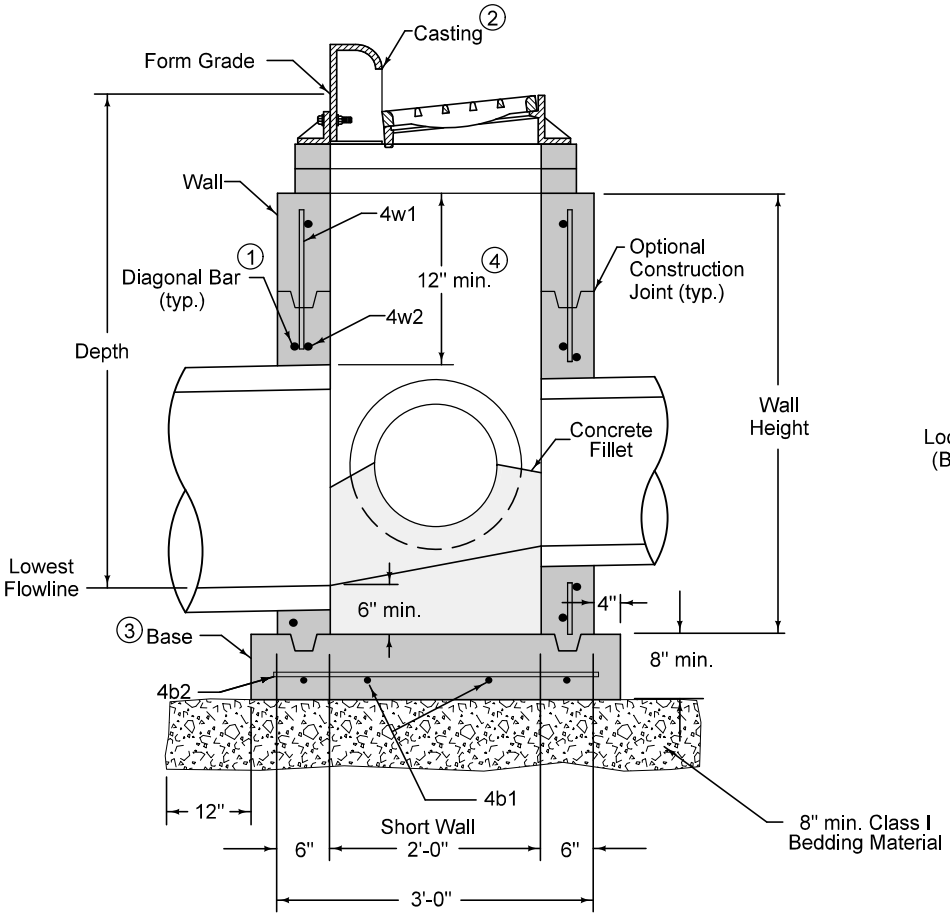
FIGURE 6010.406 | STANDARD ROAD PLAN | SW-406 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

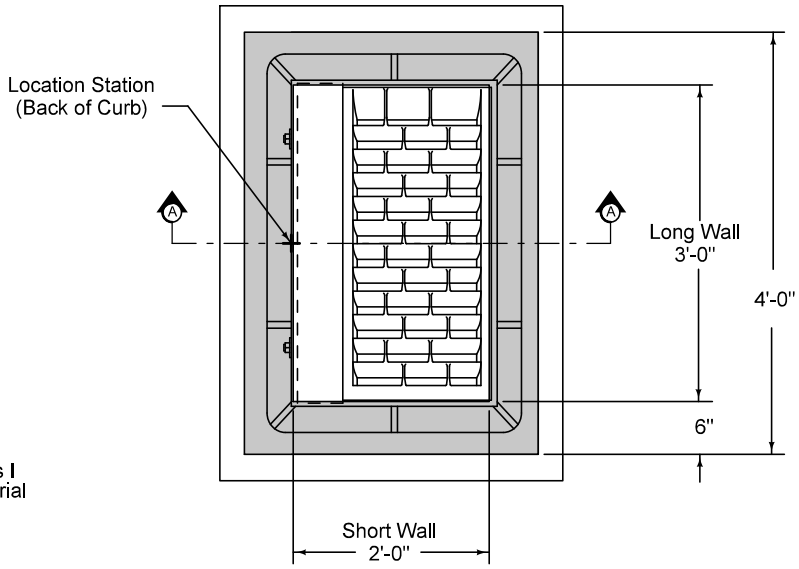
Paul D. Wigant SUDAS DIRECTOR

Stuart Nicholson DESIGN METHODS ENGINEER

SHALLOW RECTANGULAR STORM SEWER MANHOLE



SECTION A-A



PLAN

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at all pipe openings.
2. SW-603 Type R unless Type Q is specified in the contract documents.
3. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
4. 12 inch minimum wall height above all pipes.

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Length	Count	Spacing
4w1	4	Walls	———	Wall Height minus 4"	14	12"
4w2	4	Long Walls	———	3'-8"	Varies	12"
4w3	4	Short Walls	———	2'-8"	Varies	12"
4b1	4	Base	———	4'-2"	4	10"
4b2	4	Base	———	3'-2"	5	10"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	15"	18"
Long Wall	24"	30"

SUDAS | IOWADOT | REVISION 3 04-21-20

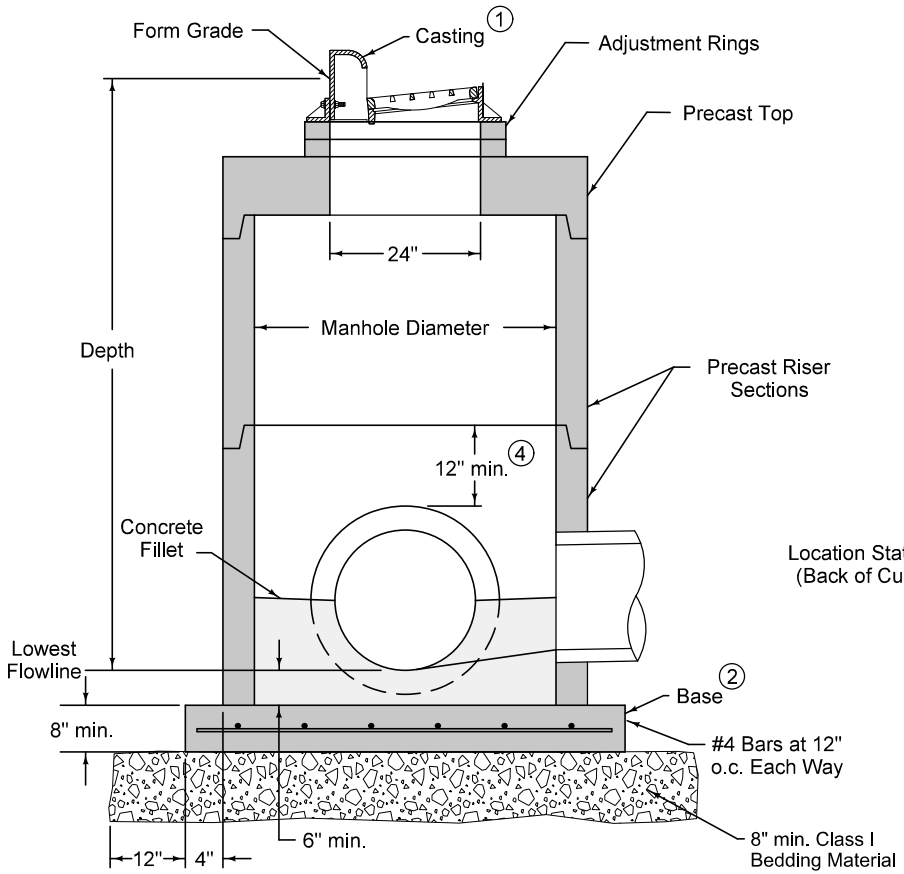
FIGURE 6010.501 | STANDARD ROAD PLAN | SW-501 | SHEET 1 of 1

REVISIONS: Added Class I Bedding Material.

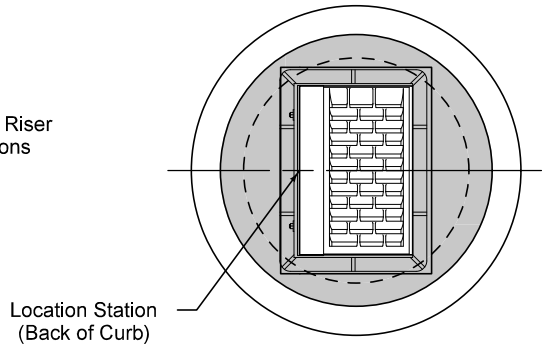
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE

FIGURE 6010.501 | SHEET 1 OF 1



TYPICAL SECTION



PLAN

Refer to SW-514 for boxout details.

① SW-603 Type R unless Type Q is specified in the contract documents.

② Cast-in-place base shown. Base may be square. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

③ For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings.

④ 12 inch minimum riser height above all pipes.

Manhole Diameter (inches)	Maximum Pipe Diameter ③ (inches) for 2 Pipes	
	at 180° Separation	at 90° Separation
48	24	18
60	36	24
72	42	30
84	48	36
96	60	42

SUDAS | IOWA DOT

REVISION: 1 | 04-21-20

FIGURE 6010.502 | STANDARD ROAD PLAN | SW-502

SHEET 1 of 1

REVISIONS: Added Class I Bedding Material.

Paul D. Wigand
SUDAS DIRECTOR

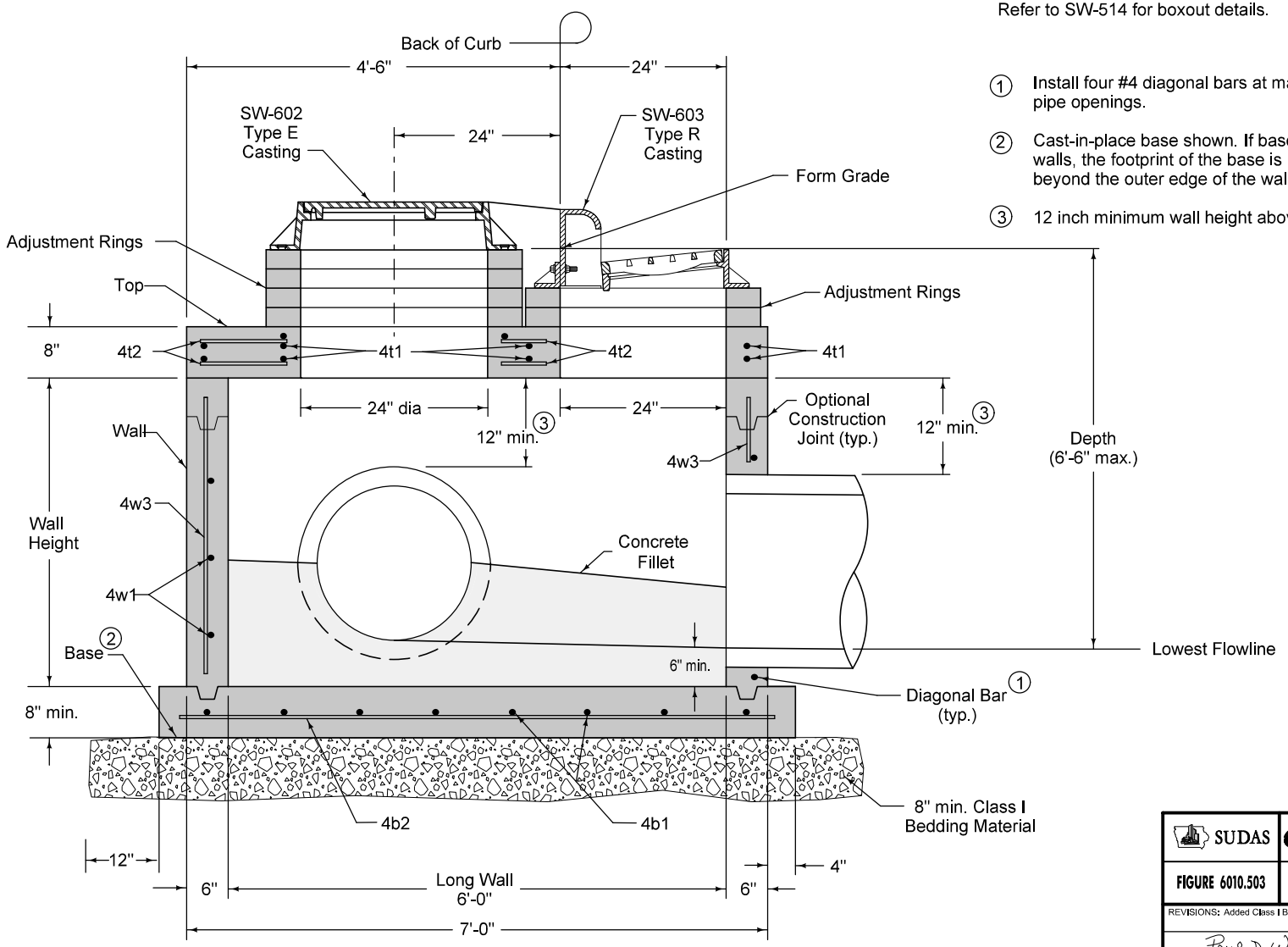
Stuart Nicholson
DESIGN METHODS ENGINEER

CIRCULAR SINGLE GRATE INTAKE

FIGURE 6010.502 SHEET 1 OF 1

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at manhole opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.



TYPICAL SECTION

FIGURE 6010.503 SHEET 1 OF 2

SUDAS | IOWA DOT | REVISION 3 04-21-20

FIGURE 6010.503 | STANDARD ROAD PLAN | SW-503 | SHEET 1 of 2

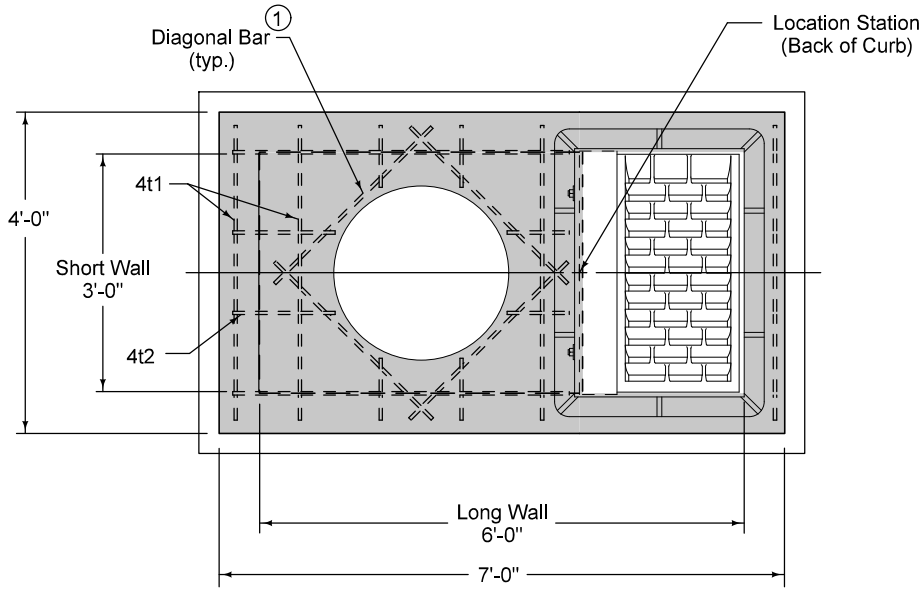
REVISIONS: Added Class I Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR

Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE WITH MANHOLE

① Install four #4 diagonal bars at manhole opening and at all pipe openings.



PLAN

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	12	3'-8"	12"
4t2	4	Top	——	8	4'-2"	12"
4b1	4	Base	——	7	4'-2"	13"
4b2	4	Base	——	5	7'-2"	10"
4w1	4	Short Walls	——	Varies	3'-8"	12"
4w2	4	Long Walls	——	Varies	6'-8"	12"
4w3	4	Walls	——	18	Wall Height minus 4"	13"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	24"	30"
Long Wall	30"	36"

SUDAS | IOWA DOT | REVISION 3 04-21-20

FIGURE 6010.503 | STANDARD ROAD PLAN | SW-503 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

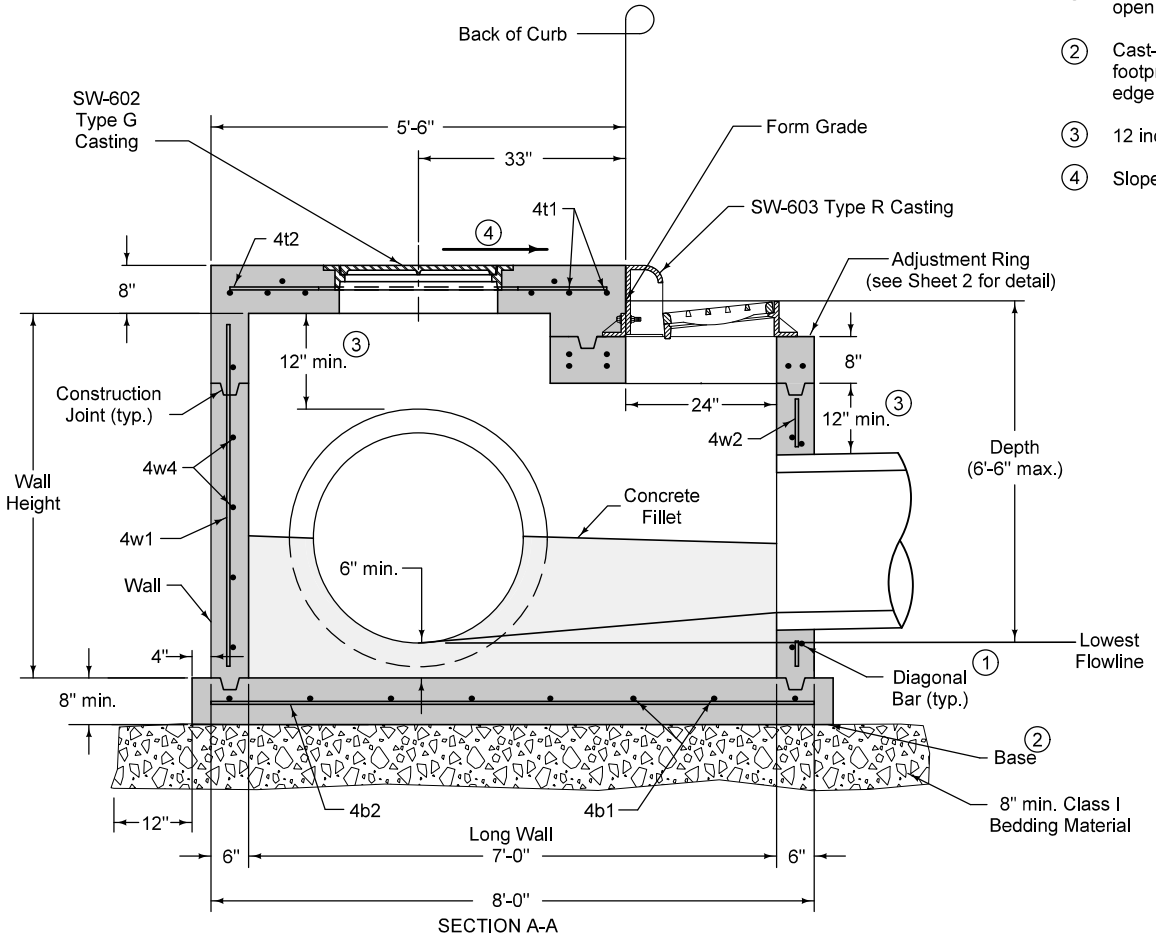
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE WITH MANHOLE

FIGURE 6010.503 SHEET 2 OF 2

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at manhole opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. Slope of 1.5% or as specified in the contract documents.



SECTION A-A

FIGURE 6010.504 | SHEET 1 OF 2

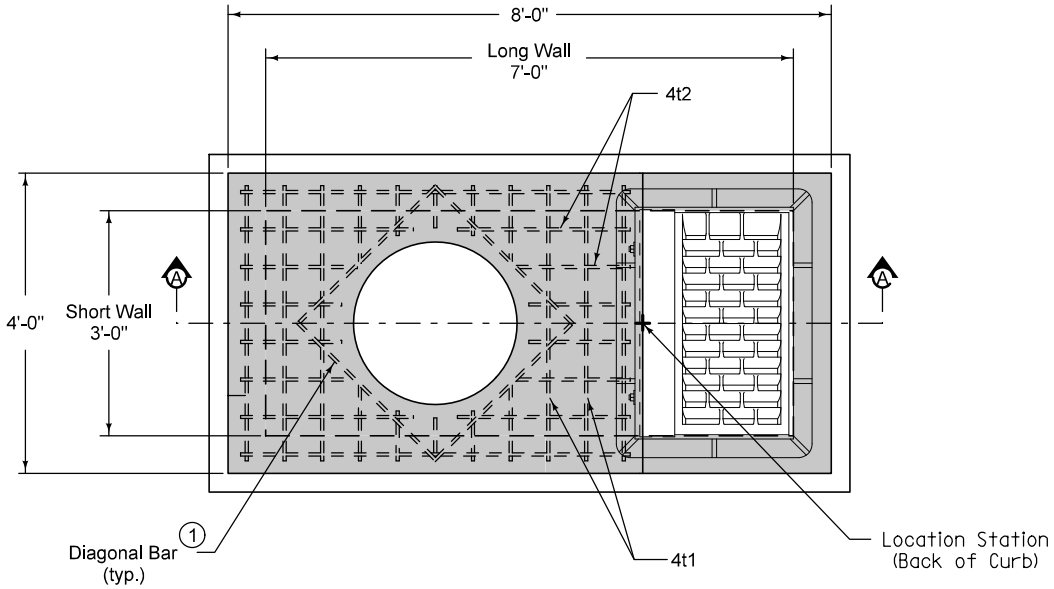
SUDAS	IOWA DOT	REVISION 4 04-21-20
FIGURE 6010.504	STANDARD ROAD PLAN	SW-504 SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

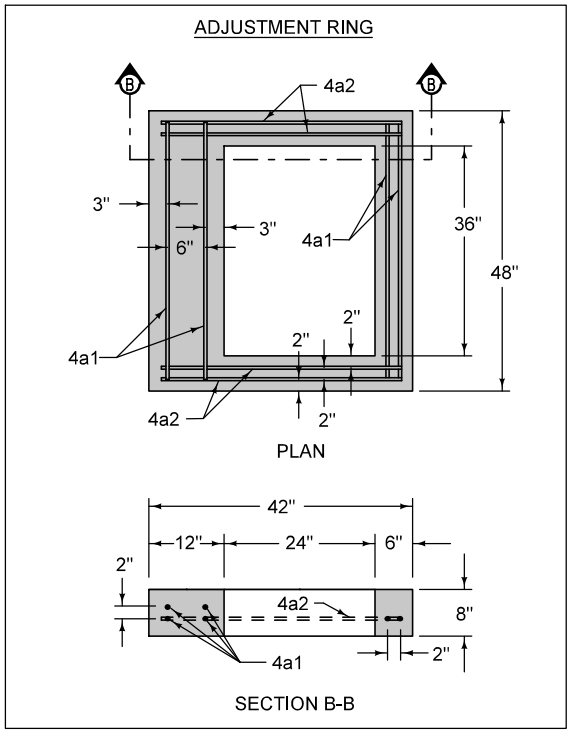
Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE WITH FLUSH-TOP MANHOLE

① Install four #4 diagonal bars at manhole opening and at all pipe openings.



PLAN



REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	1 1	3'-8"	6"
4t2	4	Top	——	8	5'-2"	6"
4b1	4	Base	——	8	4'-2"	13"
4b2	4	Base	——	5	8'-2"	10"
4a1	4	Adj. Ring	——	6	3'-8"	See Adj. Ring Plan
4a2	4	Adj. Ring	——	4	3'-2"	See Adj. Ring Plan
4w1	4	Walls	——	13	Wall Height minus 4"	12"
4w2	4	Walls	——	1 1	Wall Height minus 16"	12"
4w3	4	Long Walls	——	Varies	7'-8"	12"
4w4	4	Short Walls	——	Varies	3'-8"	12"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	18"	24"
Long Wall	30"	36"

SUDAS | IOWADOT | REVISION 4 04-21-20

FIGURE 6010.504 | STANDARD ROAD PLAN | SW-504 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

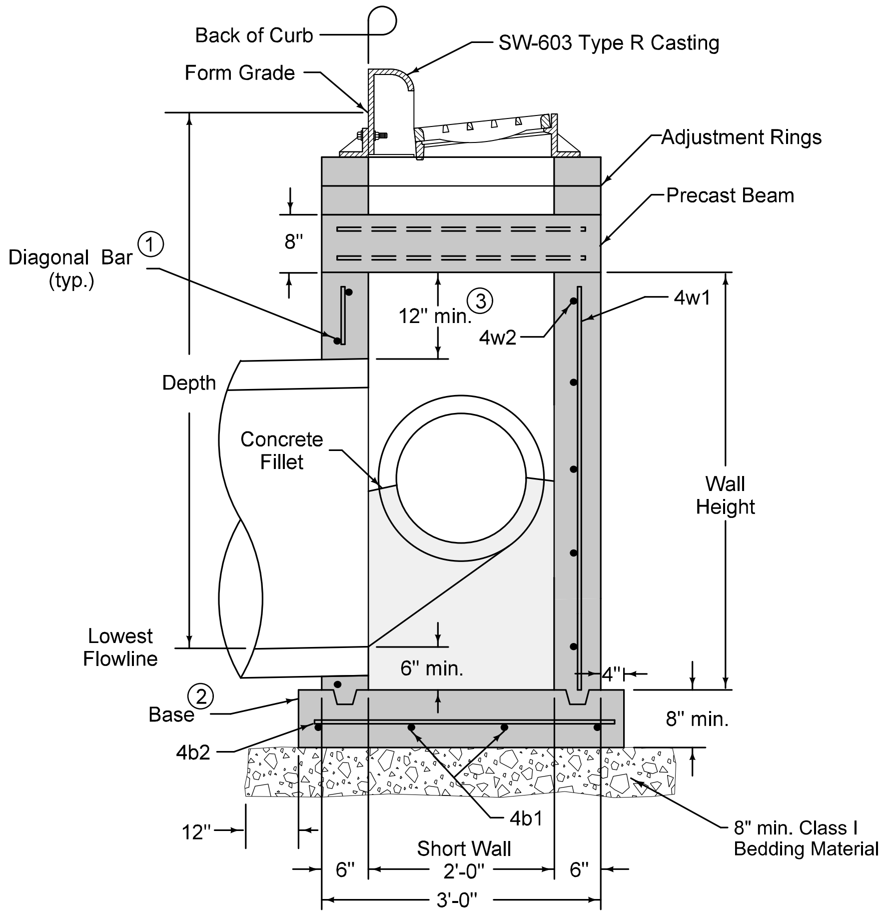
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE GRATE INTAKE WITH FLUSH-TOP MANHOLE

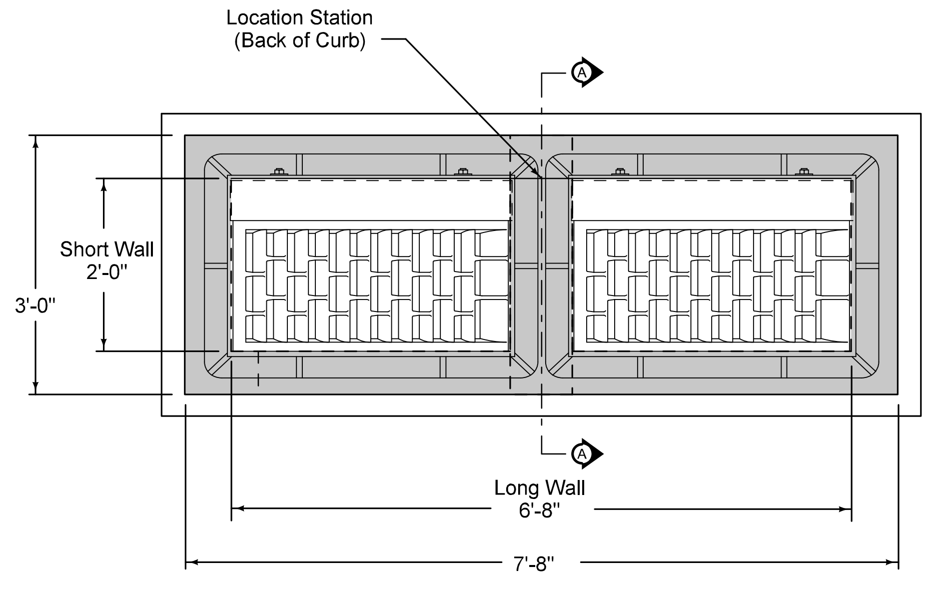
FIGURE 6010.504 | SHEET 2 OF 2

Refer to SW-514 for boxout details.

1. Install four #4 diagonal bars at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.



SECTION A-A



PLAN

SUDAS	IOWADOT	REVISION 3 04-21-20
FIGURE 6010.505	STANDARD ROAD PLAN	SW-505 SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

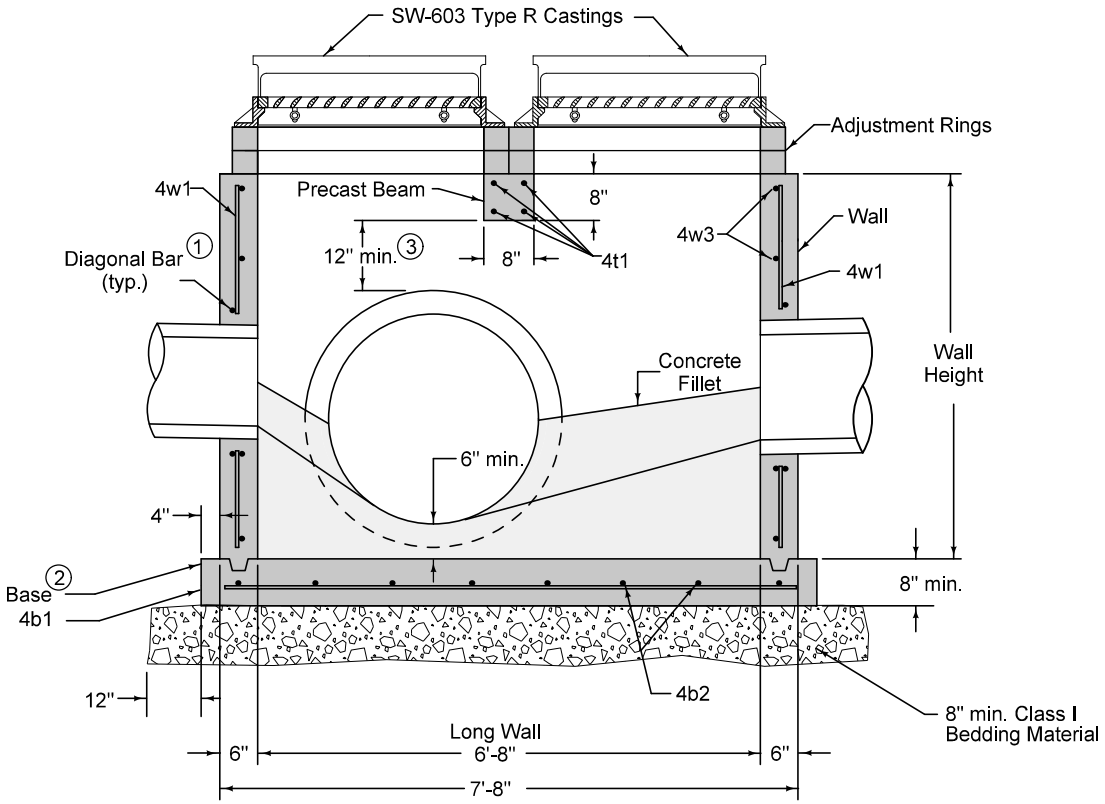
SUDAS DIRECTOR — DESIGN METHODS ENGINEER

DOUBLE GRATE INTAKE

① Install four #4 diagonal bars at all pipe openings.

② Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

③ 12 inch minimum wall height above all pipes.



TYPICAL SECTION

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Beam	——	4	2'-8"	4"
4b1	4	Base	——	4	7'-10"	10"
4b2	4	Base	——	8	3'-2"	12"
4w1	4	Walls	——	20	Wall Height minus 4"	12"
4w2	4	Long Walls	——	Varies	7'-4"	12"
4w3	4	Short Walls	——	Varies	2'-8"	12"

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	15"	18"
Long Wall	60"	66"

SUDAS | IOWADOT | REVISION 3 04-21-20

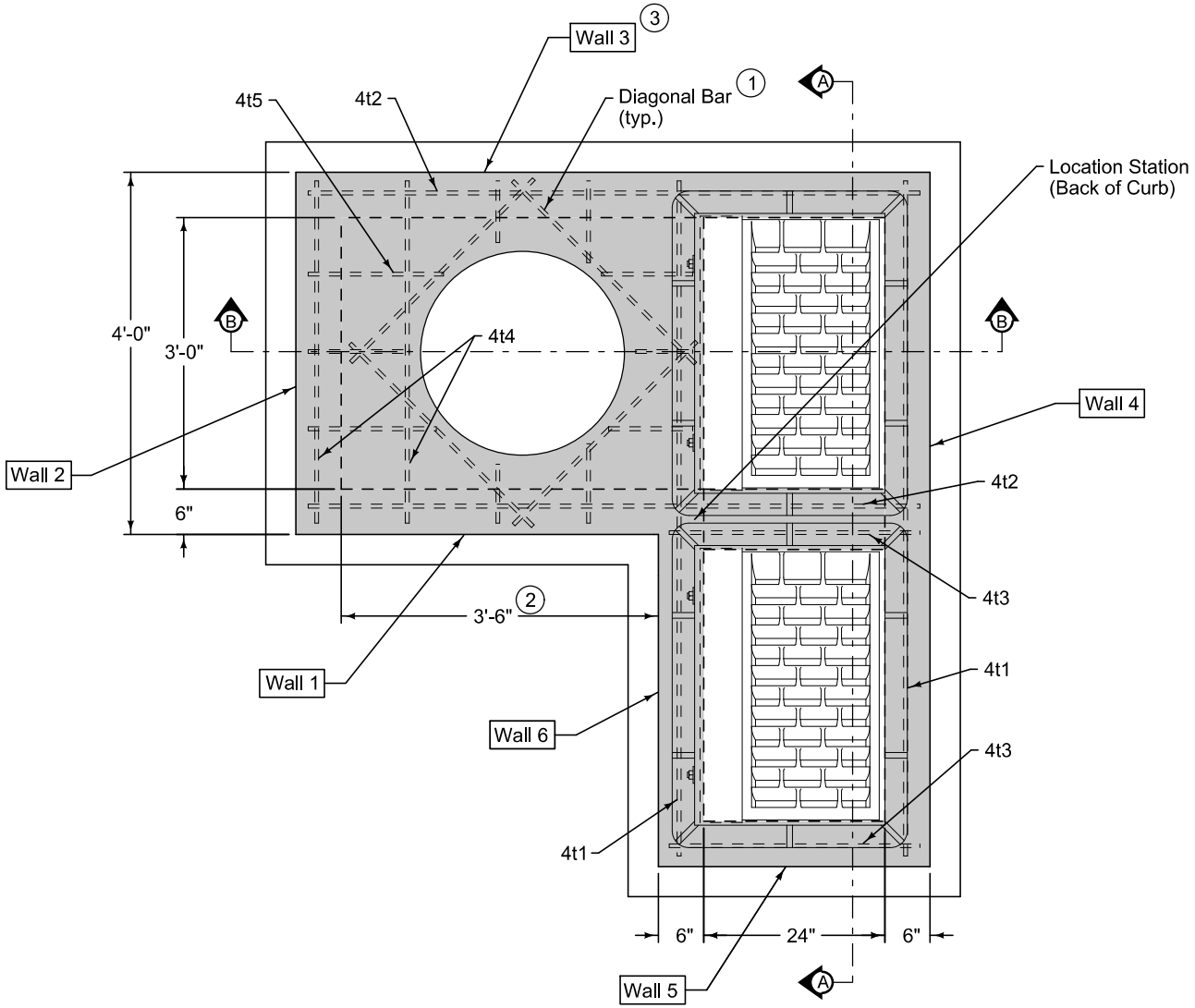
FIGURE 6010.505 | STANDARD ROAD PLAN | SW-505 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material.

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

DOUBLE GRATE INTAKE

FIGURE 6010.505 SHEET 2 OF 2



PLAN

Maximum pipe diameters are set based on maximum structure depth of 6 feet-6 inches and the objective of placement of the centerline of the pipe on the centerline of the manhole opening for maintenance purposes.

Refer to SW-514 for boxout details.

(1) Install four #4 diagonal bars at manhole opening and at all pipe openings.

(2) If Wall 1 is widened to 4 feet, the maximum pipe diameter can be increased to 36 inches.

(3) If Wall 1 is widened to 4 feet, the maximum pipe diameter in Wall 3 can be increased to 42 inches.

MAXIMUM PIPE DIAMETERS	
Wall	Max. Dia.
1	30" (2)
2	24"
3	36" (3)
4	42"

FIGURE 6010.506 | SHEET 1 OF 2

SUDAS | IOWA DOT

REVISION 4 04-21-20

FIGURE 6010.506 | STANDARD ROAD PLAN | SW-506

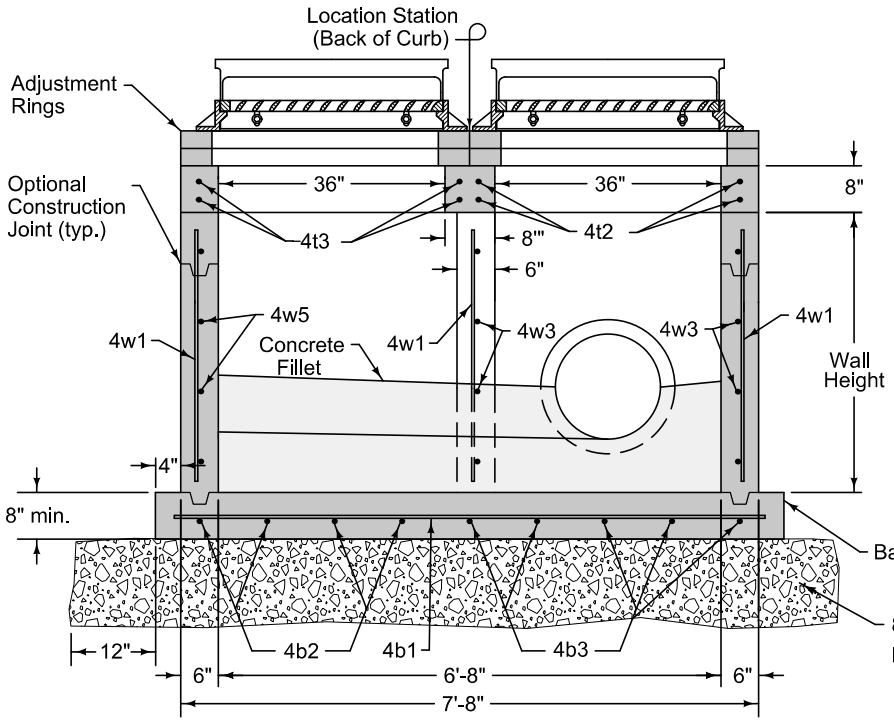
SHEET 1 of 2

REVISIONS: Added Class I Bedding Material.

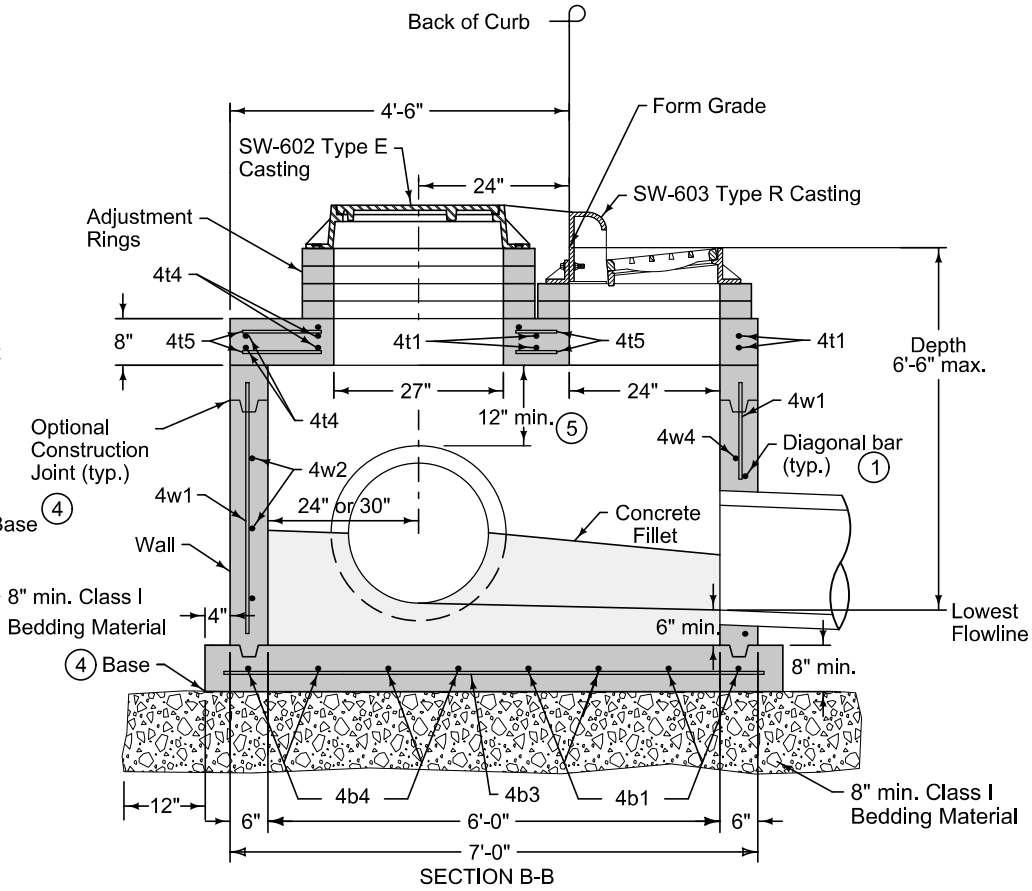
Paul D. Wigard
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

DOUBLE GRATE INTAKE WITH MANHOLE



SECTION A-A



SECTION B-B

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	4	7'-4"	See Detail
4t2	4	Top	——	4	6'-8"	See Detail
4t3	4	Top	——	4	2'-8"	See Detail
4t4	4	Top	——	8	3'-8"	12"
4t5	4	Top	——	6	4'-2"	12"
4b1	4	Base	——	4	7'-10"	12"
4b2	4	Base	——	4	3'-2"	12"
4b3	4	Base	——	5	7'-2"	12"
4b4	4	Base	——	4	4'-2"	12"
4w1	4	Walls	——	29	Wall Height minus 4"	12"
4w2	4	Wall 2	——	Varies	3'-8"	12"
4w3	4	Walls 1 and 3	——	Varies	6'-8"	12"
4w4	4	Wall 4	——	Varies	7'-4"	12"
4w5	4	Wall 5	——	Varies	2'-8"	12"
4w6	4	Wall 6	——	Varies	3'-10"	12"

(1) Install four #4 diagonal bars at manhole opening and at all pipe openings.

(4) Cast-in-place base shown. If base is precast integral with walls, the footprint of base is not required to extend beyond the outer edge of the walls.

(5) 12 inch minimum wall height above all pipes.

SUDAS | IOWA DOT

REVISION: 4 | 04-21-20

FIGURE 6010.506 | STANDARD ROAD PLAN | SW-506

SHEET 2 of 2

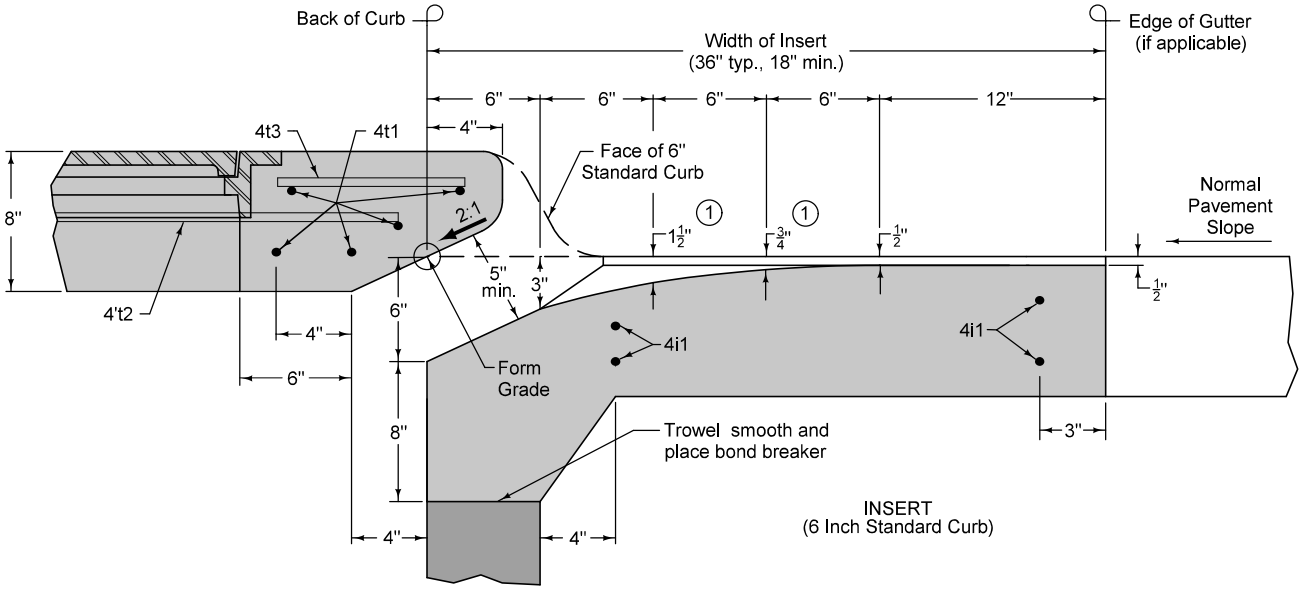
REVISIONS: Added Class I Bedding Material.

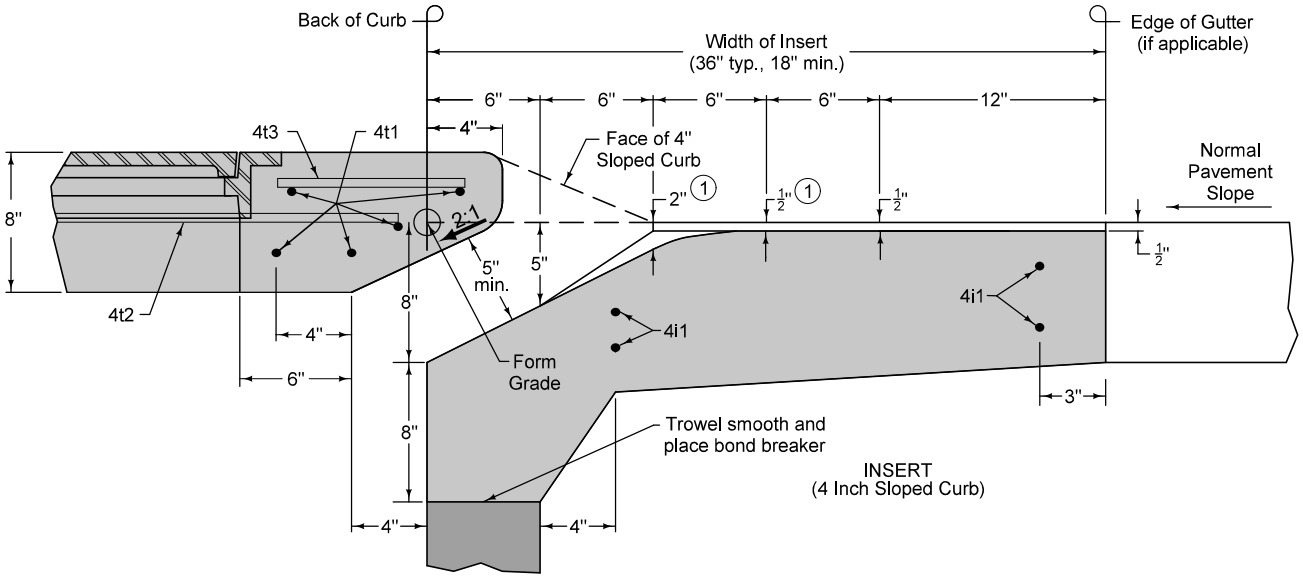
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE GRATE INTAKE WITH MANHOLE

FIGURE 6010.506 | SHEET 2 OF 2





① Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by ½ inch.

FIGURE 6010.507 SHEET 1 OF 2

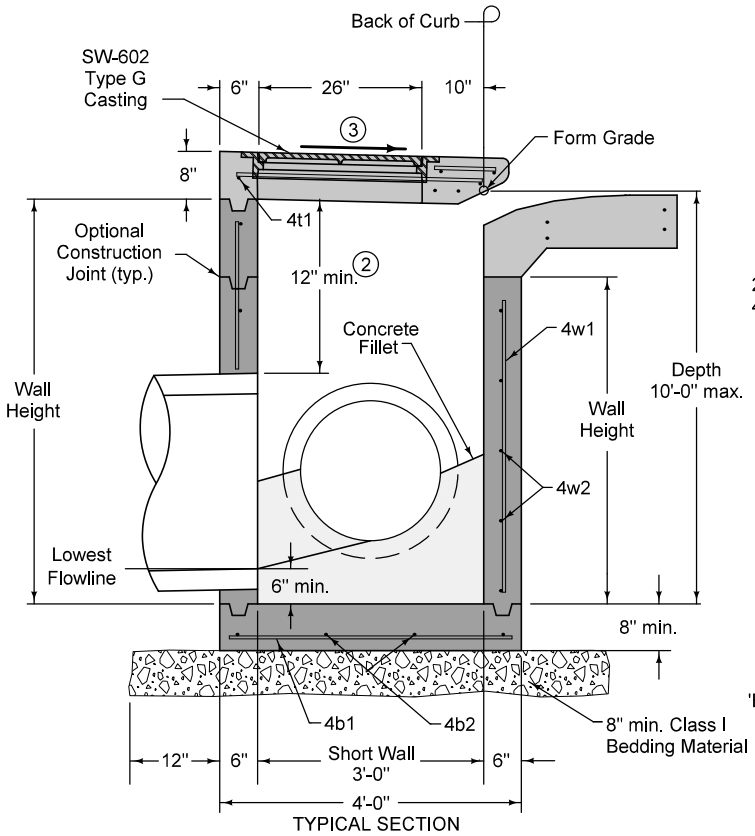
SUDAS	IOWA DOT	REVISION 4 04-21-20
FIGURE 6010.507	STANDARD ROAD PLAN	SW-507
		SHEET 1 of 2

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

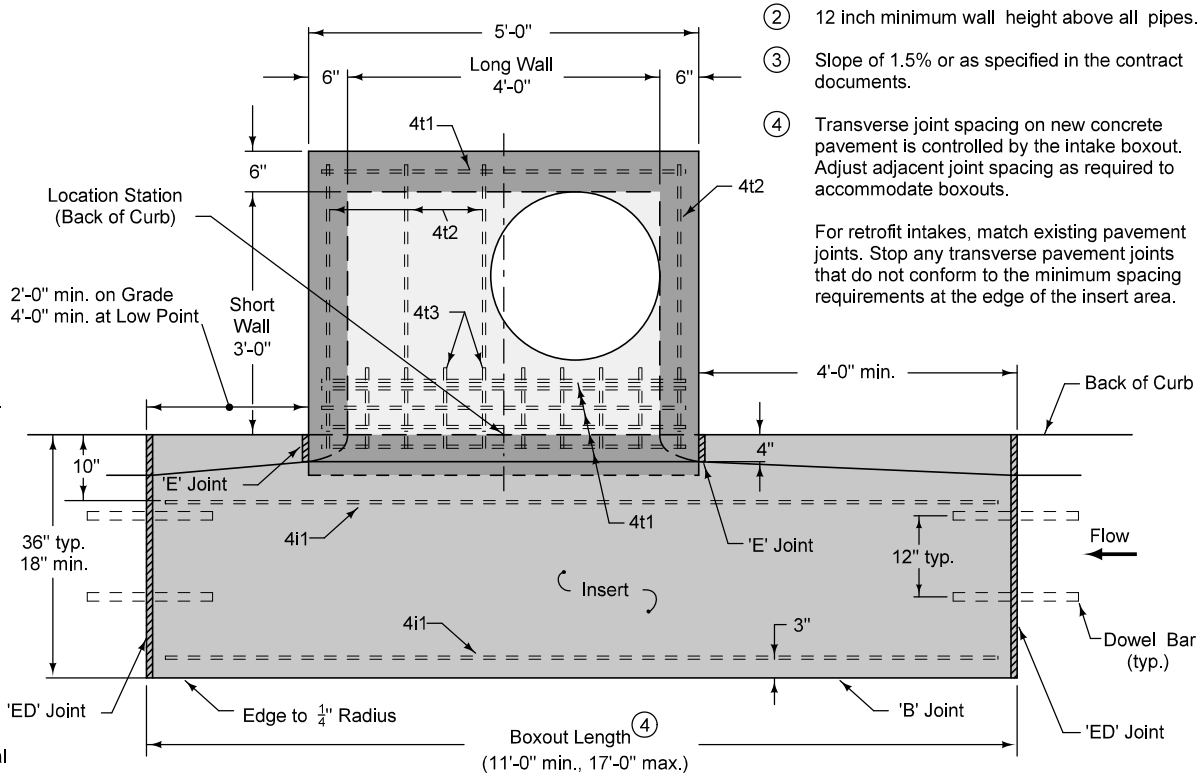
Paul D. Wigand
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, SMALL BOX



TYPICAL SECTION



PLAN

2 12 inch minimum wall height above all pipes.

3 Slope of 1.5% or as specified in the contract documents.

4 Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	24"	30"
Long Wall	30"	36"

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	——	6	4'-8"	See Insert
4t2	4	Top	——	4	3'-6"	12"
4t3	4	Top	——	10	10"	6"
4b1	4	Base	——	6	3'-6"	1 1"
4b2	4	Base	——	5	4'-6"	10"
4i1	4	Insert	——	4	Boxout Length minus 8"	See Plan
4w1	4	Walls	——	14	Wall Height minus 4"	14"
4w2	4	Long Walls	——	Varies	4'-8"	12"
4w3	4	Short Walls	——	Varies	3'-8"	12"

SUDAS | IOWADOT

REVISION 4 04-21-20

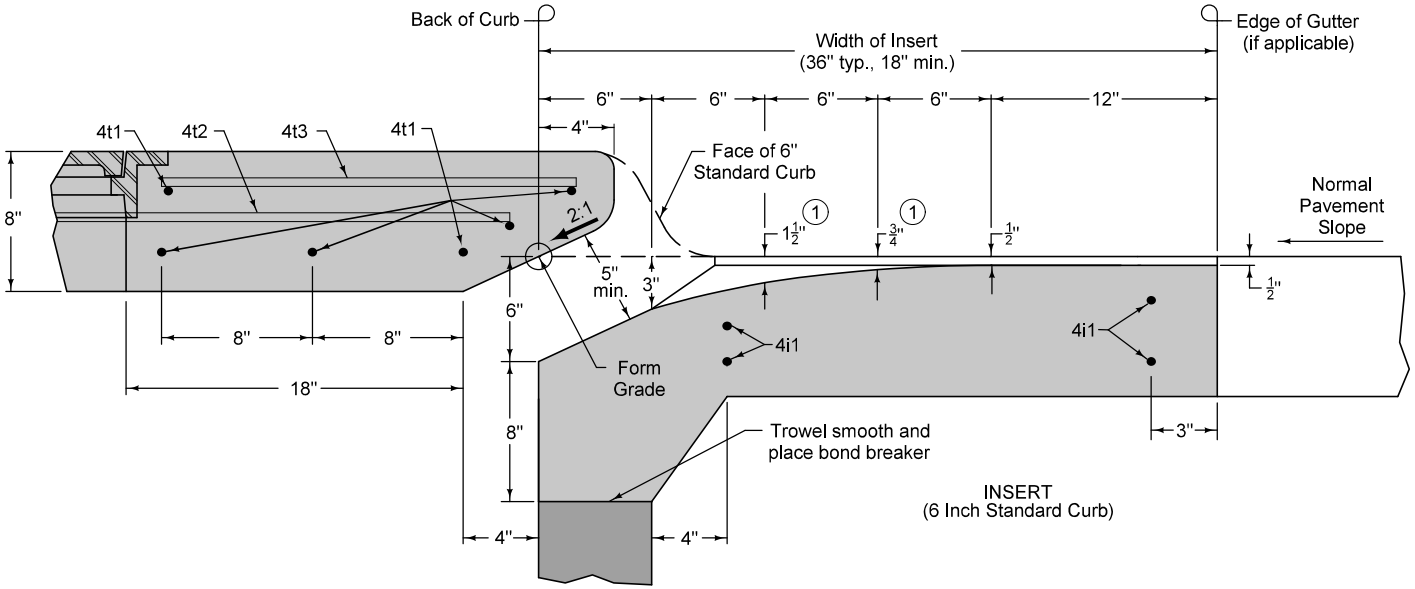
FIGURE 6010.507 | STANDARD ROAD PLAN | SW-507 | SHEET 2 of 2

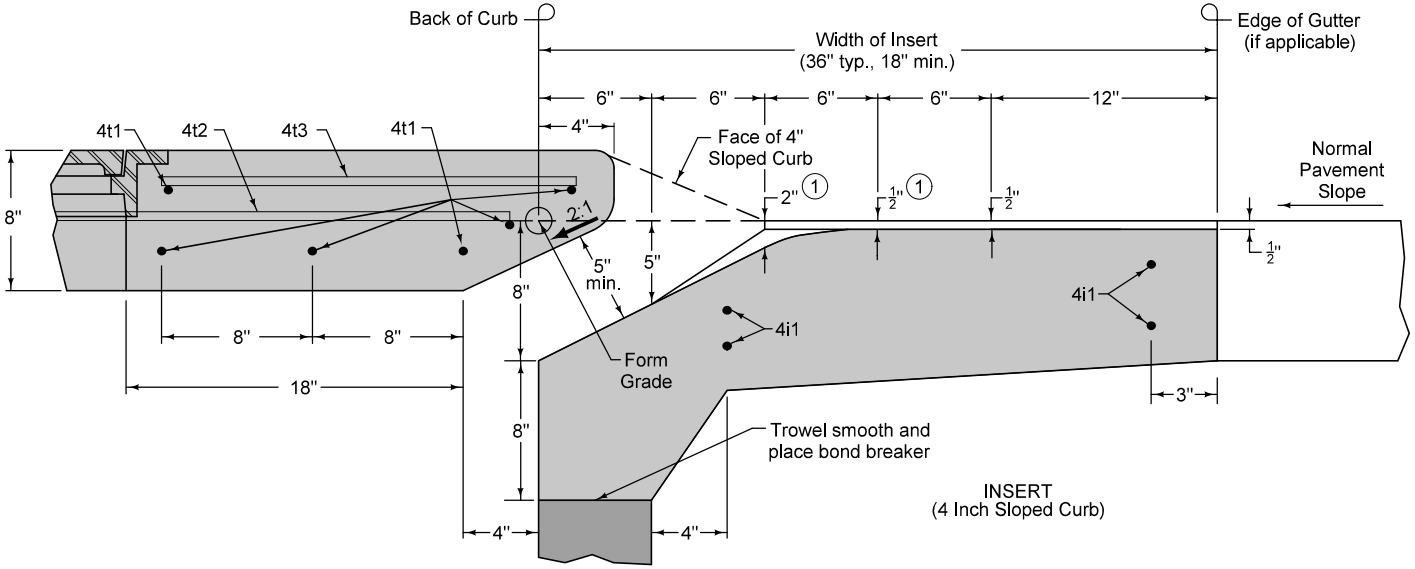
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, SMALL BOX





① Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by ½ inch.

FIGURE 6010.508 SHEET 1 OF 2

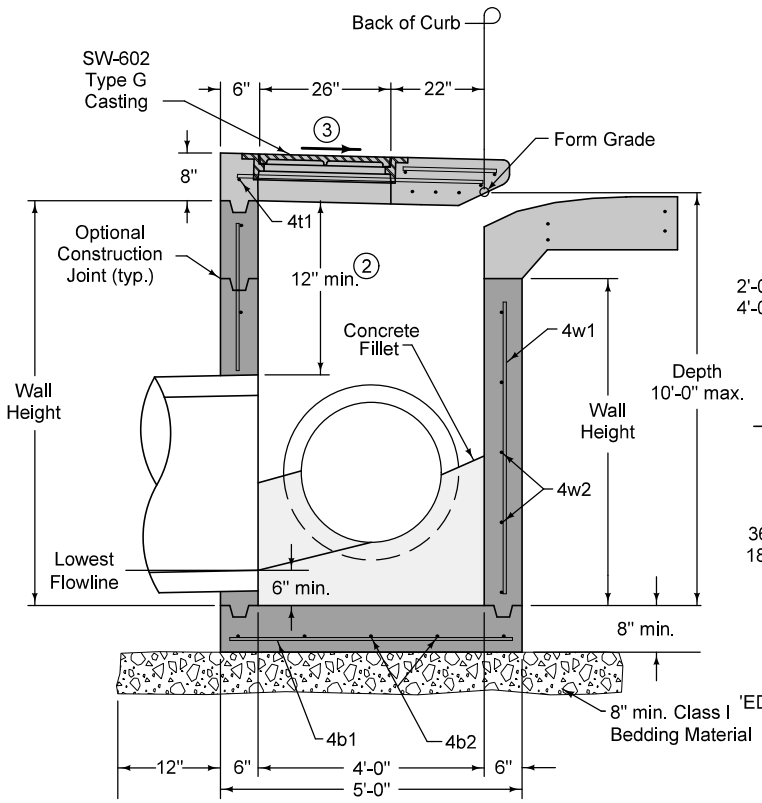
SUDAS	IOWA DOT	REVISION 4	04-21-20
FIGURE 6010.508	STANDARD ROAD PLAN	SW-508	
		SHEET 1 of 2	

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

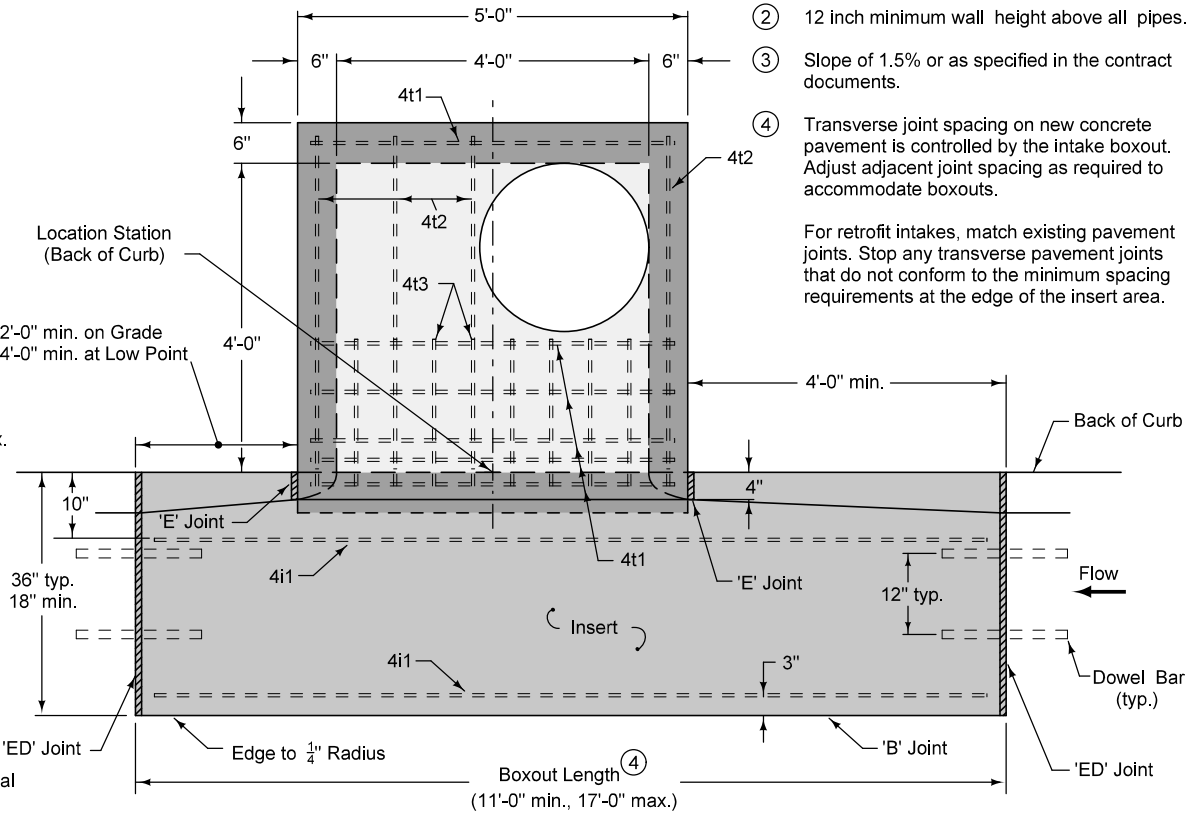
Paul D. Wigant
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, LARGE BOX



TYPICAL SECTION



PLAN

2 12 inch minimum wall height above all pipes.

3 Slope of 1.5% or as specified in the contract documents.

4 Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

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

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4t1	4	Top	———	7	4'-8"	See Insert
4t2	4	Top	———	4	4'-6"	12"
4t3	4	Top	———	10	1'-10"	6"
4b1	4	Base	———	6	4'-6"	11"
4b2	4	Base	———	6	4'-6"	11"
4i1	4	Insert	———	4	Boxout Length minus 8"	See Plan
4w1	4	Walls	———	16	Wall Height minus 4"	14"
4w2	4	Walls	———	Varies	4'-8"	12"
4w3	4	Walls	———	Varies	4'-8"	12"

SUDAS | IOWADOT | REVISION 4 04-21-20

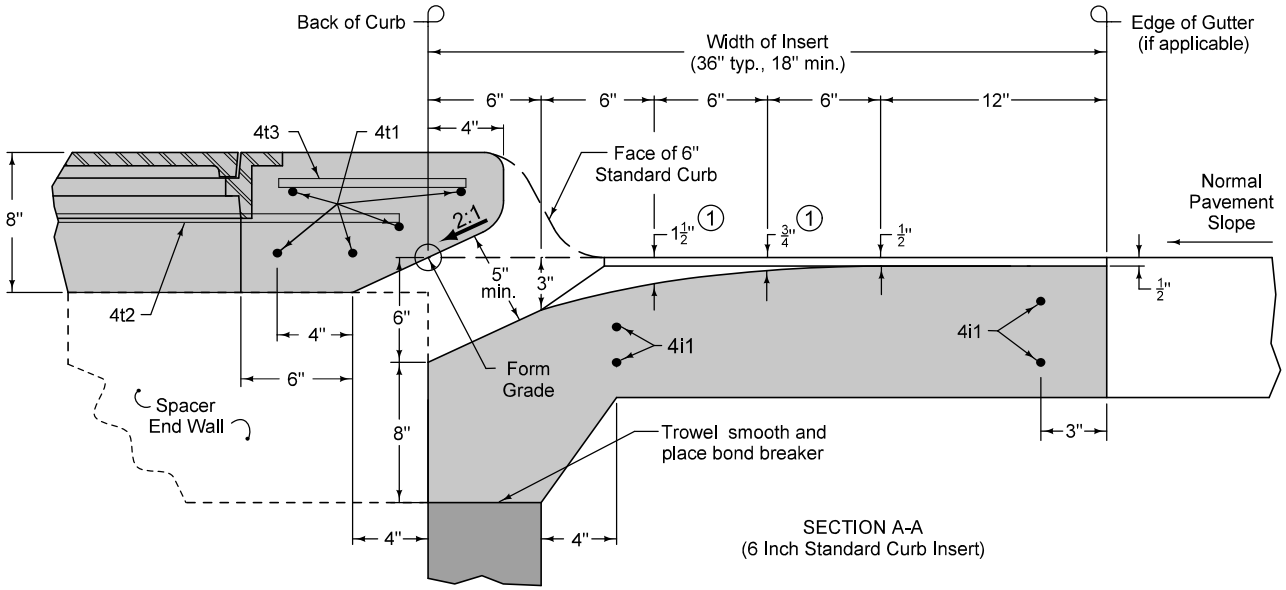
FIGURE 6010.508 | STANDARD ROAD PLAN | SW-508 | SHEET 2 of 2

REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

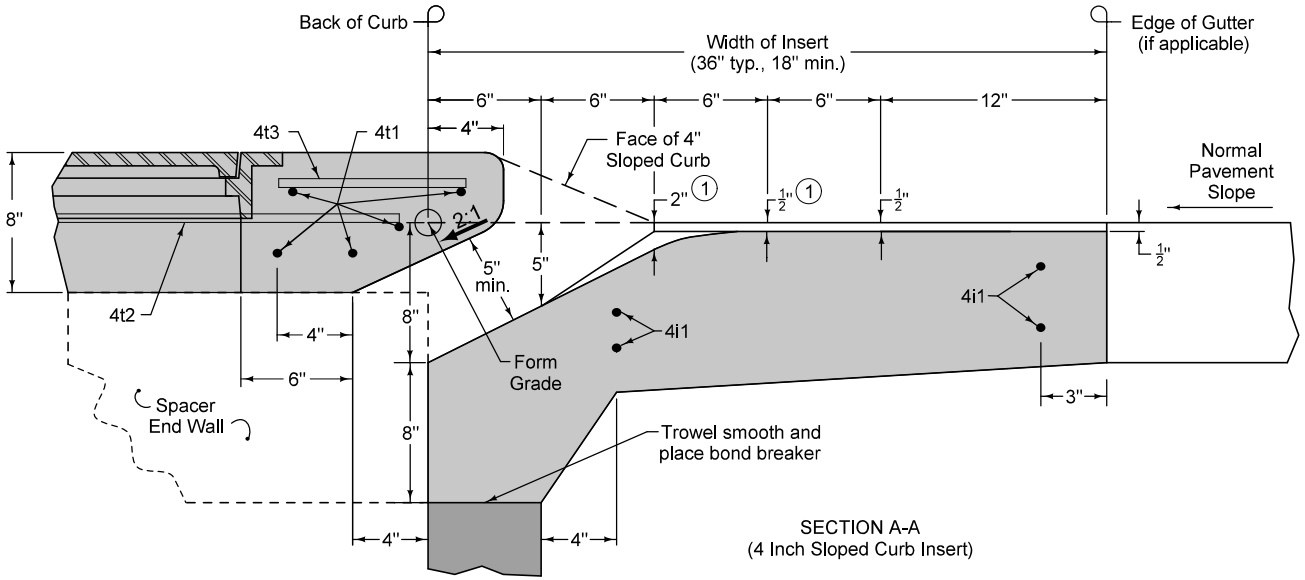
Paul D. Wigand, SUDAS DIRECTOR — Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, LARGE BOX

FIGURE 6010.508 SHEET 2 OF 2



SECTION A-A
(6 Inch Standard Curb Insert)



SECTION A-A
(4 Inch Sloped Curb Insert)

(1) Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by $\frac{1}{4}$ inch.

SUDAS	IOWADOT	REVISION 6 04-21-20
FIGURE 6010.509	STANDARD ROAD PLAN	SW-509
		SHEET 1 of 3

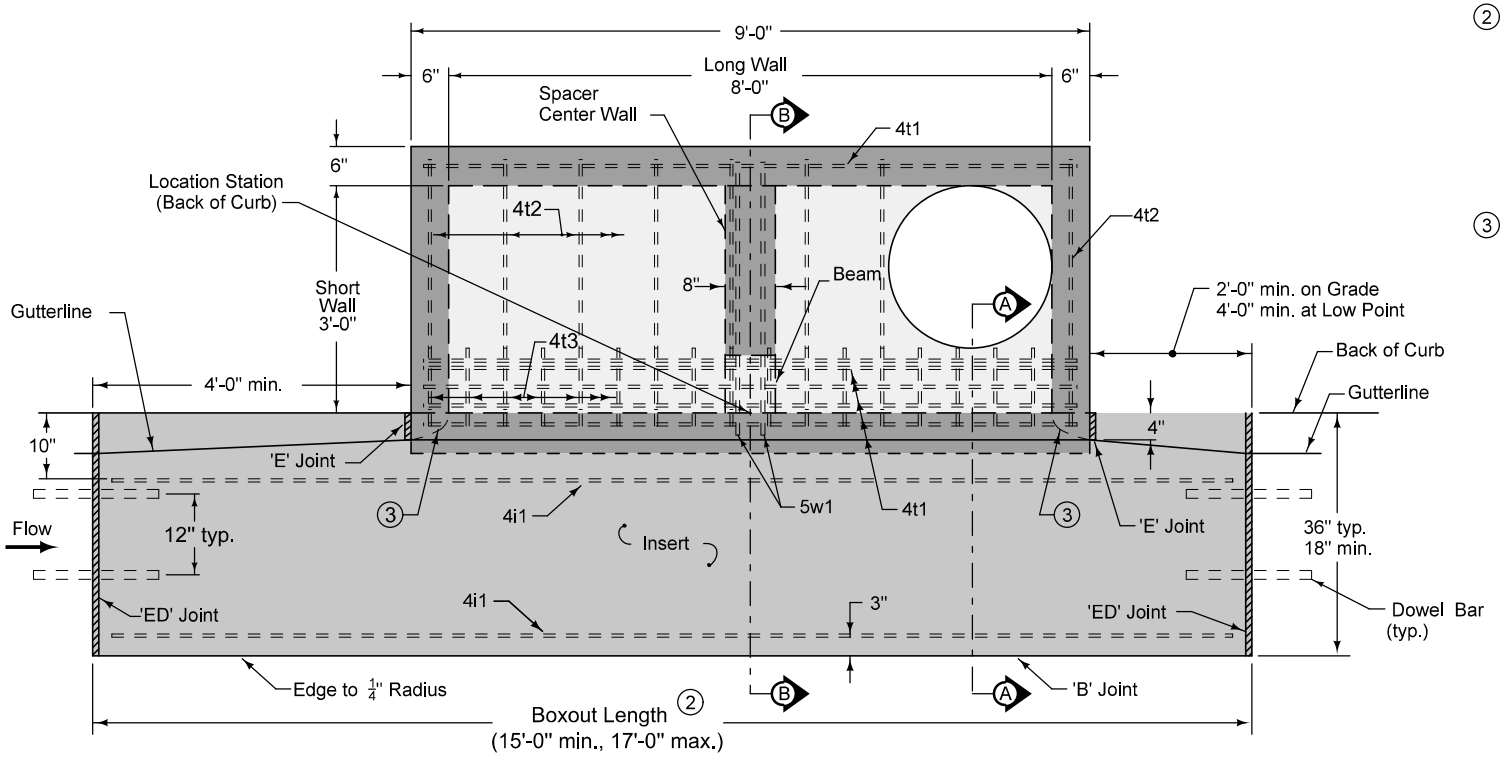
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.509 | SHEET 1 OF 3



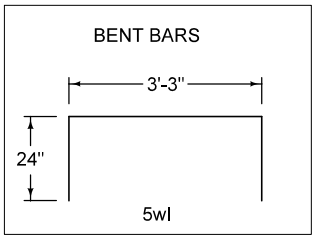
PLAN

2 Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

3 Rounded shaping at inlet.

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4b1	4	Base	——	9	3'-6"	12"
4b2	4	Base	——	5	8'-6"	10"
4i1	4	Insert	——	4	Boxout Length minus 8"	See Insert
4t1	4	Top	——	6	8'-6"	See Plan
4t2	4	Top	——	8	3'-6"	12"
4t3	4	Top	——	18	10"	6"
4w1	4	Walls	——	22	Wall Height minus 4"	13"
4w2	4	Long Walls	——	Varies	4'-8"	12"
4w3	4	Short Walls	——	Varies	3'-8"	12"
5w1	5	Beam	⌐¬	2	7'-3"	4"



SUDAS | IOWA DOT

REVISION 6 04-21-20

FIGURE 6010.509 | STANDARD ROAD PLAN | SW-509

SHEET 2 of 3

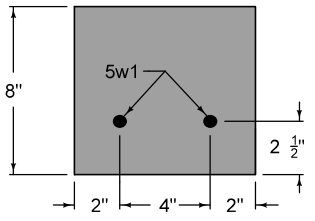
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

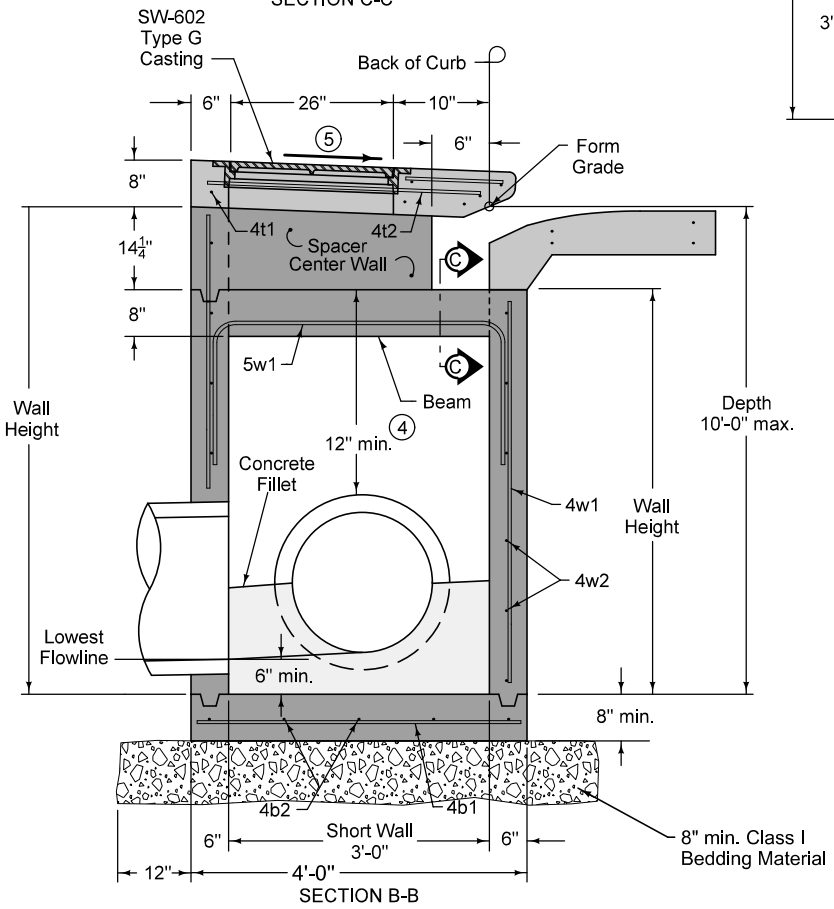
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

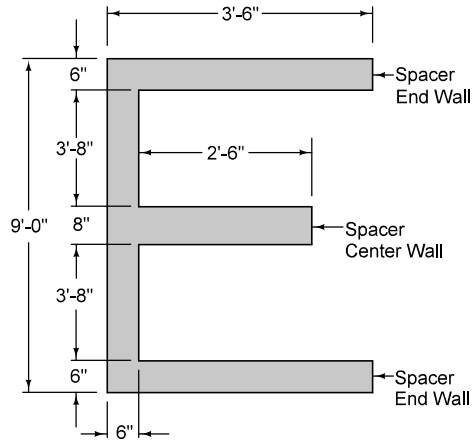
FIGURE 6010.509 SHEET 2 OF 3



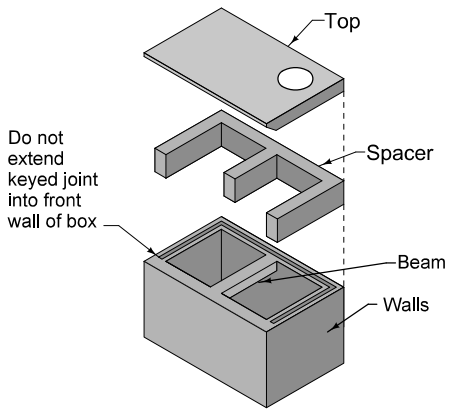
SECTION C-C



SECTION B-B



PLAN
(SPACER)



ISOMETRIC
(Refer to SECTION B-B for
alignment of Top with Spacer)

(4) 12 inch minimum wall height above all pipes.

(5) Slope of 1.5% or as specified in the contract documents.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	24"	30"
Long Wall	60"	66"

SUDAS | IOWADOT | REVISION 6 04-21-20

FIGURE 6010.509 | STANDARD ROAD PLAN | SW-509 | SHEET 3 of 3

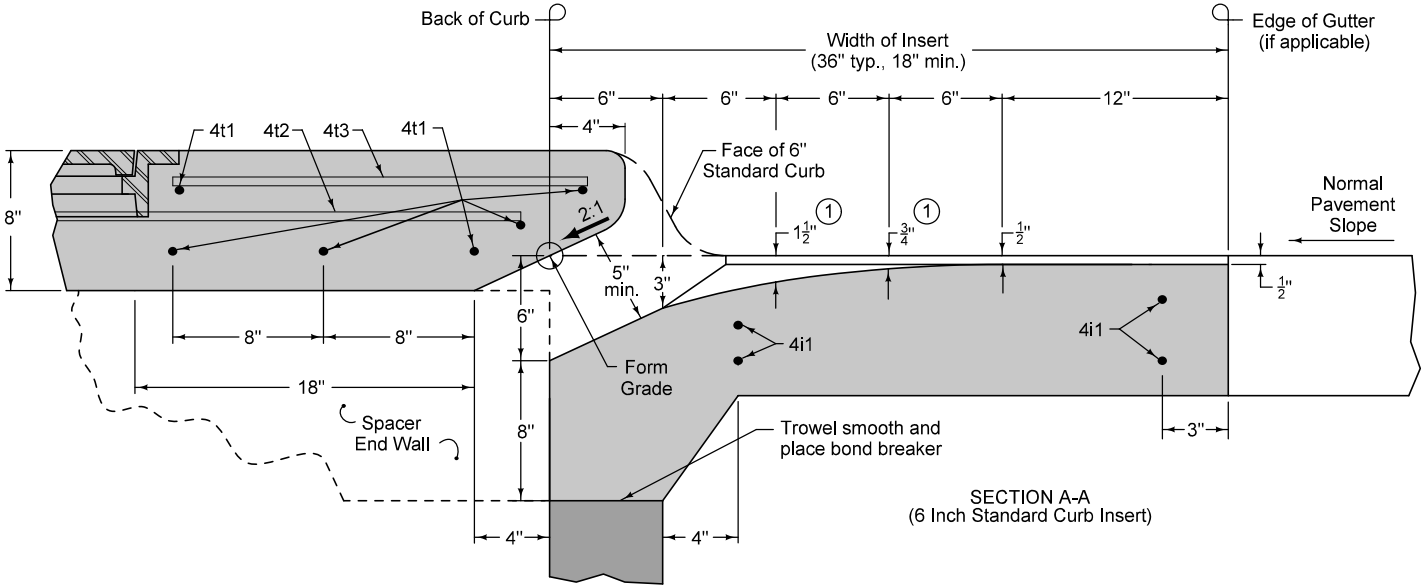
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

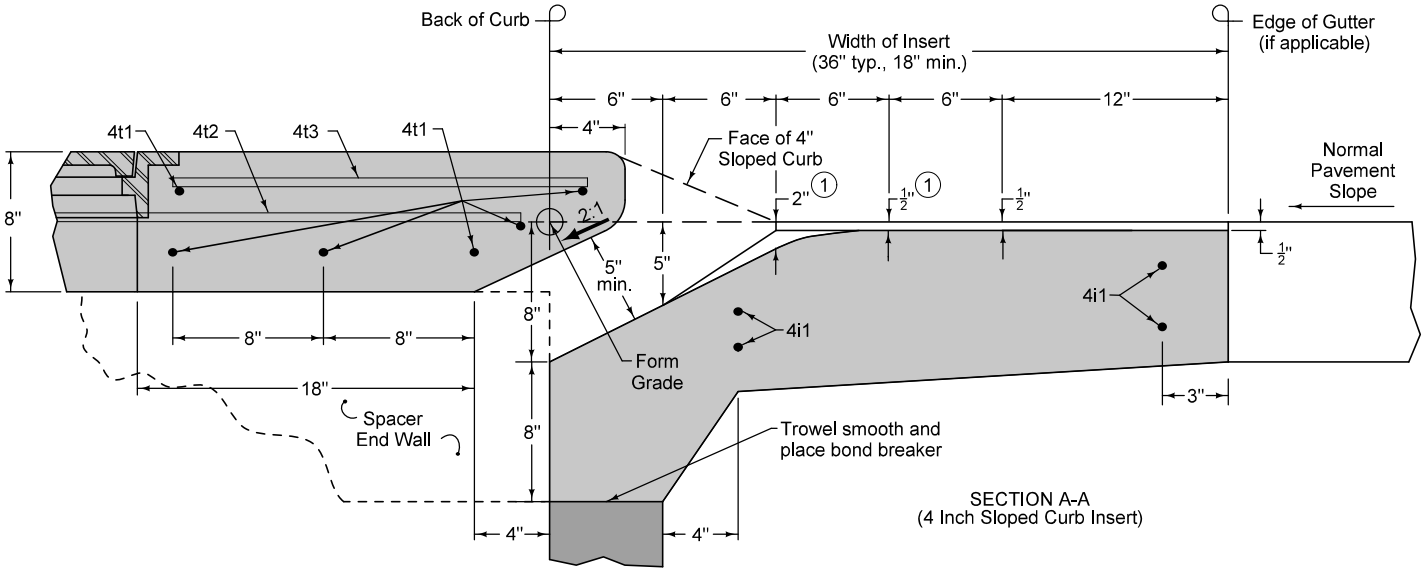
Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.509 SHEET 3 OF 3



SECTION A-A
(6 Inch Standard Curb Insert)



SECTION A-A
(4 Inch Sloped Curb Insert)

① Insert shaping may be modified for insert widths less than 36 inches. For an 18 inch insert, reduce dimensions indicated by $\frac{1}{4}$ inch.

SUDAS | IOWA DOT

REVISION: 6 | 04-21-20

FIGURE 6010.510 | STANDARD ROAD PLAN | SW-510

SHEET 1 of 3

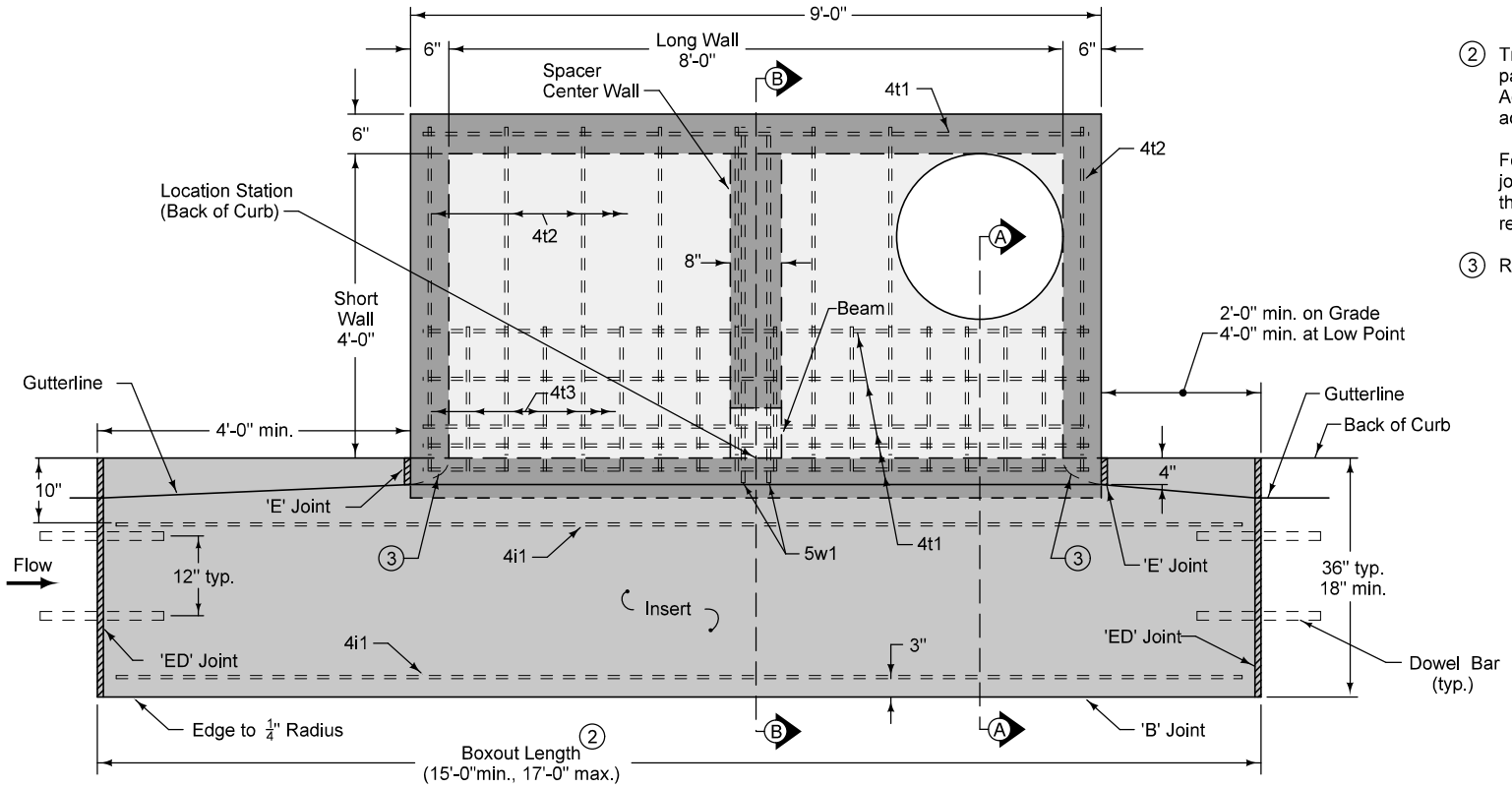
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX

FIGURE 6010.510 | SHEET 1 OF 3



PLAN

② Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the insert area.

③ Rounded shaping at inlet.

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4b1	4	Base	——	9	4'-6"	12"
4b2	4	Base	——	6	8'-6"	11"
4i1	4	Insert	——	4	Boxout Length minus 8"	See Insert
4t1	4	Top	——	7	8'-6"	See Plan
4t2	4	Top	——	8	4'-4"	12"
4t3	4	Top	——	18	1'-10"	6"
4w1	4	Walls	——	24	Wall Height minus 4"	13"
4w2	4	Long Walls	——	Varies	4'-8"	12"
4w3	4	Short Walls	——	Varies	8'-8"	12"
5w1	5	Beam	⌐¬	2	8'-3"	4"

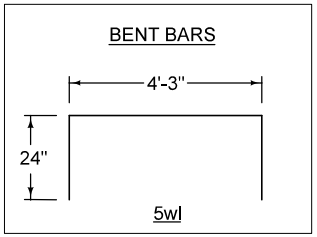


FIGURE 6010.510 SHEET 2 OF 3

SUDAS | IOWA DOT

REVISION 6 04-21-20

SW-510

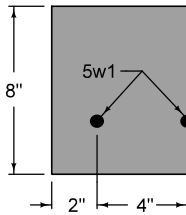
FIGURE 6010.510 | STANDARD ROAD PLAN

SHEET 2 of 3

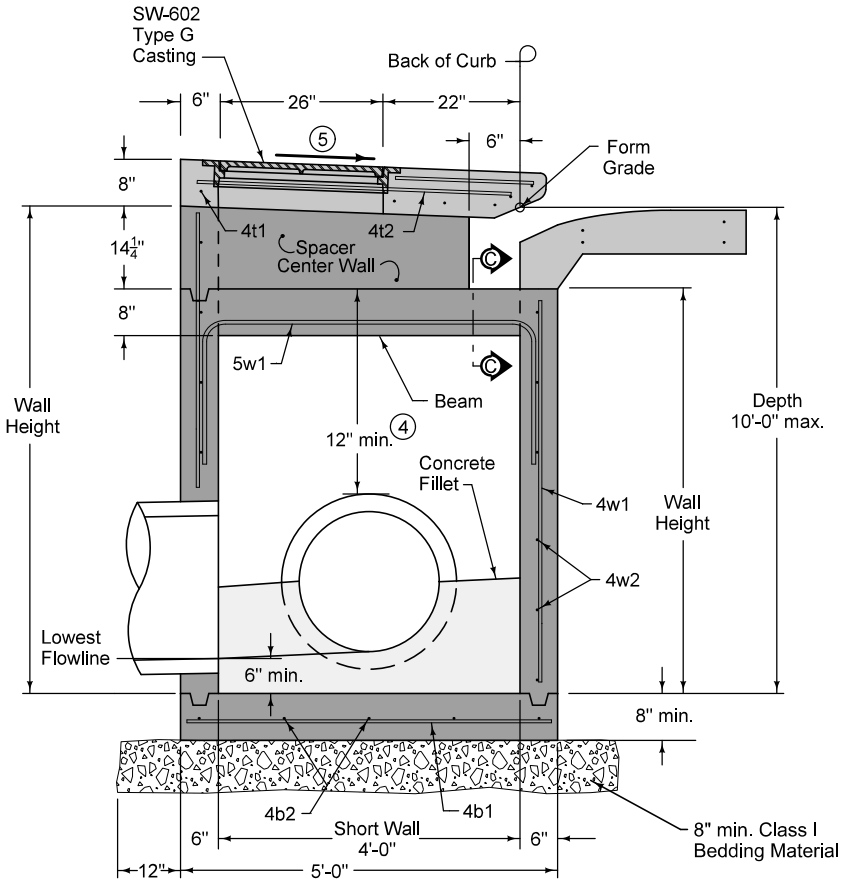
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

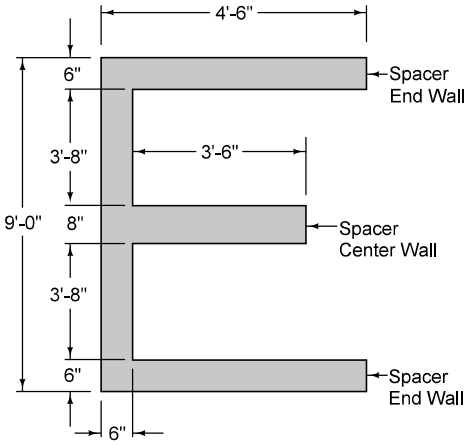
DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX



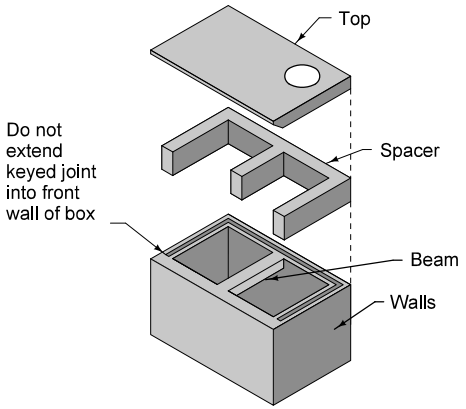
SECTION C-C



SECTION B-B



PLAN
(SPACER)



ISOMETRIC
(Refer to Section B-B
for alignment of Top
with Spacer)

(4) 12 inch minimum wall height above all pipes.

(5) Slope of 1.5% or as specified in the contract documents.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	30"	36"
Long Wall	60"	66"

SUDAS | IOWADOT | REVISION 6 04-21-20

FIGURE 6010.510 | STANDARD ROAD PLAN | SW-510 | SHEET 3 of 3

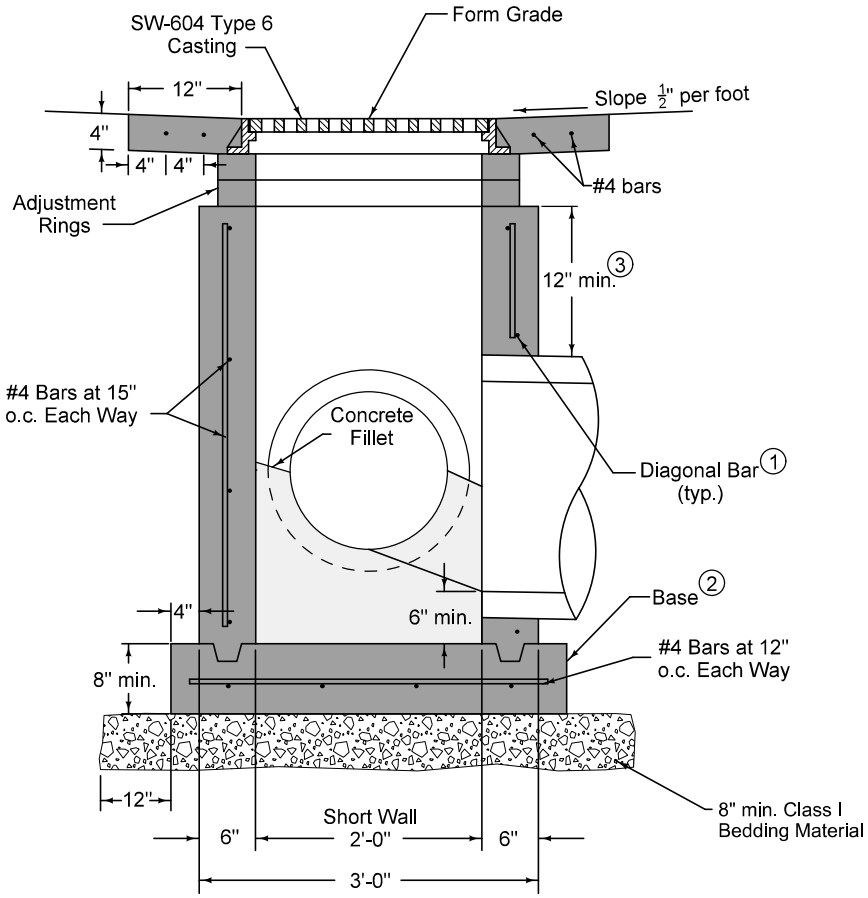
REVISIONS: Added Class I Bedding Material and changed maximum box out length to 17'.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX

FIGURE 6010.510 | SHEET 3 OF 3

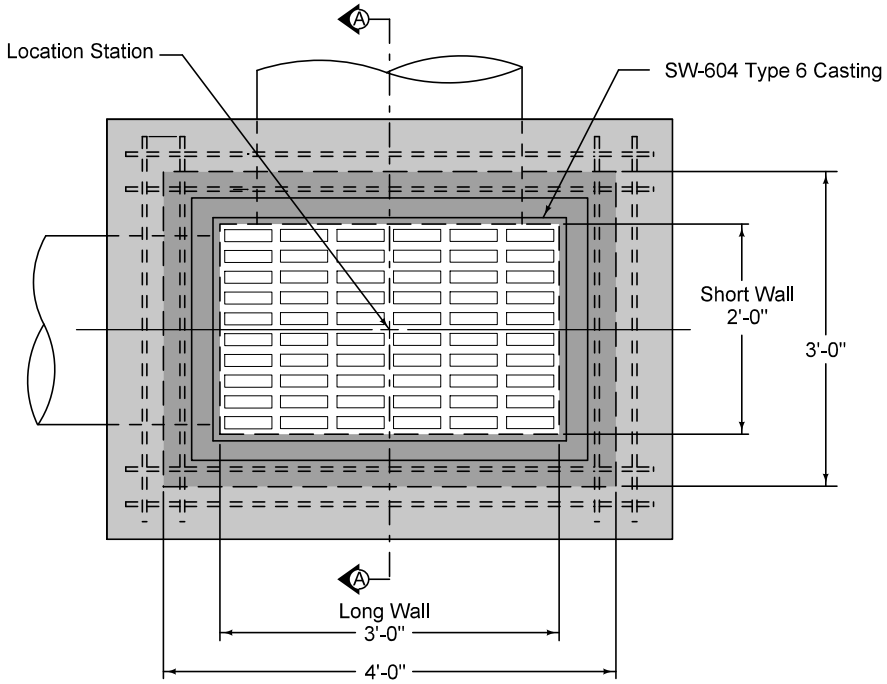


SECTION A-A

① Install four #4 diagonal bars at all pipe openings.

② Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

③ 12 inch minimum wall height above all pipes.



PLAN

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	15"	18"
Long Wall	24"	30"

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

FIGURE 6010.511 | STANDARD ROAD PLAN | SW-511 | SHEET 1 of 1

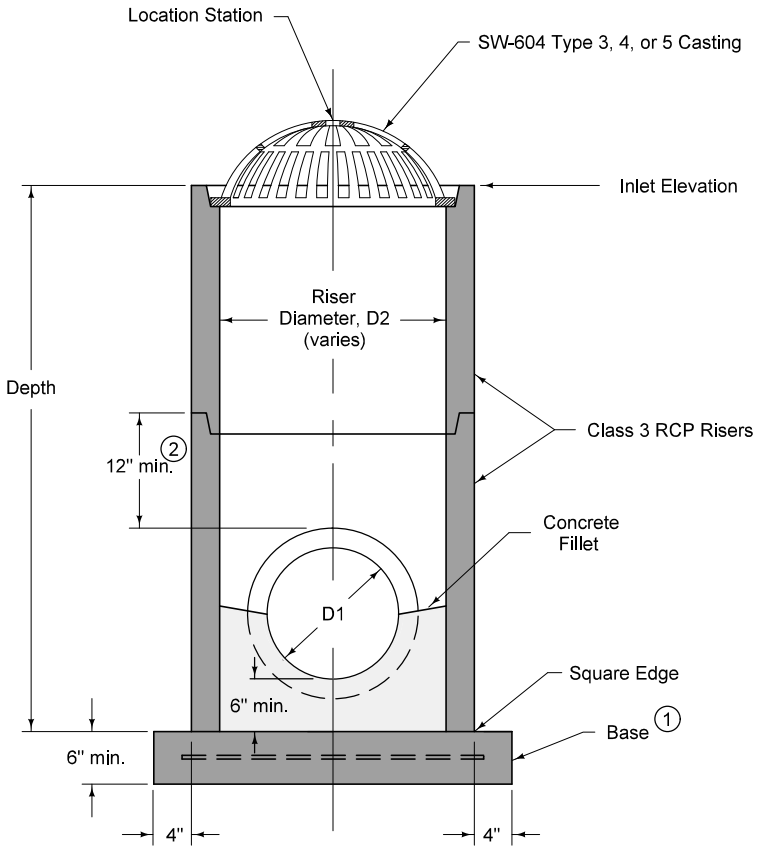
REVISIONS: Added Class I Bedding Material.

Paul D. Wigand, SUDAS DIRECTOR

Stuart Nicholson, DESIGN METHODS ENGINEER

RECTANGULAR AREA INTAKE

FIGURE 6010.511 | SHEET 1 OF 1



TYPICAL SECTION

CASE 1

1. Precast (shown) or cast-in-place base:
   - Precast: 6 inch thick concrete with #6 welded wire mesh on 4 inch centers (WWF 4" x 4"). Center mesh vertically within base.
   - Cast-in-place: 8 inch thick non-reinforced concrete.
2. 12 inch minimum riser height above all pipes.

INTAKE SIZE - CASE 1	
Outlet Pipe Diameter, D1	Minimum Riser Diameter, D2
12"	18"
15"	24"
18"	24"
21"	30"
24"	30"
27"	36"

FIGURE 6010.512 | SHEET 1 OF 2

SUDAS | IOWA DOT

REVISION 4 04-21-20

FIGURE 6010.512 | STANDARD ROAD PLAN | SW-512

SHEET 1 of 2

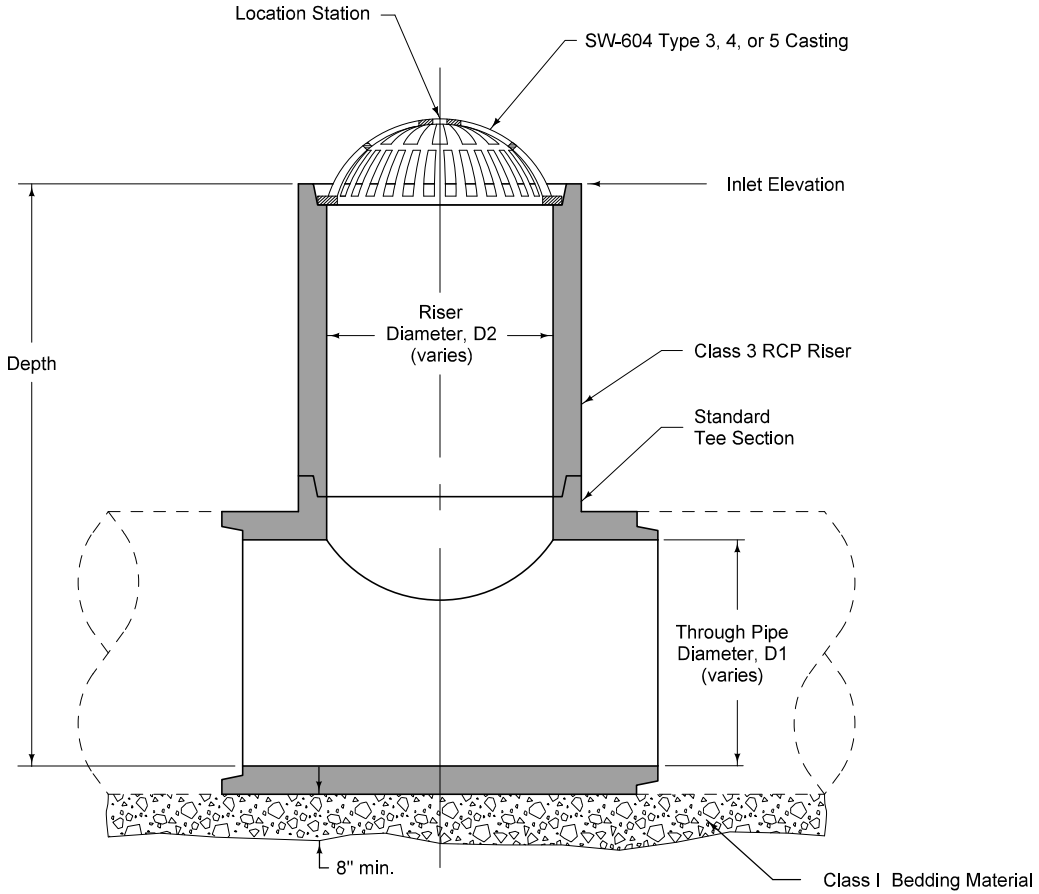
REVISIONS: Changed 1 to I on Bedding Material

Paul D. Wigant
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

CIRCULAR AREA INTAKE

③ Minimum riser diameter is 18 inches.



TYPICAL SECTION

CASE 2

INTAKE SIZE - CASE 2	
Through Pipe Diameter, D1	Maximum ③ Riser Diameter, D2
18"	18"
21"	18"
24"	24"
27"	24"
30"	30"
36" or more	36"

SUDAS | IOWA DOT | REVISION 4 04-21-20

FIGURE 6010.512 | STANDARD ROAD PLAN | SW-512 | SHEET 2 of 2

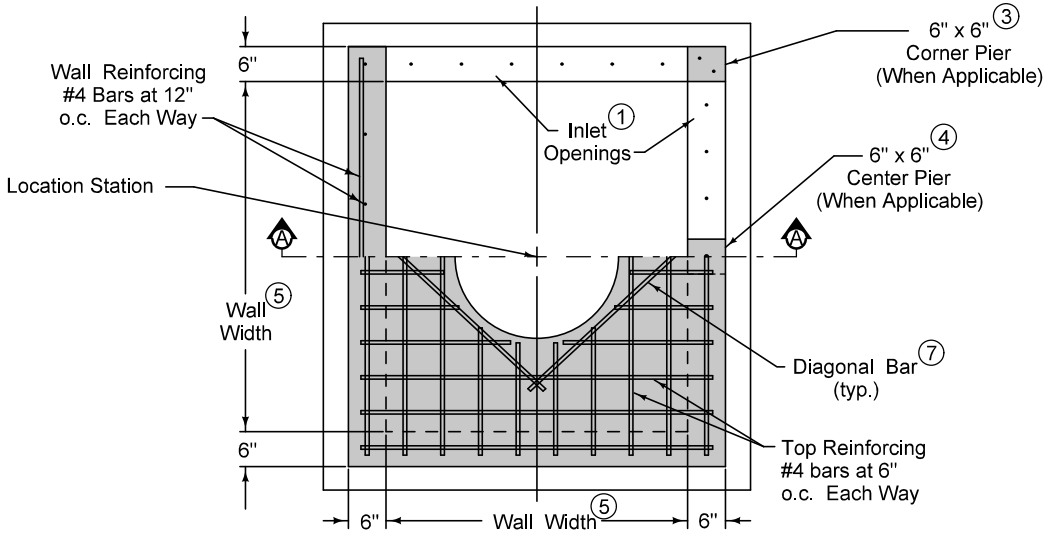
REVISIONS: Changed 1 to I on Bedding Material.

Paul D. Wigand
SUDAS DIRECTOR

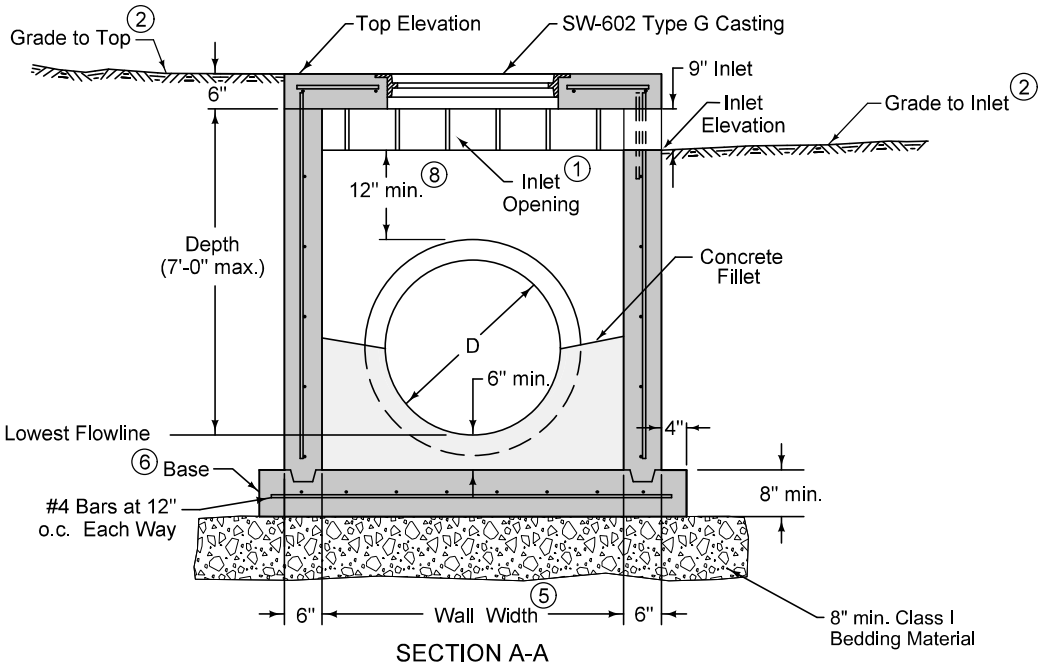
Stuart Nicholson
DESIGN METHODS ENGINEER

CIRCULAR AREA INTAKE

FIGURE 6010.512 SHEET 2 OF 2



PLAN



SECTION A-A

Structure may be built with openings on any or all sides. Provide openings and orientation as specified in the contract documents.

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

① Construct inlet openings with 15-inch #4 epoxy-coated bars at 8 inches on center. Embed bars a minimum of 3 inches into walls and top at all openings.

② Grade to inlet elevation on open sides. Grade to top elevation on closed sides.

③ Corner pier required between openings of two adjacent walls. Extend wall reinforcing vertically through pier. Install one additional 15-inch #4 bar in pier.

④ Center pier required at center of any inlet opening with length of 5 feet or greater. Extend wall reinforcing vertically through pier. Install one additional 15-inch #4 bar in pier.

⑤ Wall widths vary with pipe diameter. Provide 6 inches of wall width (minimum) each side of pipe opening. Minimum wall width is 36 inches. Maximum wall width is 72 inches.

⑥ Cast-in-place base shown. If base is precast integral with walls, the footprint of base is not required to extend beyond the outer edge of the walls.

⑦ Install four #4 diagonal bars at all pipe openings.

⑧ 12" minimum wall height above all pipes.

SUDAS	IOWADOT	REVISION 2	04-21-20
FIGURE 6010.513	STANDARD ROAD PLAN	SW-513	SHEET 1 of 1

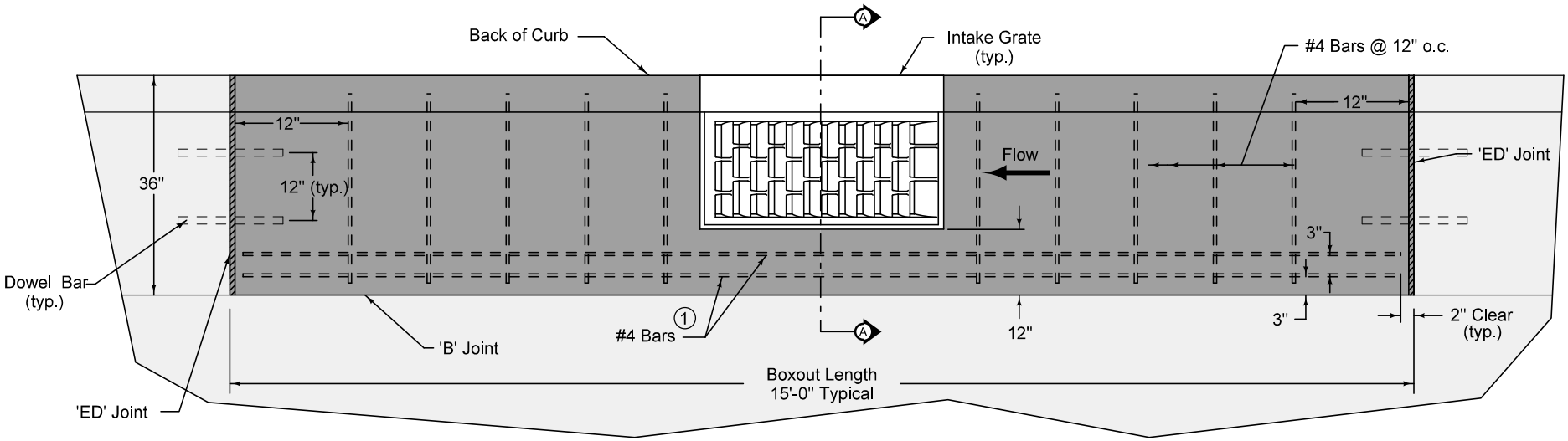
REVISIONS: Added Class I Bedding Material.

Paul D. Wigand
SUDAS DIRECTOR

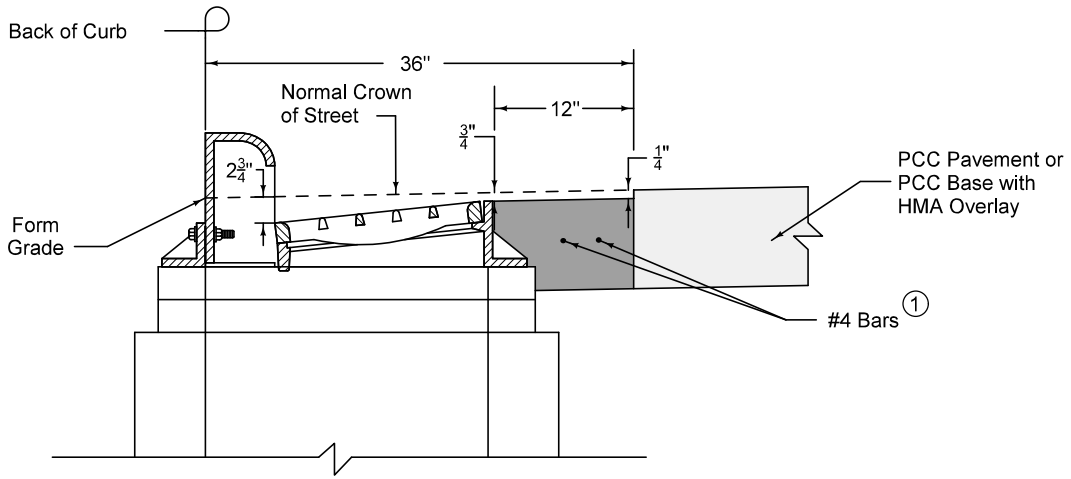
Stuart Nicholson
DESIGN METHODS ENGINEER

OPEN-SIDED AREA INTAKE

FIGURE 6010.513 SHEET 1 OF 1



BOXOUT IN PCC PAVEMENT AND PCC BASE WITH HMA OVERLAY



SECTION A-A

Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

For retrofit intakes, match existing concrete pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the boxout.

(1) Center bars vertically within slab.

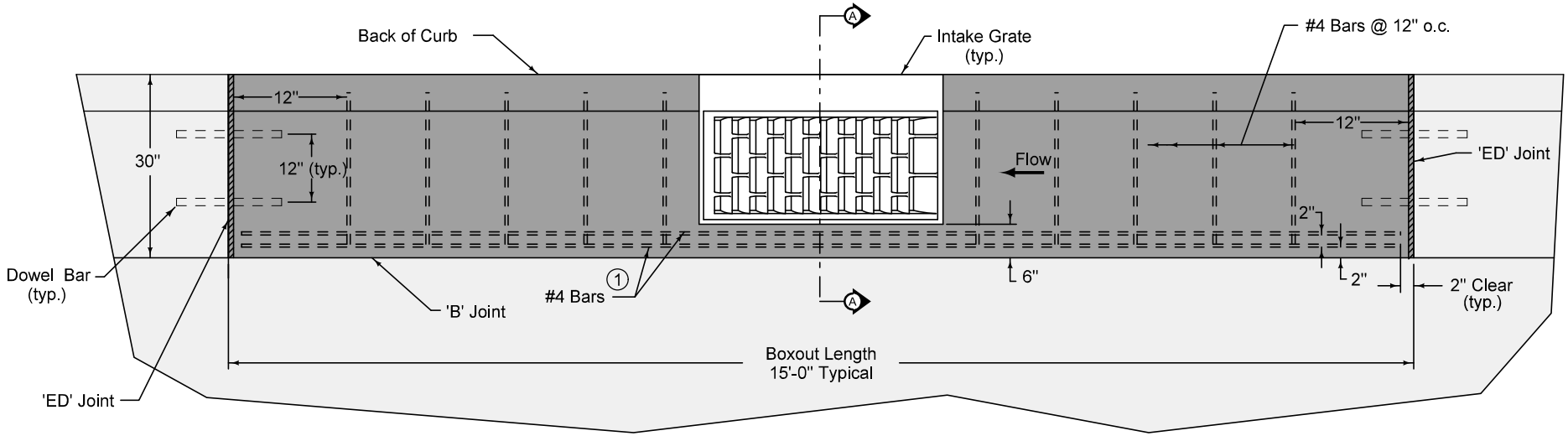
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.514	STANDARD ROAD PLAN	SW-514
		SHEET 1 of 3

REVISIONS: Added dimension to back of grate. Updated line work and Iowa DOT and SUDAS logo.

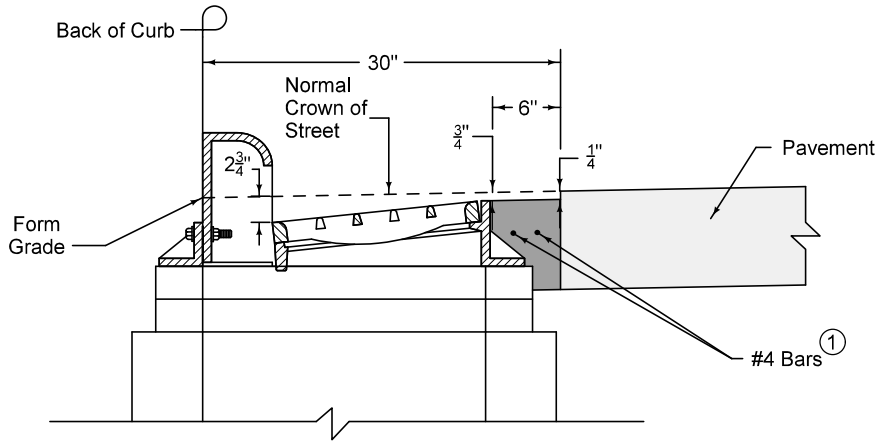
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

BOXOUT FOR GRATE INTAKES

FIGURE 6010.514 SHEET 1 OF 3



BOXOUT IN PCC CURB AND GUTTER



SECTION A-A

1 Center bars vertically within slab.

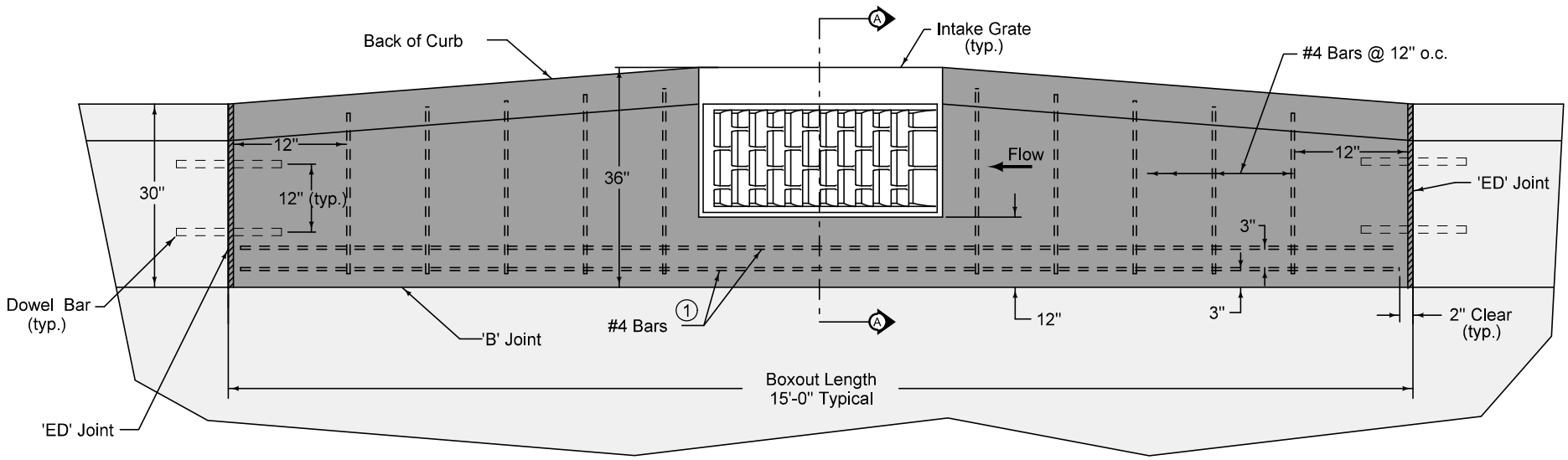
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.514	STANDARD ROAD PLAN	SW-514
		SHEET 2 of 3

REVISIONS: Added dimension to back of grate. Updated line work and Iowa DOT and SUDAS logo.

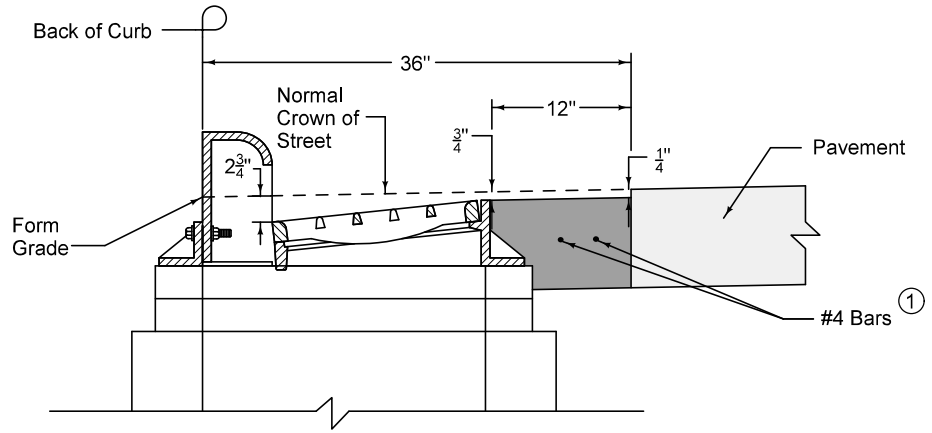
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

BOXOUT FOR GRATE INTAKES

FIGURE 6010.514 SHEET 2 OF 3



ALTERNATE BOXOUT IN PCC CURB AND GUTTER



SECTION A-A

Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjacent joint spacing may need to be field adjusted to fit boxouts.

For retrofit intakes, match existing concrete pavement joints. Stop any transverse pavement joints that do not conform to the minimum spacing requirements at the edge of the boxout.

(1) Center bars vertically within slab.

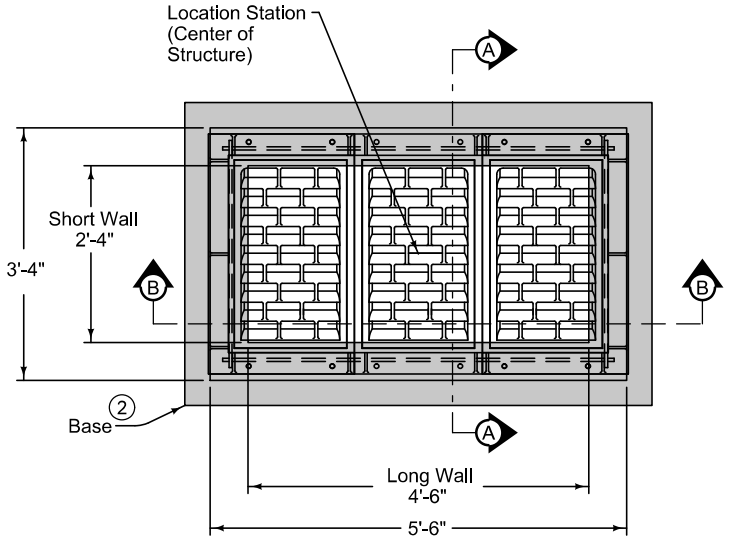
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.514	STANDARD ROAD PLAN	SW-514
		SHEET 3 of 3

REVISIONS: Added dimension to back of grate. Updated line work and Iowa DOT and SUDAS logo.

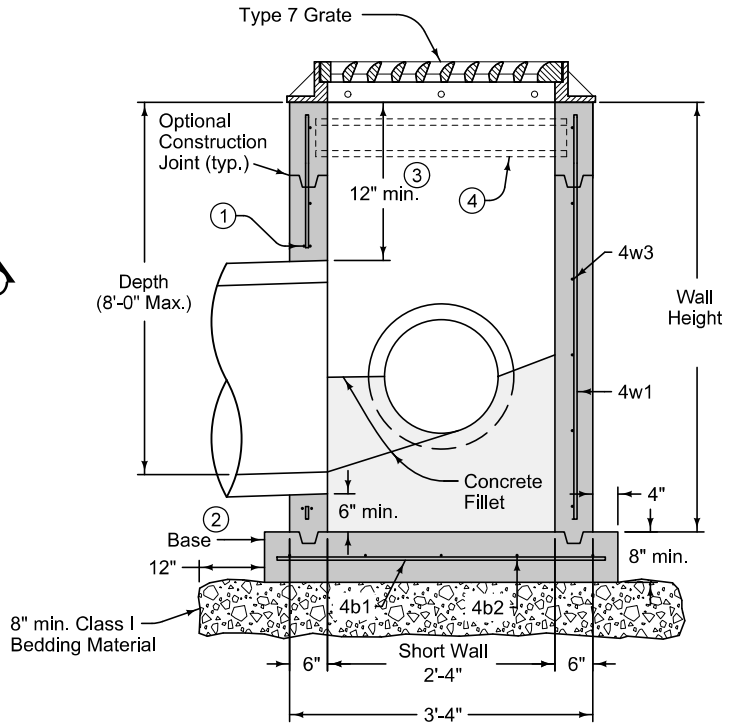
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

BOXOUT FOR GRATE INTAKES

FIGURE 6010.514 SHEET 3 OF 3



PLAN



SECTION A-A

1. Provide two #4 hoop bars at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. If required by casting manufacturer, provide support beam under all frame joints. Modify structure walls as required to provide pocket for beam.

FIGURE 6010.515 | SHEET 1 OF 2

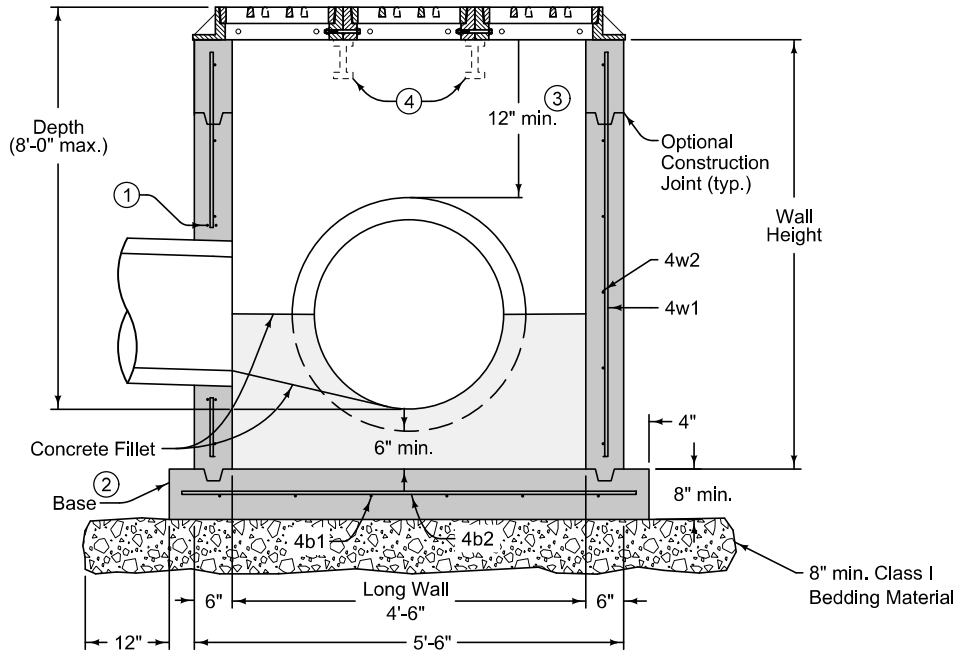
SUDAS	IOWA DOT	REVISION: New 04-21-20
FIGURE 6010.515	STANDARD ROAD PLAN	SW-515
		SHEET 1 of 2

REVISIONS: New.

Paul D. Wigand
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

TRIPLE RECTANGULAR AREA INTAKE



SECTION B-B

1. Provide two #4 hoop bars at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. 12 inch minimum wall height above all pipes.
4. If required by casting manufacturer, provide support beam under all frame joints. Modify structure walls as required to provide pocket for beam.

MAXIMUM PIPE DIAMETERS		
Pipe Location	Precast Structure	Cast-in-place Structure
Short Wall	18"	21"
Long Wall	36"	42"

REINFORCING BAR LIST						
Mark	Size	Location	Shape	Count	Length	Spacing
4b1	4	Base	——	6	3'-6"	12"
4b2	4	Base	——	4	5'-8"	12"
4w1	4	Walls	——	20	Wall Height minus 4"	12"
4w2	4	Short Wall	——	Varies	3'-0"	12"
4w3	4	Long Wall	——	Varies	5'-2"	12"

SUDAS | IOWADOT

REVISION: New 04-21-20

FIGURE 6010.515 | STANDARD ROAD PLAN | SW-515

SHEET 2 of 2

REVISIONS: New.

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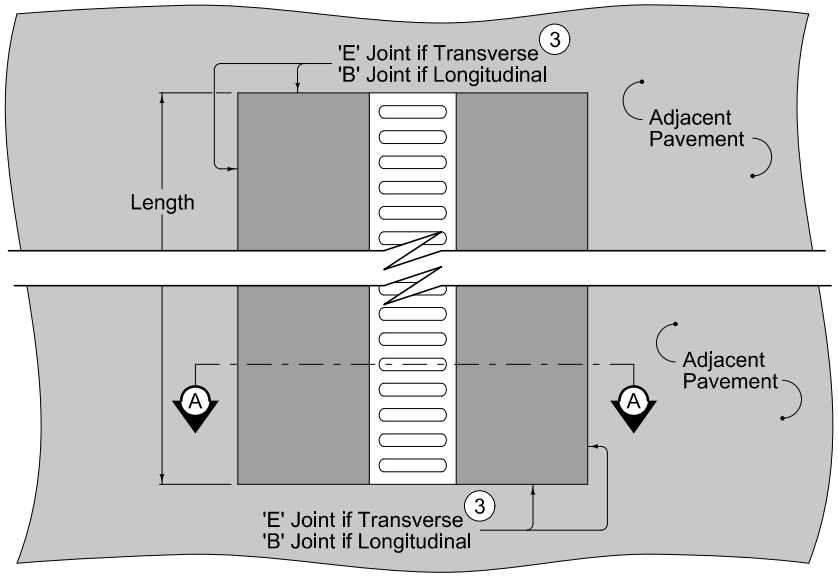
SUDAS DIRECTOR

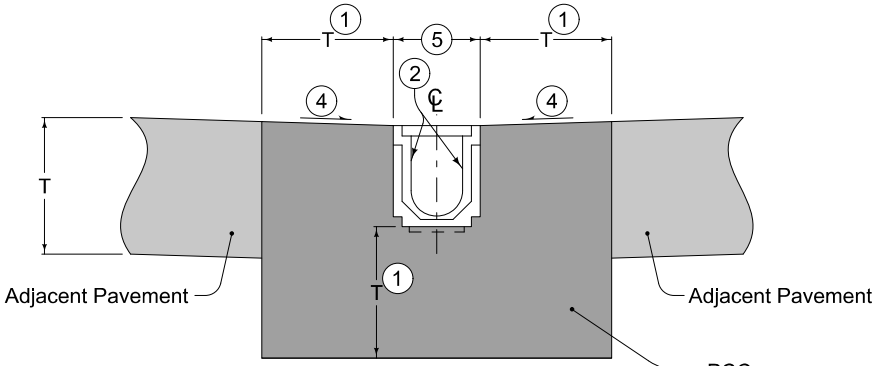
Stuart Nicholson
DESIGN METHODS ENGINEER

TRIPLE RECTANGULAR AREA INTAKE

FIGURE 6010.515 | SHEET 2 OF 2



PLAN



SECTION A-A

1. 6 inches or same as thickness of adjacent pavement, whichever is greater.
2. Linear Trench Drain.
3. For joint details, see PV-101.
4. Slope same as adjacent pavement.
5. Width as determined by manufacturer. Minimum 6 inches.

SUDAS	IOWA DOT	REVISION 2 04-21-20
FIGURE 6010.521	STANDARD ROAD PLAN	SW-521
		SHEET 1 of 2

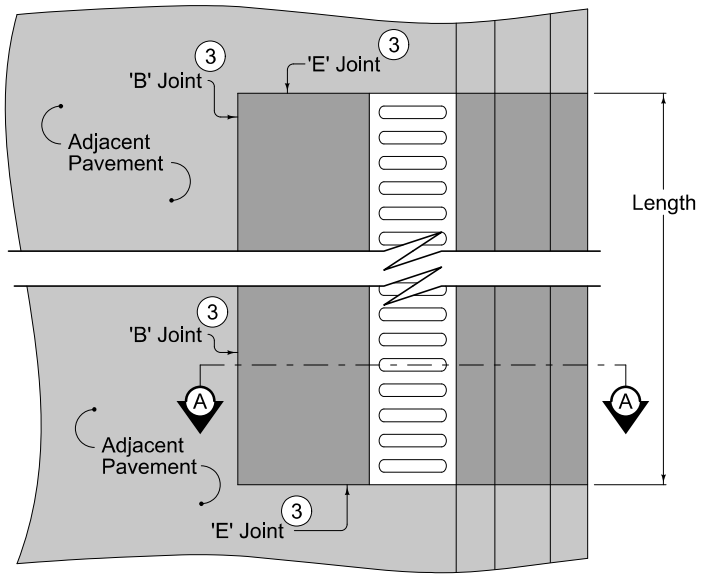
REVISIONS: Converted to joint standard. Modified circle note 1.

Paul D. Wigand
SUDAS DIRECTOR

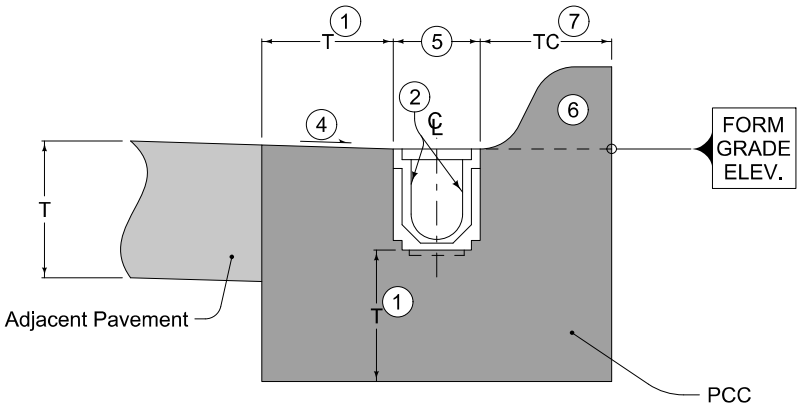
DESIGN METHODS ENGINEER

LINEAR TRENCH DRAIN

FIGURE 6010.521 | SHEET 1 OF 2



PLAN



SECTION A-A

1. 6 inches or same as thickness of adjacent pavement, whichever is greater.
2. Linear Trench Drain.
3. For joint details, see PV-101.
4. Slope same as adjacent pavement.
5. Width as determined by manufacturer. Minimum 6 inches.
6. Standard or sloped curb. For curb details, see PV-102.
7. Minimum thickness same as thickness of adjacent pavement or curb width, whichever is greater.

SUDAS	IOWADOT	REVISION 2 04-21-20
FIGURE 6010.521	STANDARD ROAD PLAN	SW-521 SHEET 2 of 2

REVISIONS: Converted to joint standard. Modified circle note 1.

Paul D. Wigand — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

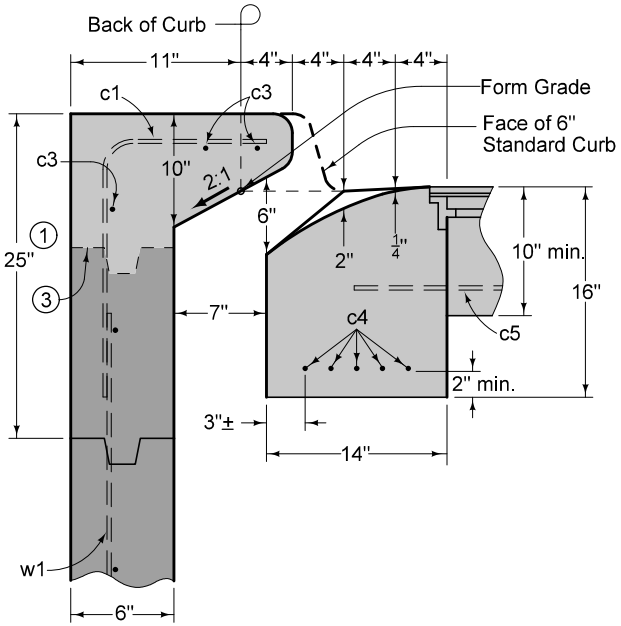
LINEAR TRENCH DRAIN

FIGURE 6010.521 SHEET 2 OF 2

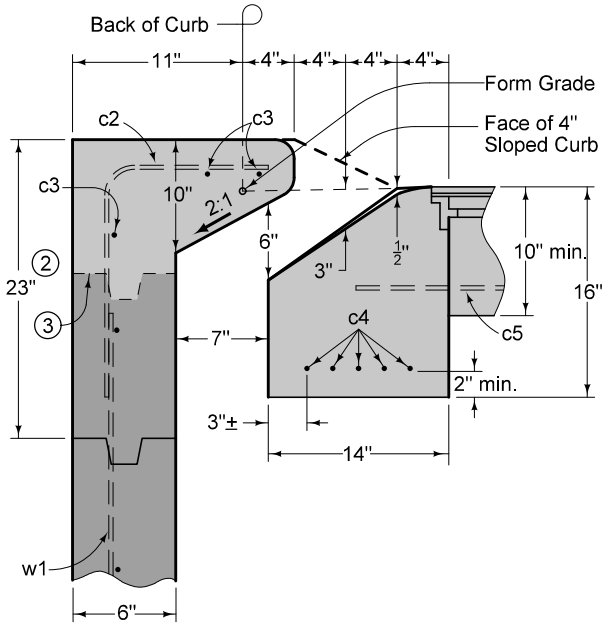
(1) 39 inches when attaching the SW-542 extension unit.

(2) 37 inches when attaching the SW-542 extension unit.

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



INSERT
(6 Inch Standard Curb)



INSERT
(4 Inch Sloped Curb)

FIGURE 6010.541 | SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 5 04-21-20
FIGURE 6010.541	STANDARD ROAD PLAN	SW-541
		SHEET 1 of 2

REVISIONS: Changed wall walls to 6 inch reinforced. Modified TYPICAL SECTION and c1 and c2 bar lengths. Added note 4. Added Class I bedding material.

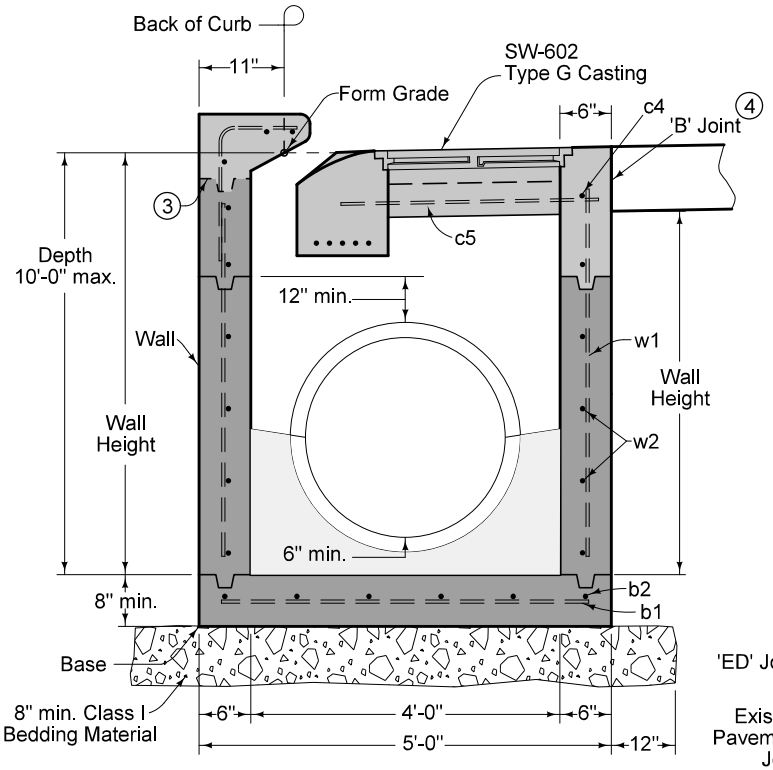
Paul D. Wigand — SUDAS DIRECTOR
Stuart Nicholson — DESIGN METHODS ENGINEER

OPEN-THROAT CURB INTAKE UNDER PAVEMENT

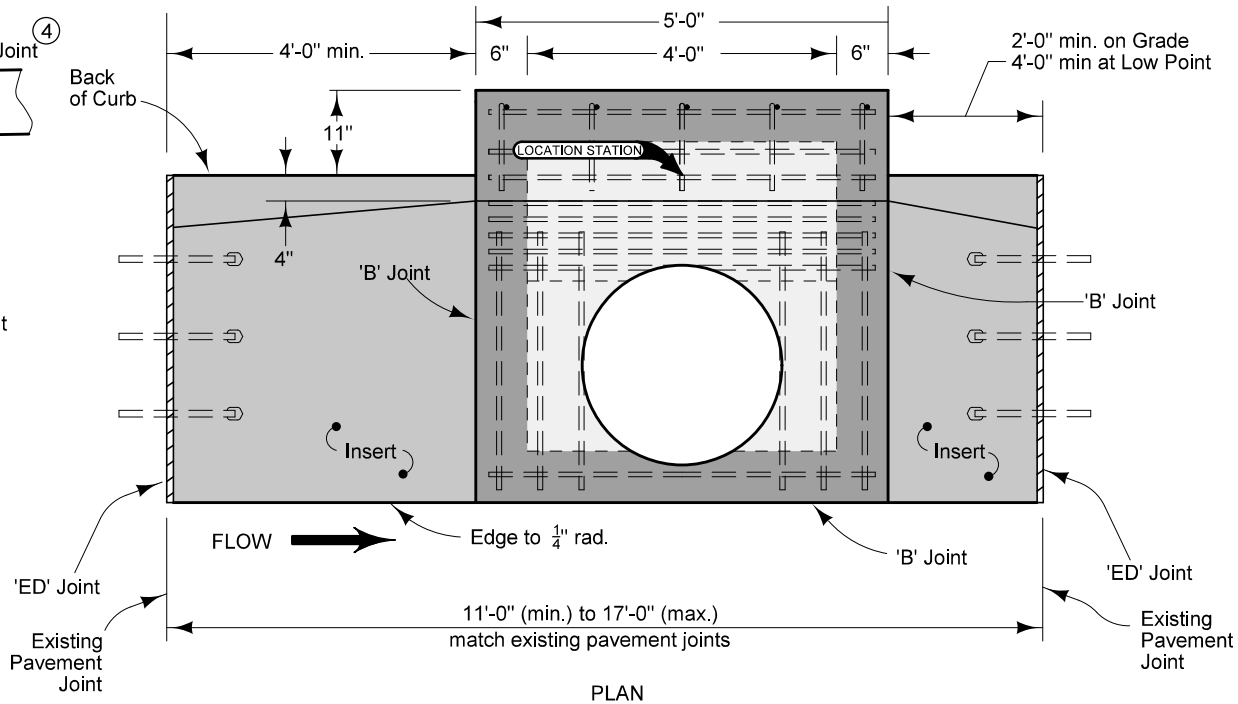
For joint details, refer to PV-101.

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

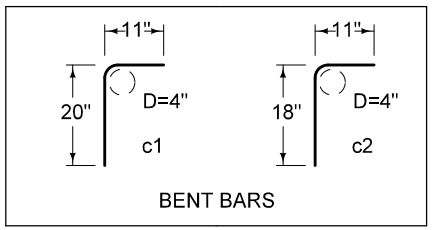
④ Top of well flush with pavement.



TYPICAL SECTION



PLAN



BENT BARS

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
b1	4	Base	——	4'-6"	11"
b2	4	Base	——	4'-6"	11"
w1	4	Wall	——	Wall Height minus 4"	14"
w2	4	Wall	——	4'-8"	12"
c1	4	Top	⌜	2'-7"	14"
c2	4	Top	⌜	2'-5"	14"
c3	4	Top	——	4'-8"	See Detail
c4	4	Top	——	4'-8"	See Detail
c5	4	Top	——	3'-2"	See Detail

MAXIMUM PIPE DIAMETER	
Precast	30"
Cast-in-Place	36"

FIGURE 6010.541 | SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 5 04-21-20

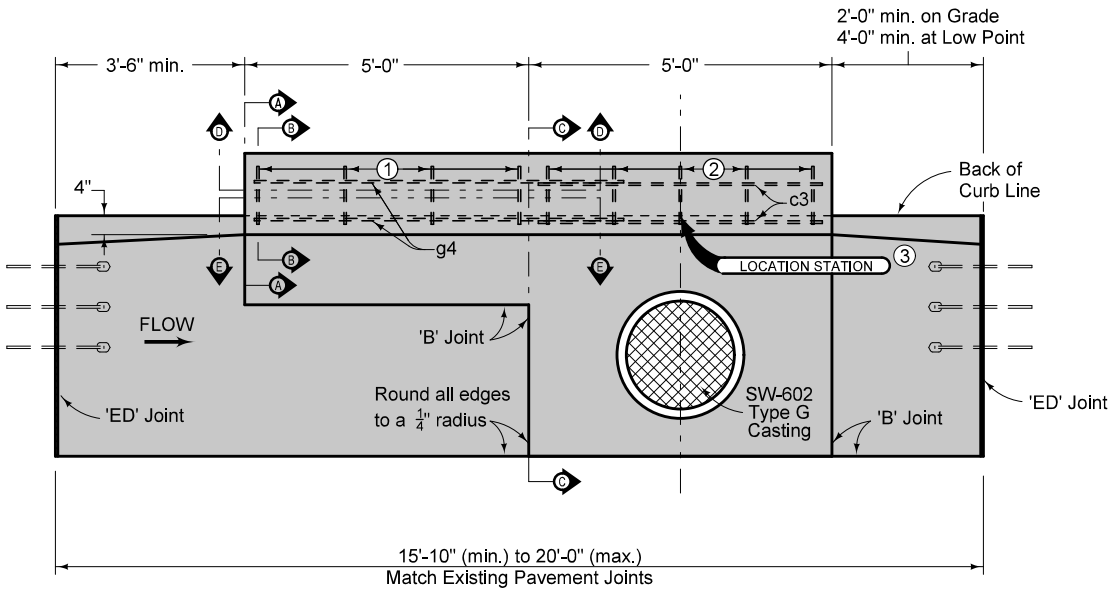
FIGURE 6010.541 | STANDARD ROAD PLAN | SW-541 | SHEET 2 of 2

REVISIONS: Changed wall walls to 6 Inch reinforced. Modified TYPICAL SECTION and c1 and c2 bar lengths. Added note 4. Added Class I bedding material.

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.

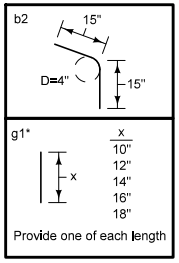
② c1 for 6 inch standard curb; c2 for 4 inch sloped curb. See SW-541 for reinforcing.

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

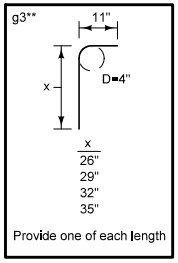
Placing sequence: 1. Base; 2. Walls and Extension; 3. Top; 4. Insert

REINFORCING BAR LIST

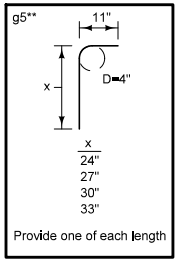
BAR	SIZE	LOCATION	SHAPE	NO.	LENGTH	WEIGHT	SPACING
b2	4	Intake Wall	⌐	3	2'-6"	5.0	9"
f1	4	Bottom	—	3	4'-9"	9.5	9"
f2	4	Bottom	—	4	1'-7"	4.2	18"
g1	4	Wall	—	5	Varies*	Varies*	12"
g2	4	Wall	—	1	4'-8"	3.1	-
g3	4	Top	⌐	4	Varies**	Varies**	18"
g4	4	Top	—	3	6'-4"	12.7	-
g5	4	Top	⌐	4	Varies**	Varies**	18"



Provide one of each length



Provide one of each length



Provide one of each length

INTERIM

REVISION	
4	04-21-20

FIGURE 6010.542 | STANDARD ROAD PLAN | SW-542

SHEET 1 of 4

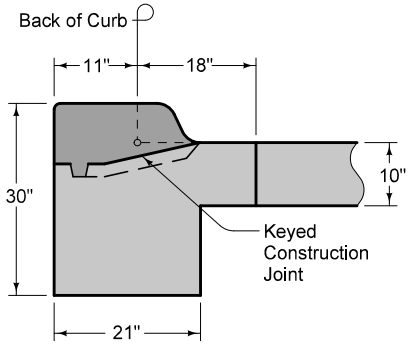
REVISIONS: Modified box dimensions on Sheets 1, 2, and 3.

Paul D. Wigand — SUDAS DIRECTOR

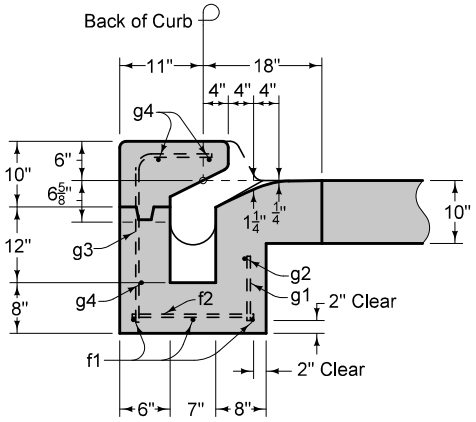
Stuart Nicholson — DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

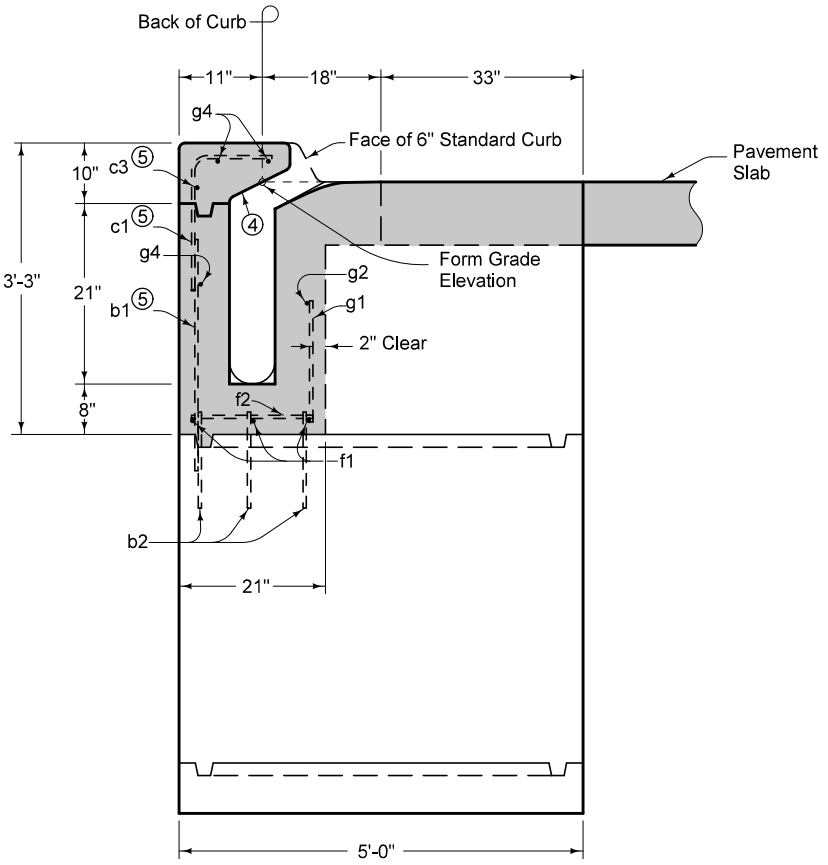
FIGURE 6010.542 | SHEET 1 OF 4



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

INTERIM

REVISION 4 04-21-20

FIGURE 6010.542 | STANDARD ROAD PLAN | SW-542

SHEET 2 of 4

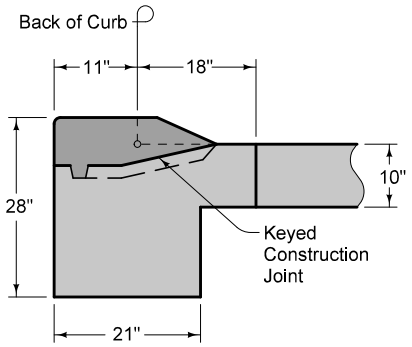
REVISIONS: Modified box dimensions on Sheets 1, 2, and 3.

Paul D. Wigand
SUDAS DIRECTOR

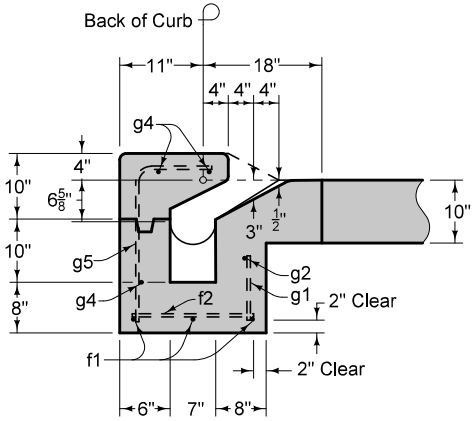
Stuart Nicholson
DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

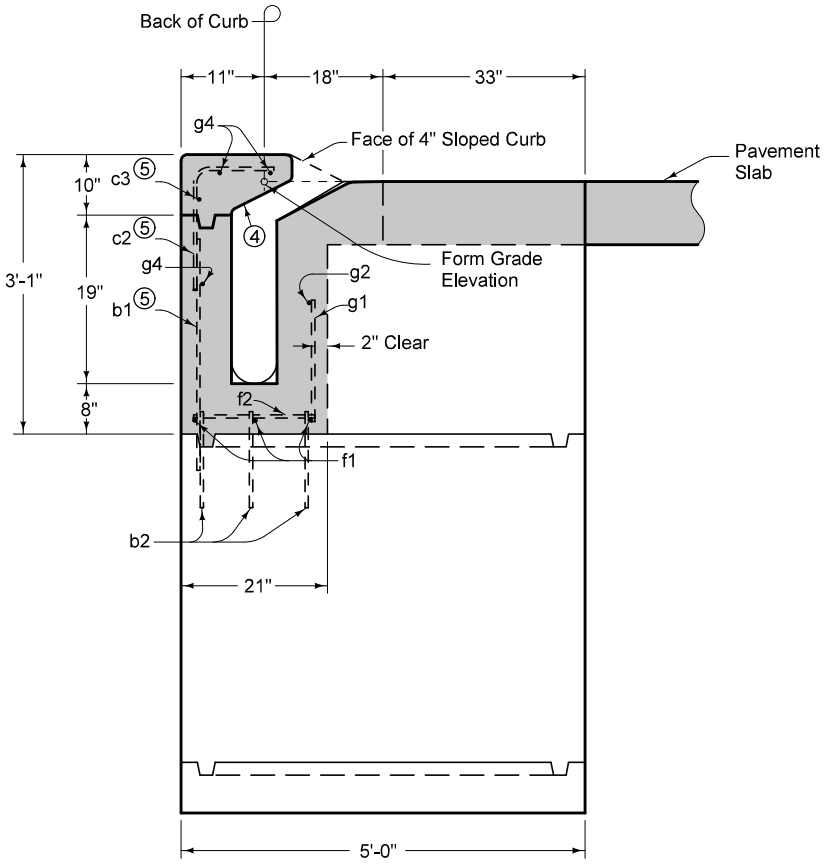
FIGURE 6010.542 SHEET 2 OF 4



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

INTERIM

REVISION	
4	04-21-20

FIGURE 6010.542 | **STANDARD ROAD PLAN** | **SW-542**

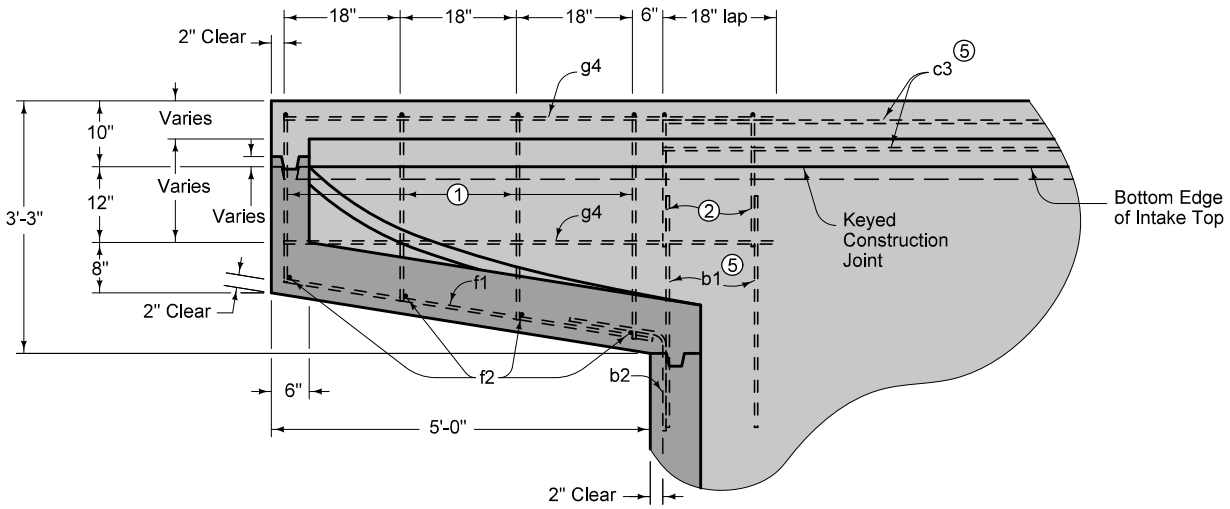
SHEET 3 of 4

REVISIONS: Modified box dimensions on Sheets 1, 2, and 3.

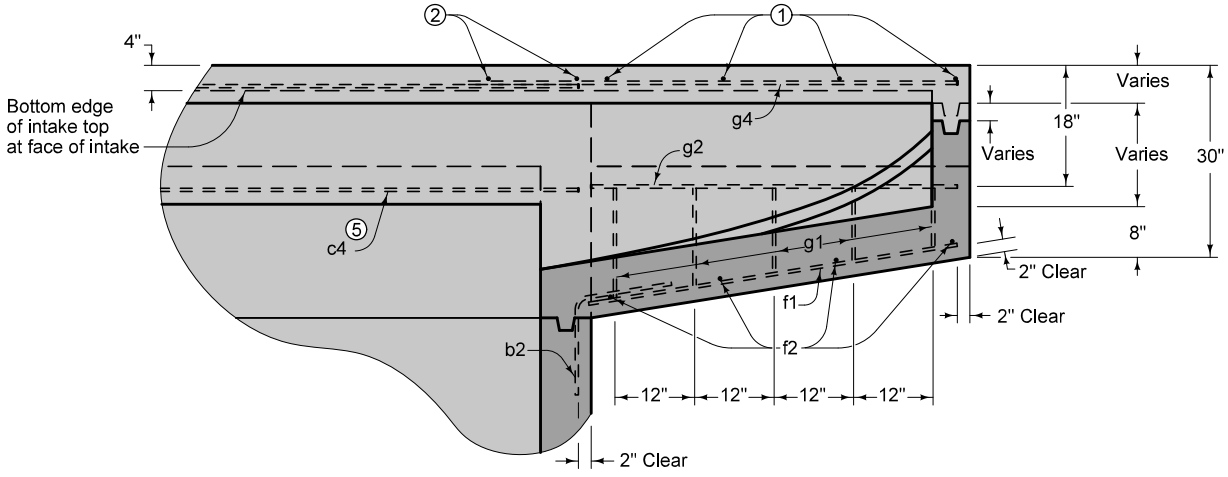
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
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.

INTERIM

REVISION	
4	04-21-20

FIGURE 6010.542 | **STANDARD ROAD PLAN** | **SW-542**

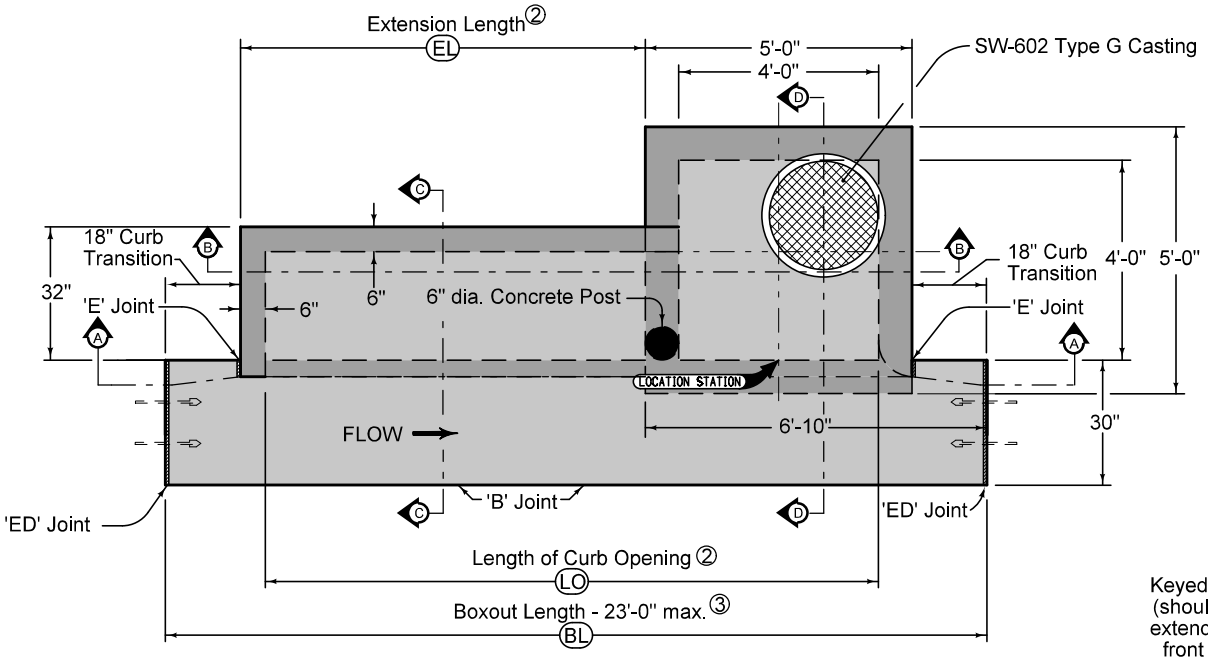
SHEET 4 of 4

REVISIONS: Modified box dimensions on Sheets 1, 2, and 3.

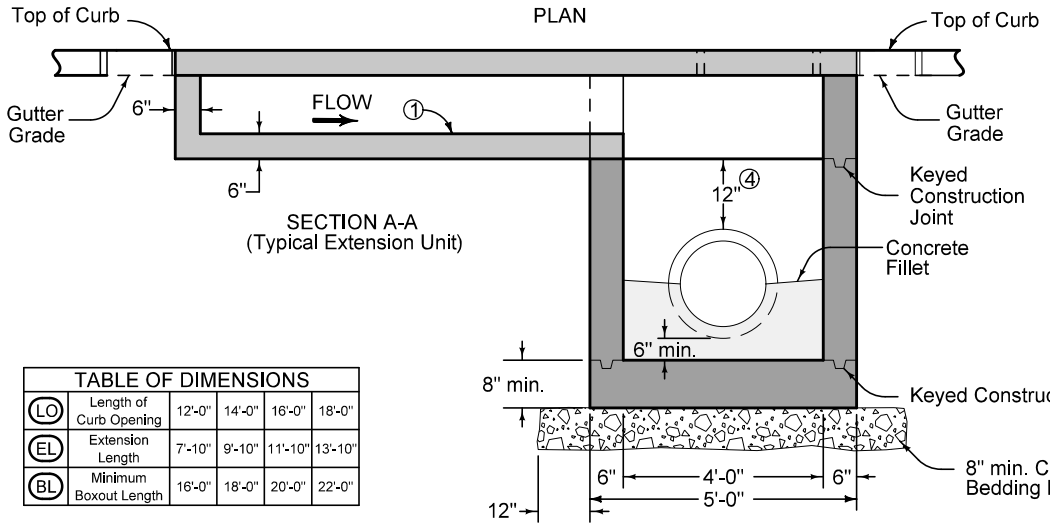
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

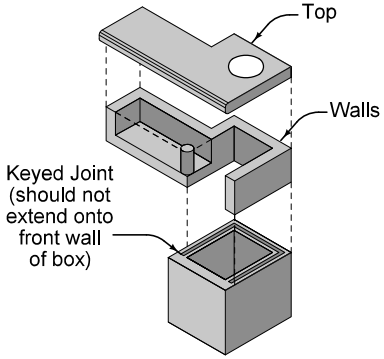


PLAN



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

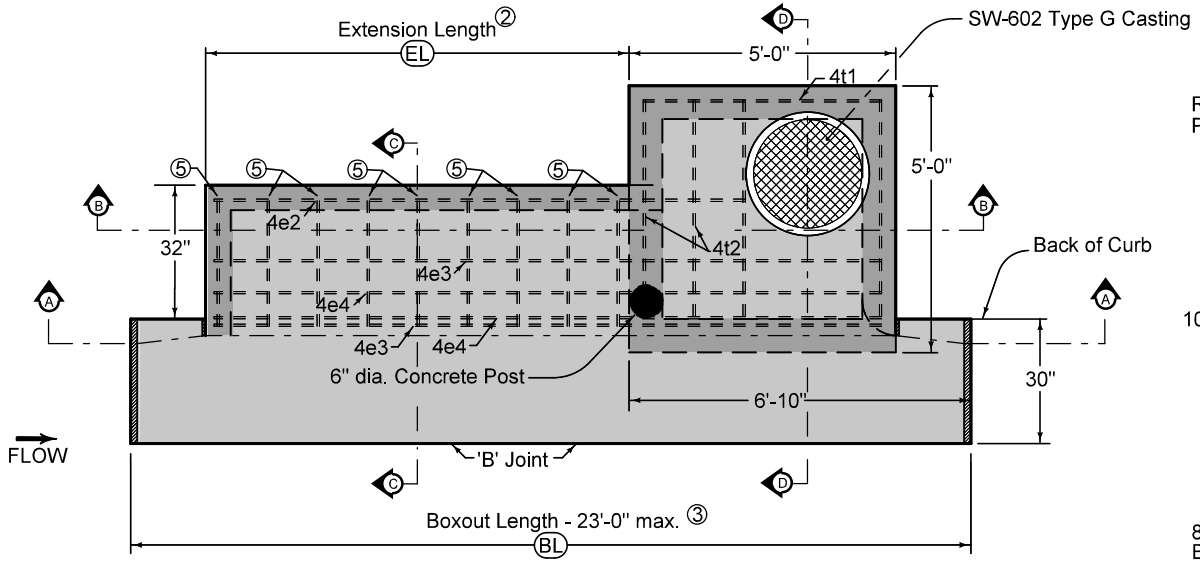
FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545 | SHEET 1 of 4

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.

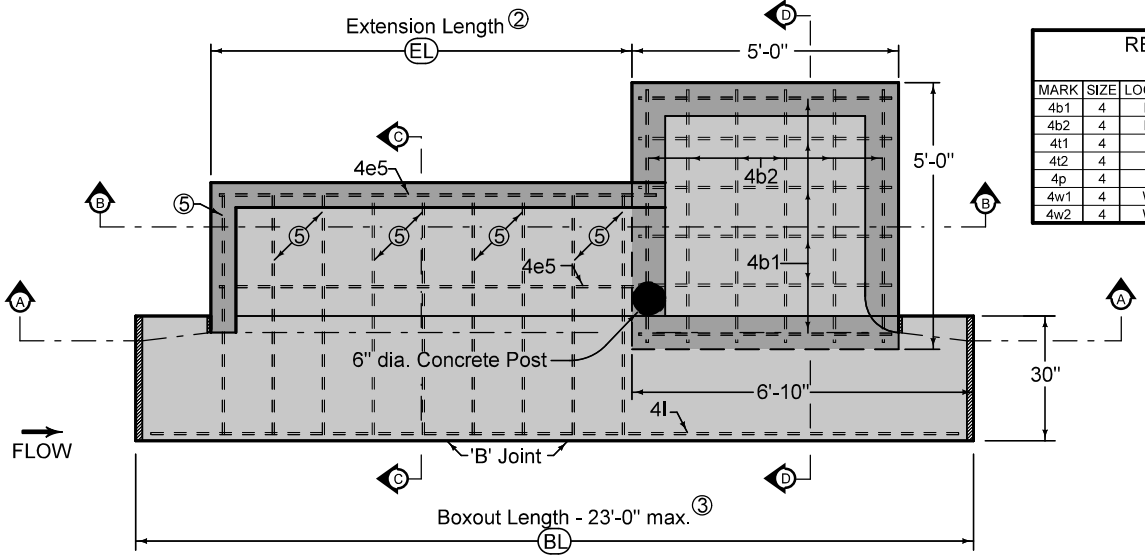
Paul D. Wigard
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

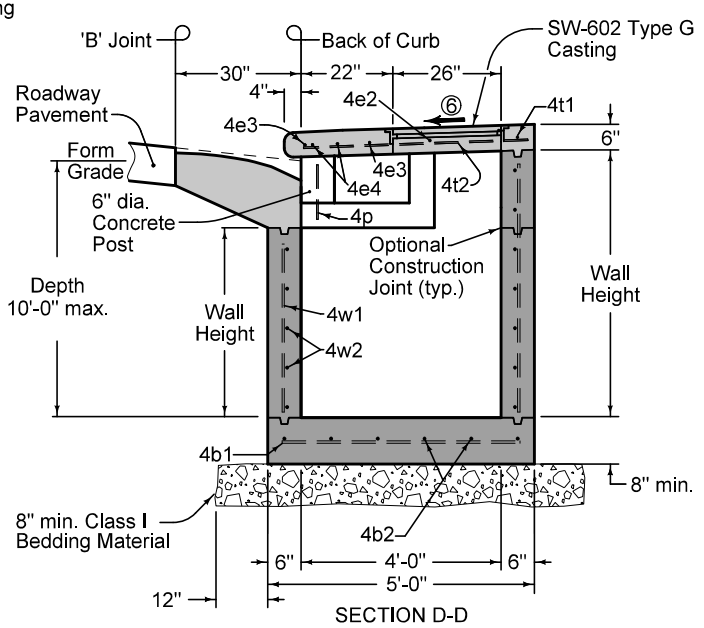
SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING



PLAN
TOP REINFORCING PLACEMENT



PLAN
BOTTOM REINFORCING PLACEMENT



SECTION D-D

REINFORCING BAR LIST
Intake Well

MARK	SIZE	LOCATION	NO.	LENGTH	SPACING
4b1	4	Base	6	4'-6"	11"
4b2	4	Base	6	4'-6"	11"
4t1	4	Top	1	4'-8"	12"
4t2	4	Top	4	4'-3"	See Detail
4p	4	Post	1	13"	
4w1	4	Walls	16	Wall Height minus 4"	14"
4w2	4	Walls	Varies	4'-8"	12"

② Other lengths of opening may be constructed by varying the length of the extension and the rebar.

③ Includes 2 inches for 'ED' Joints.

⑤ 4e1 or 4e6. See Sheets 3 and 4.

⑥ Slope of 1.5% or as specified in the contract documents.

SUDAS | IOWADOT

REVISION
5 | 04-21-20

FIGURE 6010.545 | STANDARD ROAD PLAN

SW-545

SHEET 2 of 4

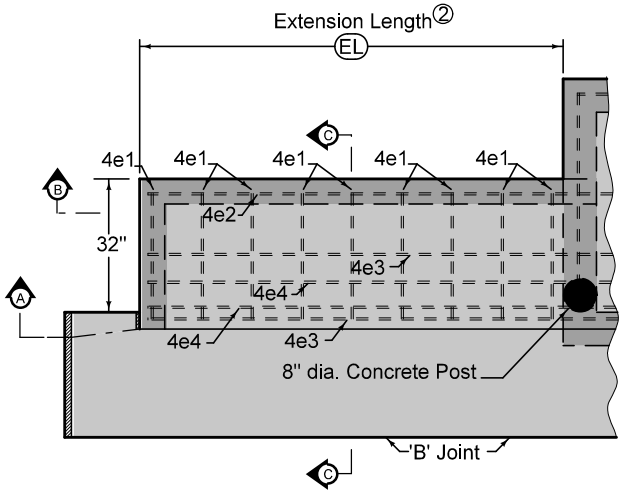
REVISIONS: Changed well walls to 6 Inch reinforced. Modified 4b1 and 4b2 bar spacing. Modified bars 4e1 and 4e6. Modified SECTION C-C on Sheets 3 and 4.

Paul D. Wigand
SUDAS DIRECTOR

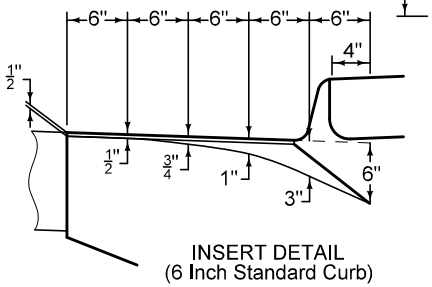
Stuart Nicholson
DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

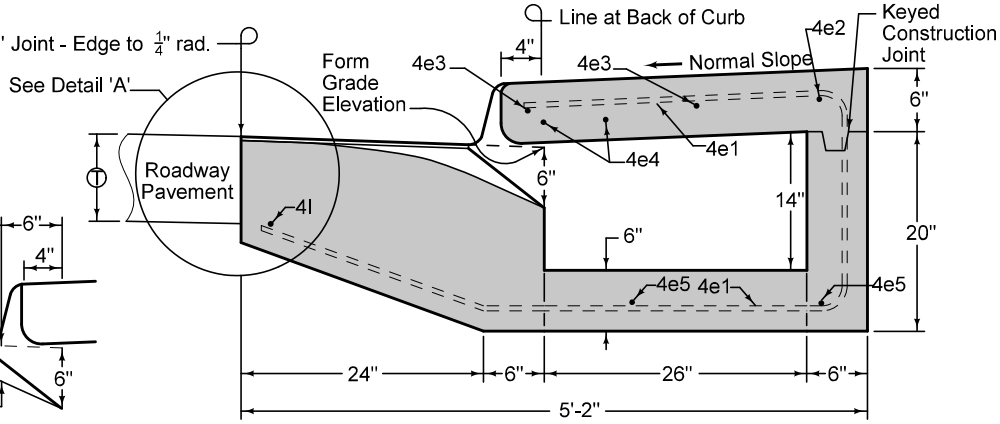
FIGURE 6010.545 SHEET 2 OF 4



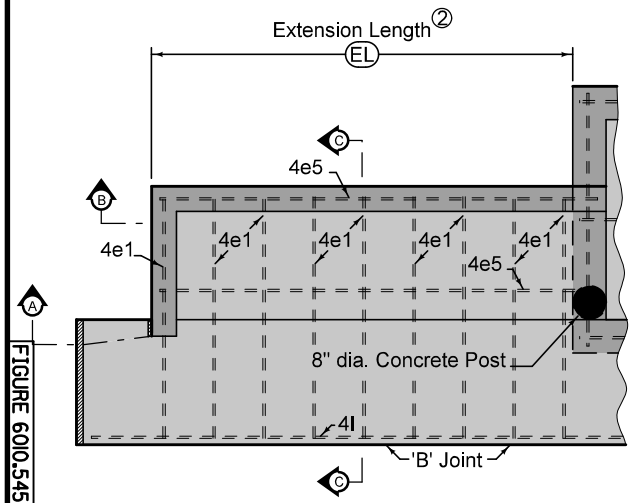
PLAN
TOP OF EXTENSION REINFORCING PLACEMENT



INSERT DETAIL
(6 Inch Standard Curb)



SECTION C-C
(6 Inch Standard Curb)



PLAN
BOTTOM OF EXTENSION REINFORCING PLACEMENT

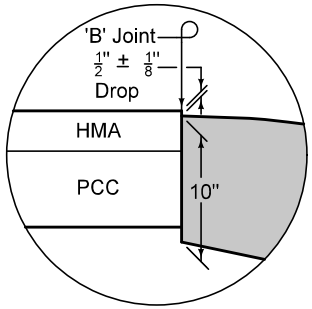
REINFORCING BAR LIST (LO) = 12'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	9	9'-5½"	56.9	12"
4e2	4	Top	1	10'-0"	6.7	
4e3	4	Top	2	12'-9"	17.0	15½"
4e4	4	Top	2	12'-9"	17.0	6"
4e5	4	Base	2	8'-2"	10.9	22"
4l*	4	Insert	1	15'-10"	10.6	
* With 16'-6" Boxout.				Total	119.1 lbs.	

REINFORCING BAR LIST (LO) = 14'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	11	9'-5½"	69.5	12"
4e2	4	Top	1	12'-0"	8.0	
4e3	4	Top	2	14'-9"	19.7	15½"
4e4	4	Top	2	14'-9"	19.7	6"
4e5	4	Base	2	10'-2"	13.6	22"
4l*	4	Insert	1	17'-10"	11.9	
* With 18'-6" Boxout.				Total	142.4 lbs.	

REINFORCING BAR LIST (LO) = 16'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	13	9'-5½"	82.1	12"
4e2	4	Top	1	14'-0"	9.3	
4e3	4	Top	2	16'-9"	22.4	15½"
4e4	4	Top	2	16'-9"	22.4	6"
4e5	4	Base	2	12'-2"	16.2	22"
4l*	4	Insert	1	19'-10"	13.2	
* With 20'-6" Boxout.				Total	165.6 lbs.	

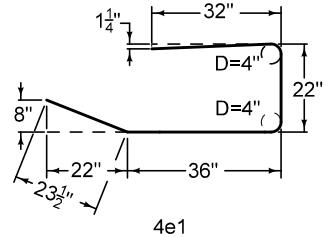
REINFORCING BAR LIST (LO) = 18'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	15	9'-5½"	94.8	12"
4e2	4	Top	1	16'-0"	10.7	
4e3	4	Top	2	18'-9"	25	15½"
4e4	4	Top	2	18'-9"	25	6"
4e5	4	Base	2	14'-2"	18.9	22"
4l*	4	Insert	1	21'-10"	14.6	
* With 22'-6" Boxout.				Total	189.0 lbs.	

6 INCH STANDARD CURB



DETAIL 'A'
Use when adjacent pavement is HMA or composite.

BENT BAR DETAILS



4e1

NOTE: ALL DIMENSIONS ARE OUT TO OUT
D = PIN DIAMETER

② Other lengths of opening may be constructed by varying the length of the extension and the rebar.

SUDAS | IOWADOT

REVISION	
5	04-21-20

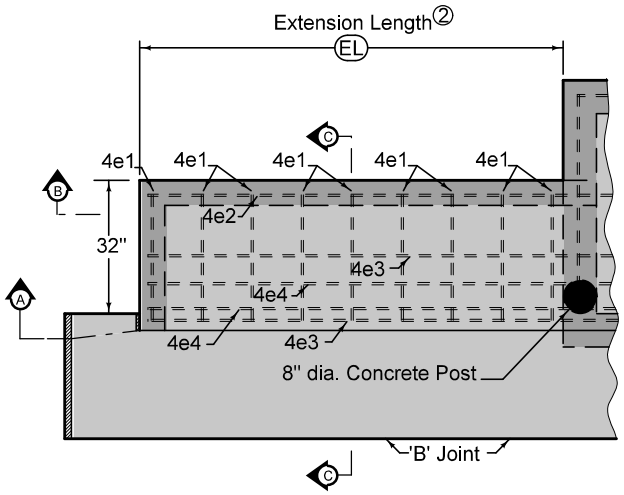
FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545 | SHEET 3 of 4

REVISIONS: Changed wall 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.

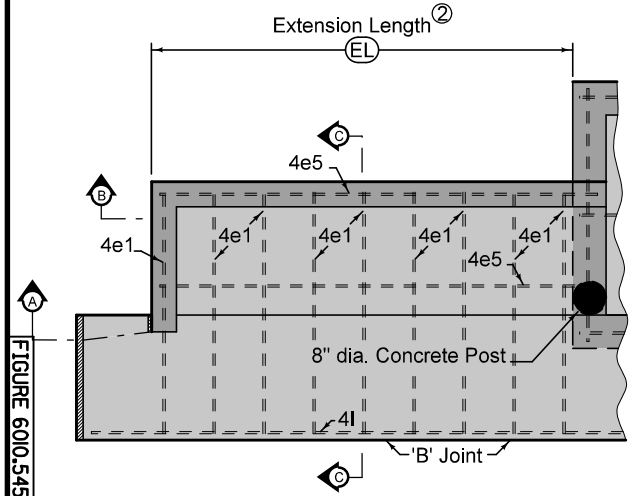
SUDAS DIRECTOR | DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

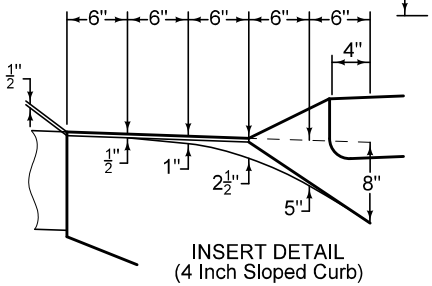
FIGURE 6010.545 | SHEET 3 OF 4



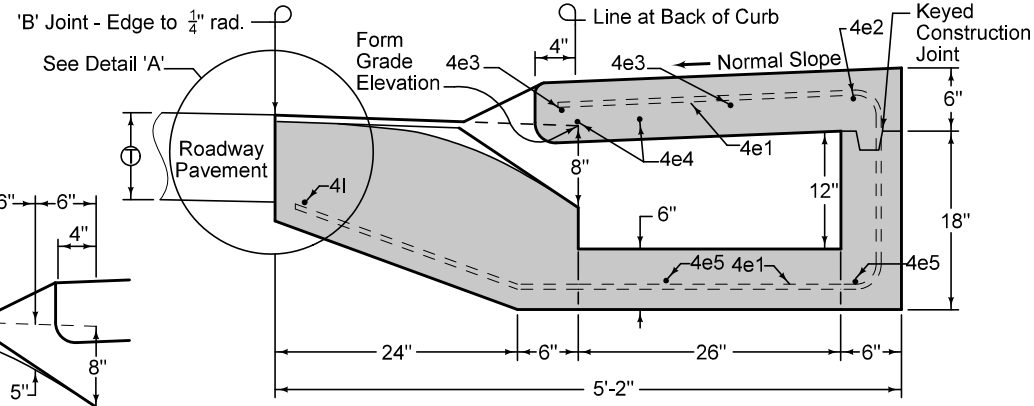
PLAN
TOP OF EXTENSION REINFORCING PLACEMENT



PLAN
BOTTOM OF EXTENSION REINFORCING PLACEMENT



INSERT DETAIL
(4 Inch Sloped Curb)



SECTION C-C
(4 Inch Sloped Curb)

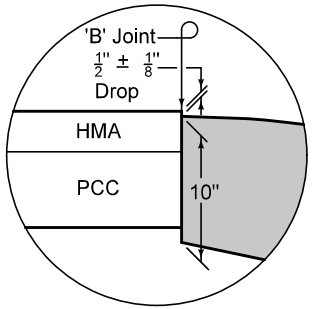
REINFORCING BAR LIST (LO) = 12'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	10'-0"	6.7	
4e3	4	Top	2	12'-9"	17.0	15½"
4e4	4	Top	2	12'-9"	17.0	6"
4e5	4	Base	2	8'-2"	10.9	22"
4e6	4	Top/Base	9	9'-3½"	56.9	12"
4l*	4	Insert	1	15'-10"	10.6	
* With 16'-6" Boxout.				Total	119.0 lbs.	

REINFORCING BAR LIST (LO) = 14'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	12'-0"	8.0	
4e3	4	Top	2	14'-9"	19.7	15½"
4e4	4	Top	2	14'-9"	19.7	6"
4e5	4	Base	2	10'-2"	13.6	22"
4e6	4	Top/Base	11	9'-3½"	69.5	12"
4l*	4	Insert	1	17'-10"	11.9	
* With 18'-6" Boxout.				Total	142.3 lbs.	

REINFORCING BAR LIST (LO) = 16'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	14'-0"	9.3	
4e3	4	Top	2	16'-9"	22.4	15½"
4e4	4	Top	2	16'-9"	22.4	6"
4e5	4	Base	2	12'-2"	16.2	22"
4e6	4	Top/Base	13	9'-3½"	82.1	12"
4l*	4	Insert	1	19'-10"	13.2	
* With 20'-6" Boxout.				Total	165.5 lbs.	

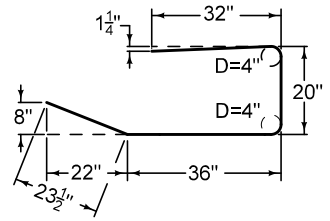
REINFORCING BAR LIST (LO) = 18'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	16'-0"	10.7	
4e3	4	Top	2	18'-9"	25	15½"
4e4	4	Top	2	18'-9"	25	6"
4e5	4	Base	2	14'-2"	18.9	22"
4e6	4	Top/Base	15	9'-3½"	94.8	12"
4l*	4	Insert	1	21'-10"	14.6	
* With 22'-6" Boxout.				Total	188.9 lbs.	

4 INCH SLOPED CURB



DETAIL 'A'
Use when adjacent pavement
is HMA or composite.

BENT BAR DETAILS



4e6

NOTE: ALL DIMENSIONS ARE OUT TO OUT
D = PIN DIAMETER

② Other lengths of opening may be constructed by varying the length of the extension and the rebar.

SUDAS | IOWADOT

FIGURE 6010.545 | STANDARD ROAD PLAN

REVISION: 5 | 04-21-20

SW-545

SHEET 4 of 4

REVISIONS: Changed wall 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. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

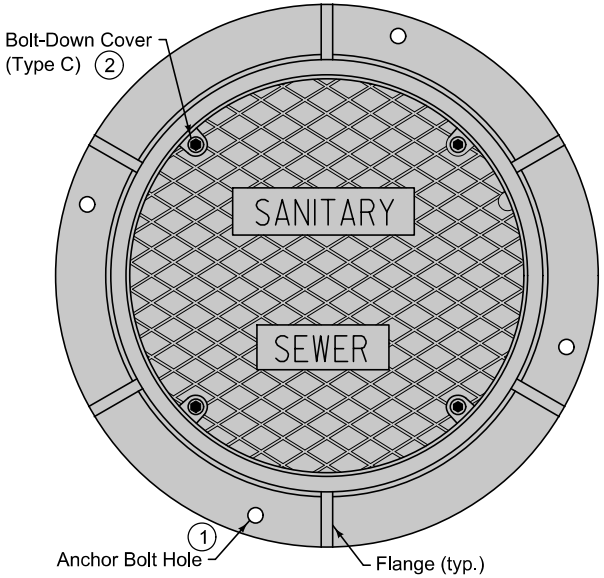
FIGURE 6010.545 SHEET 4 OF 4

TYPE A

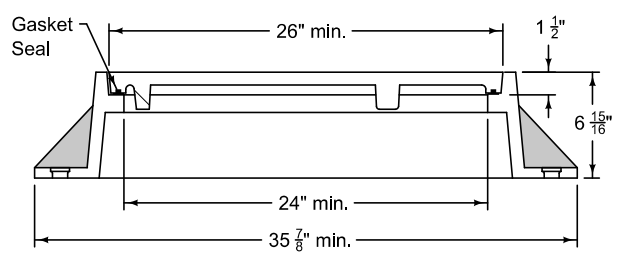
Two-piece fixed casting

TYPE C

Two-piece fixed casting with bolt-down cover (2)



PLAN



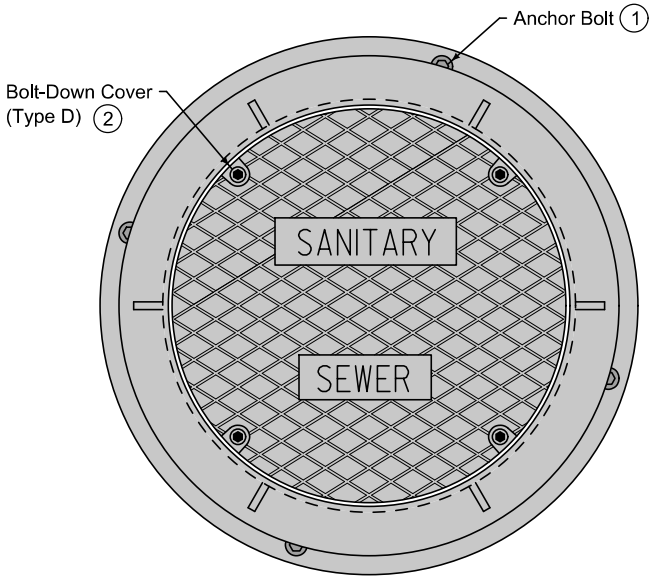
TYPICAL SECTION

TYPE B: HMA

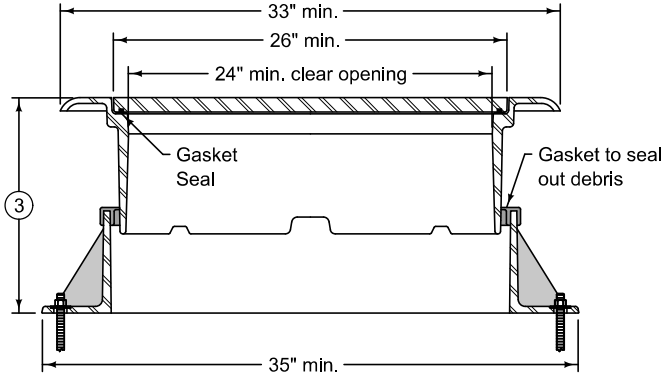
Three-piece floating casting for use in HMA paving

TYPE D: HMA

Three-piece floating casting with bolt-down cover for use in HMA paving (2)



PLAN



TYPICAL SECTION

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one concealed pickhole.

(1) Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.

(2) If specified, furnish bolt down frame and cover with four 1/2 inch minimum diameter stainless steel, hex nut, recessed cap screws. Secure cover with screws, washers, and rubber gasket seals.

(3) Casting height varies. Minimum adjustment range of 4 inches.

SUDAS	IOWA DOT	REVISION 4	04-21-20
FIGURE 6010.601	STANDARD ROAD PLAN	SW-601	SHEET 1 of 2

REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigard
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

CASTINGS FOR SANITARY SEWER MANHOLES

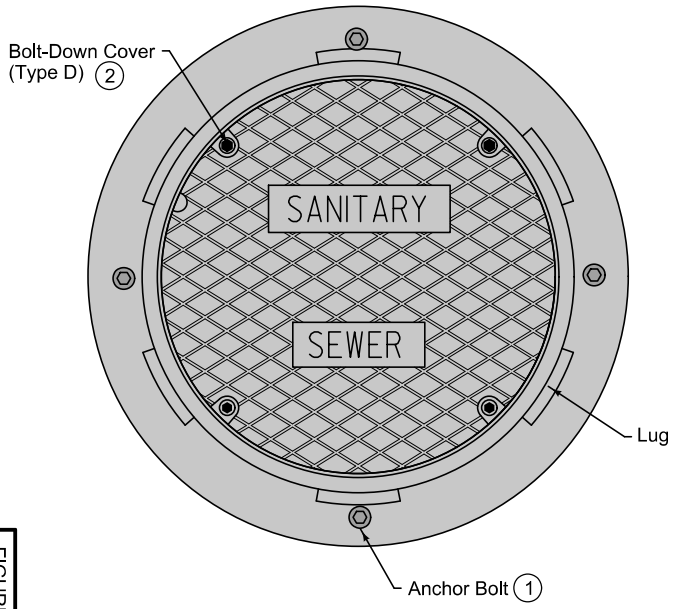
FIGURE 6010.601 | SHEET 1 OF 2

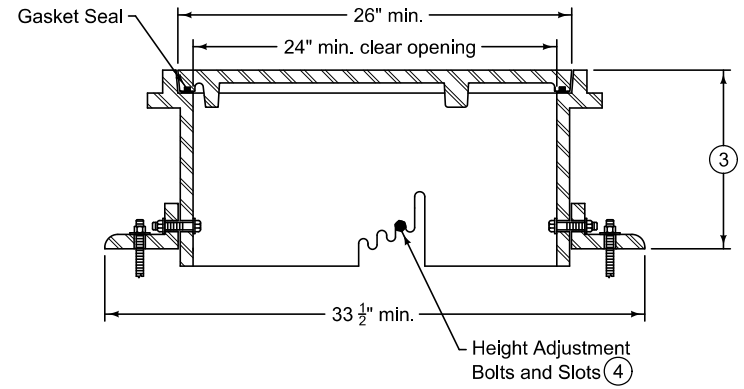
TYPE B: PCC

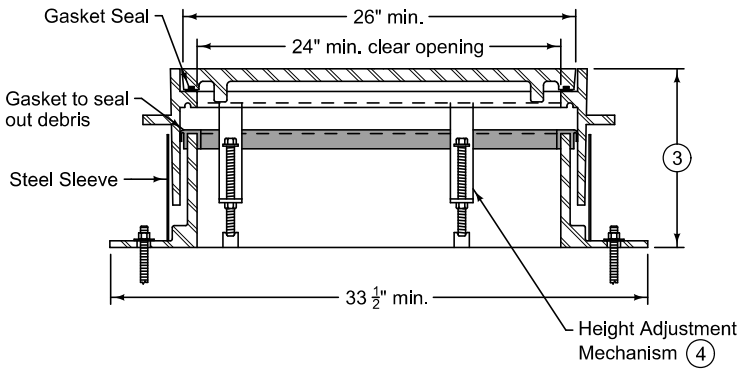
Three-piece floating casting for use in PCC paving and PCC boxouts

TYPE D: PCC

Three-piece floating casting with bolt-down cover for use in PCC paving and PCC boxouts







TYPICAL SECTION 5

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one concealed pickhole.

1. Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.
2. If specified, furnish bolt down frame and cover with four 1/2 inch minimum diameter stainless steel, hex nut, recessed cap screws. Secure cover with screws, washers, and rubber gasket seals.
3. Casting height varies. Minimum adjustment range of 4 inches.
4. Set casting at proper grade using the adjustment slots or adjustment mechanism. Remove bolts or mechanism upon completion of paving.
5. Height adjustment method may vary; two options are shown.

SUDAS	IOWADOT	REVISION 4	04-21-20
FIGURE 6010.601	STANDARD ROAD PLAN	SW-601	SHEET 2 of 2

REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigand
SUDAS DIRECTOR

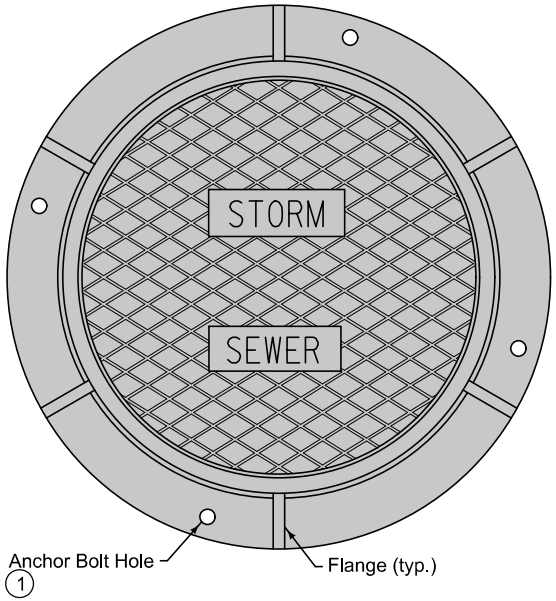
Stuart Nicholson
DESIGN METHODS ENGINEER

CASTINGS FOR SANITARY SEWER MANHOLES

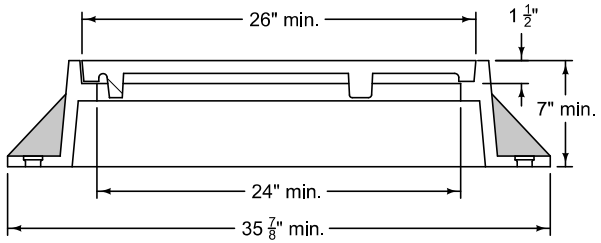
FIGURE 6010.601 | SHEET 2 OF 2

TYPE E

Two-piece fixed casting



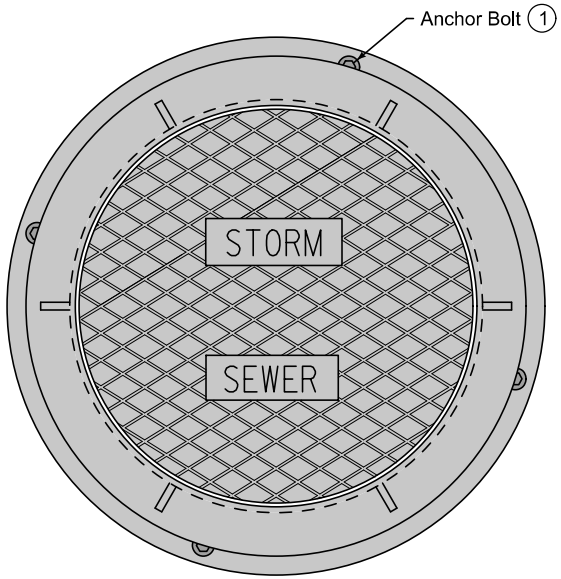
PLAN



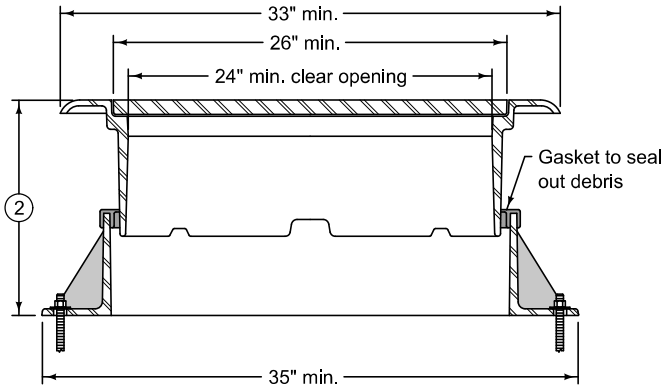
TYPICAL SECTION

TYPE F: HMA

Three-piece floating casting for use in HMA paving



PLAN



TYPICAL SECTION

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one pickhole.

(1) Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.

(2) Casting height varies. Minimum adjustment range of 4 inches.

FIGURE 6010.602 | SHEET 1 OF 3

SUDAS | IOWADOT | REVISION 4 | 04-21-20

FIGURE 6010.602 | STANDARD ROAD PLAN | SW-602 | SHEET 1 of 3

REVISIONS: Add option for 3-piece HMA casting

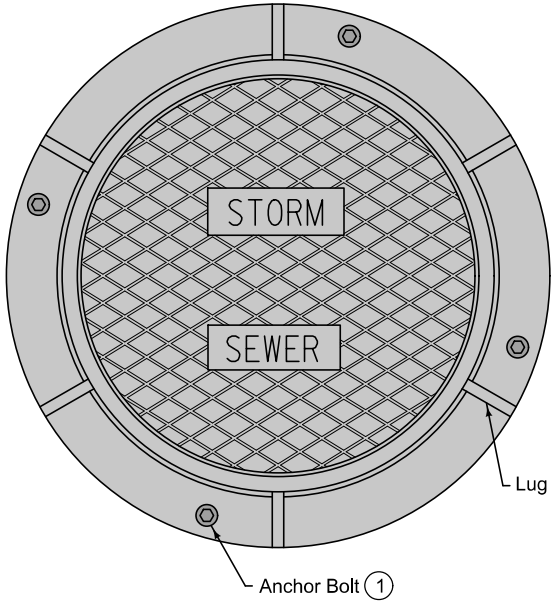
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

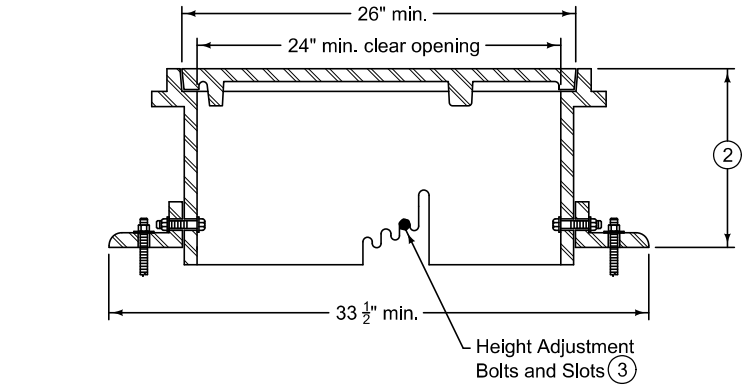
CASTINGS FOR STORM SEWER MANHOLES

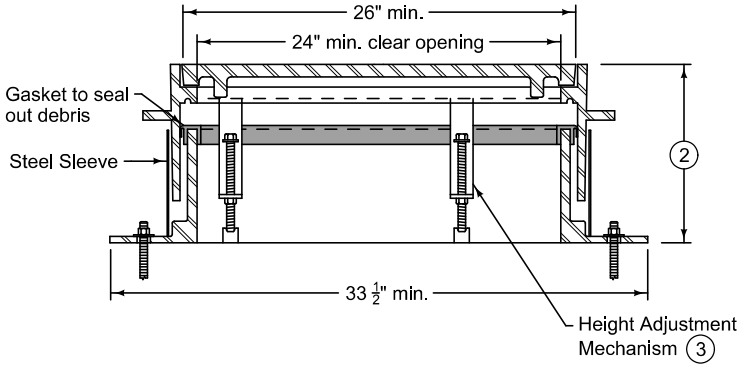
TYPE F: PCC

Three-piece floating casting for use in PCC paving and PCC boxouts



PLAN





TYPICAL SECTION (4)

Frame Notes:
Size, spacing, and number of lugs and flanges may vary.

Cover Notes:
Roughness pattern and text style may vary.
Minimum one pickhole.

(1) Anchor the lower frame of all three-piece castings to the manhole structure. When specified in the contract documents, anchor the frame of two-piece castings to the manhole structure. If casting frame does not include anchor holes or slots, drill four 7/8 inch diameter holes, equally spaced around the frame.

(2) Casting height varies. Minimum adjustment range of 4 inches.

(3) Set casting at proper grade using the adjustment slots or adjustment mechanism. Remove bolts or mechanism upon completion of paving.

(4) Height adjustment method may vary; two options are shown.

FIGURE 6010.602 | SHEET 2 OF 3

SUDAS	IOWA DOT	REVISION 4	04-21-20
FIGURE 6010.602	STANDARD ROAD PLAN	SW-602	SHEET 2 of 3

REVISIONS: Add option for 3-piece HMA casting

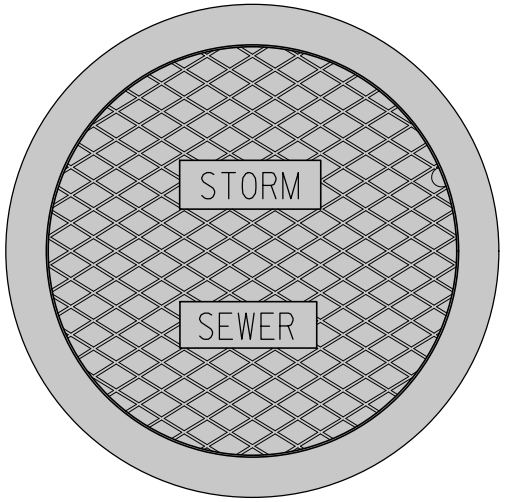
Paul D. Wigand
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

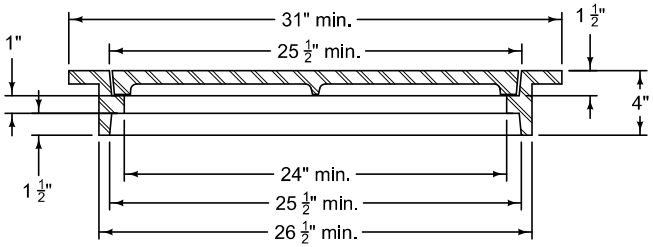
CASTINGS FOR STORM SEWER MANHOLES

TYPE G

Two piece fixed casting



PLAN



TYPICAL SECTION

Cover Notes:
Roughness pattern and text style may vary.
Minimum one pickhole.

SUDAS	IOWA DOT	REVISION 4 04-21-20
FIGURE 6010.602	STANDARD ROAD PLAN	SW-602 SHEET 3 of 3

REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigand — SUDAS DIRECTOR
Stuart Nicholson — DESIGN METHODS ENGINEER

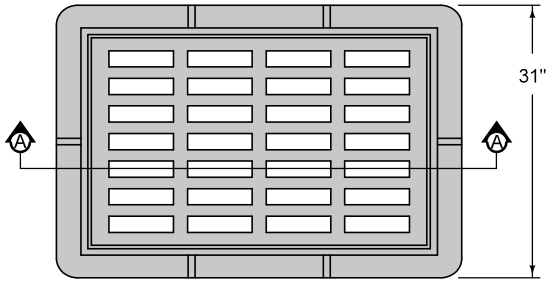
CASTINGS FOR STORM SEWER MANHOLES

FIGURE 6010.602 | SHEET 3 OF 3

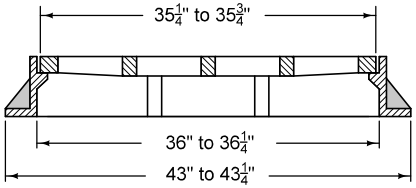
TYPE Q (1)

Driveway Grate

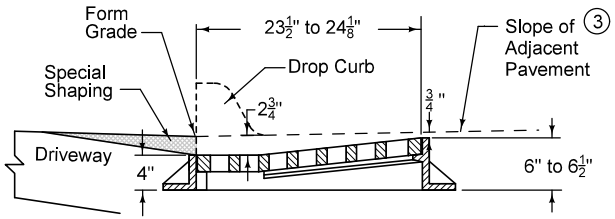
(Minimum open area 370 in^2)



PLAN



SECTION A-A

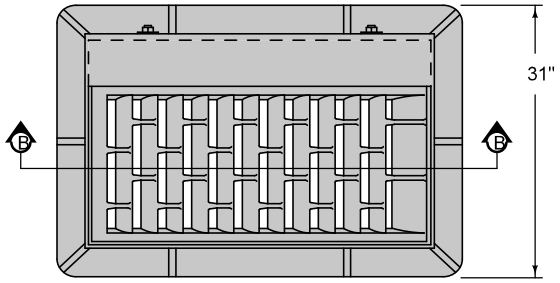


TYPICAL SECTION

TYPE R (2)

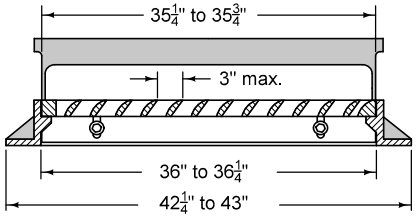
Curb Inlet Grate

(Minimum open area 180 in^2)

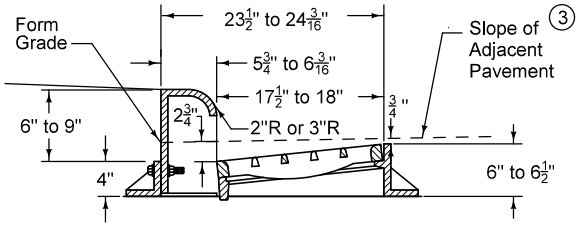


PLAN

Flow



SECTION B-B



TYPICAL SECTION

1. For use at curb drops for driveways. Use only when specified in the contract documents.
2. Provide bicycle-safe vane-style grate. At low points, grates with vanes facing both directions of flow are allowed.
3. For details of boxout pavement, refer to SW-514.

SUDAS	IOWA DOT	REVISION 6 10-16-18
FIGURE 6010.603	STANDARD ROAD PLAN	SW-603
		SHEET 1 of 2

REVISIONS: Corrected typo on page two that said SHEET 1 of 2.

Paul D. Wigant — SUDAS DIRECTOR

Brian Smith — DESIGN METHODS ENGINEER

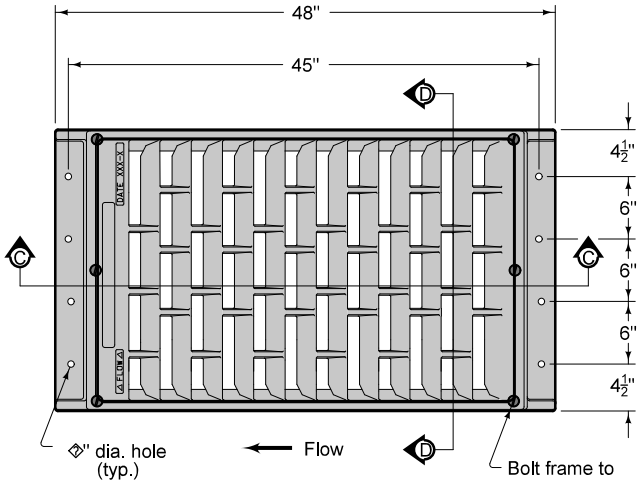
CASTINGS FOR GRATE INTAKES

FIGURE 6010.603 SHEET 1 OF 2

TYPE S ②④

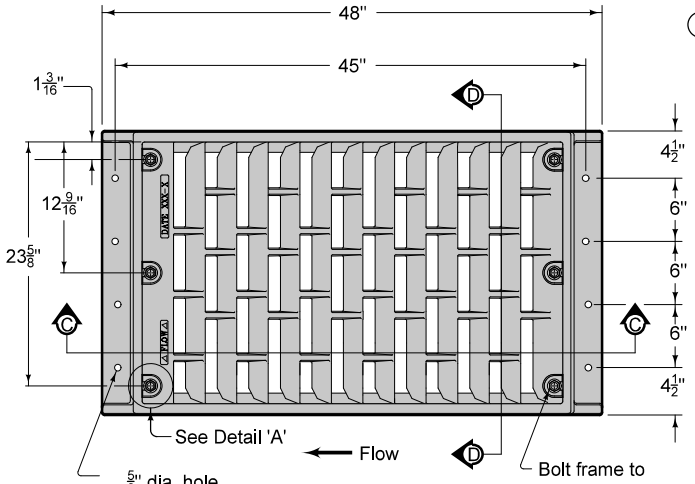
Barrier Intake Grate

(Minimum open area 300 in^2)



② dia. hole (typ.)

Bolt frame to grate with six ½" X 3¾" flat head cap screws.



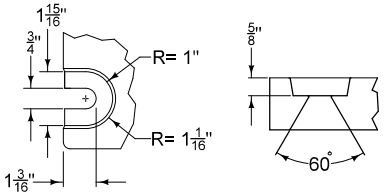
⅝" dia. hole (typ.)

Bolt frame to grate with six ⅝" X 4½" stainless steel hex head bolts.

② Provide bicycle-safe vane-style grate. At low points, grates with vanes facing both directions of flow are allowed. The Contractor has the choice of which Type S Grate to use.

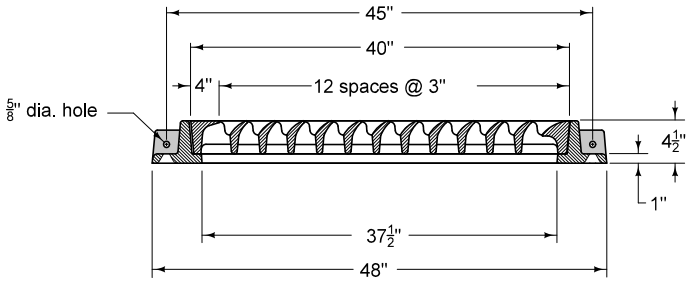
④ Use ductile iron frame castings meeting the requirements of ASTM A 536.

Frame minimum weight = 220 lbs.
Grate minimum weight = 340 lbs.

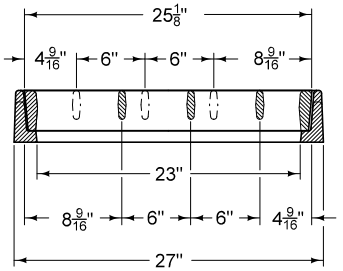


DETAIL'A'

Bolt Slot Detail



SECTION C-C



SECTION D-D

SUDAS	IOWADOT	REVISION 6 10-16-18
FIGURE 6010.603	STANDARD ROAD PLAN	SW-603 SHEET 2 of 2

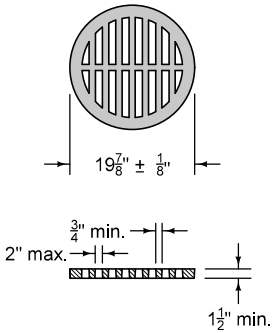
REVISIONS: Corrected typo on page two that said SHEET 1 of 2.

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

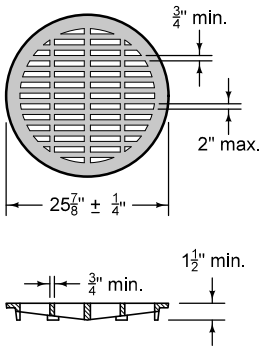
CASTINGS FOR GRATE INTAKES

FIGURE 6010.603 SHEET 2 OF 2

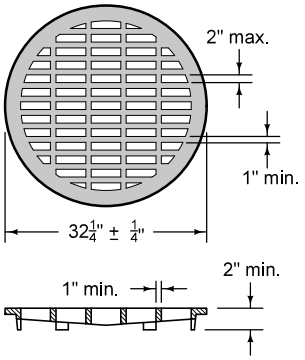
TYPE 4



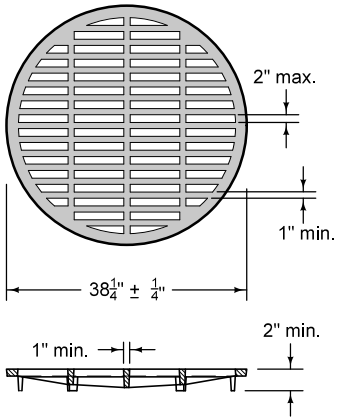
TYPE 4A
For Placement on 18" RCP



TYPE 4B
For Placement on 24" RCP

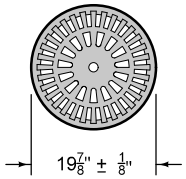


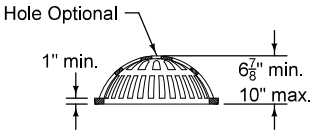
TYPE 4C
For Placement on 30" RCP



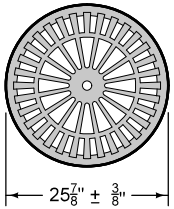
TYPE 4D
For Placement on 36" RCP

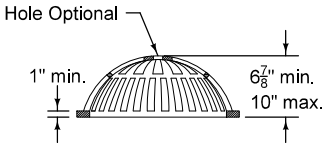
TYPE 3
(Light Duty)





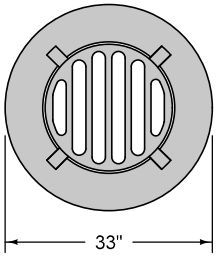
TYPE 3A
For Placement on 18" RCP





TYPE 3B
For Placement on 24" RCP

TYPE 5
(Light Duty)
For Placement on 24" to 30" RCP



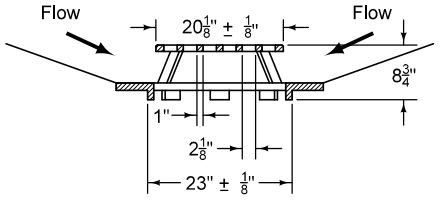


FIGURE 6010.604 SHEET 1 OF 2

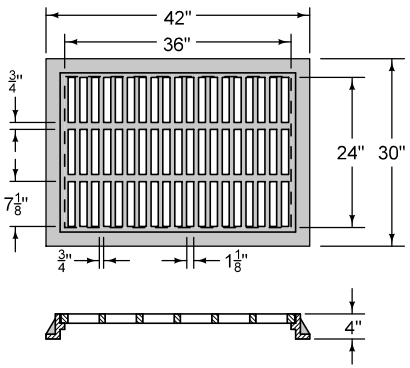
SUDAS	IOWA DOT	REVISION 3 04-21-20
FIGURE 6010.604	STANDARD ROAD PLAN	SW-604
		SHEET 1 of 2

REVISIONS: Added Type 7 casting. Modified circle notes.

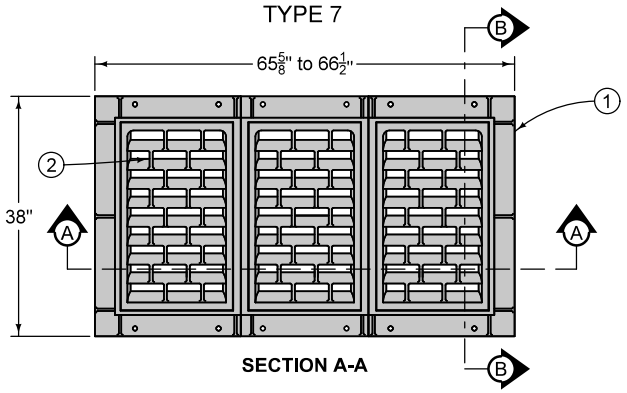
Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

CASTINGS FOR AREA INTAKES

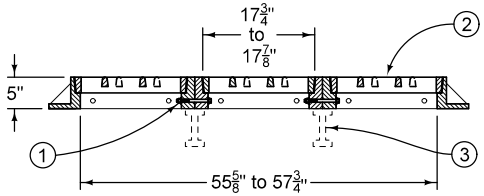
TYPE 6



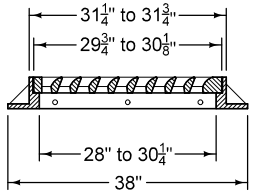
TYPE 7



SECTION A-A



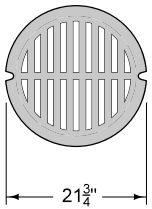
SECTION A-A

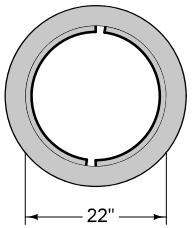


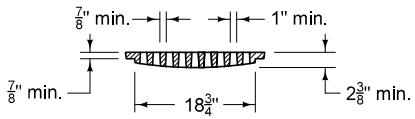
SECTION B-B

TYPE 9

(Light Duty)

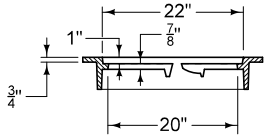






GRATE (4)

Minimum Weight = 85 lbs.



FRAME

Minimum Weight = 75 lbs.

(1) Frame provided in three segments (two ends and one center). Bolt segments together as specified by the casting manufacturer.

(2) Provide bicycle safe, vane style grates with a minimum open area of 4 square feet. At low points, grates with vanes facing both directions will be allowed.

(3) If required by casting manufacturer, provide support beam under all frame joints. Modify structure walls as required to provide pocket for beam.

(4) Cast grate without locking lugs so it may be used in an inverted position.

FIGURE 6010.604 SHEET 2 OF 2

SUDAS	IOWADOT	REVISION 3 04-21-20
FIGURE 6010.604	STANDARD ROAD PLAN	SW-604 SHEET 2 of 2

REVISIONS: Added Type 7 casting. Modified circle notes.

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

CASTINGS FOR AREA INTAKES

PART 2 - PRODUCTS

2.01 INFILTRATION BARRIER

A. Rubber Chimney Seal: Comply with Section 6010, 2.11 for external and internal rubber chimney seals.

B. Molded Shield: Comply with Section 6010, 2.11 for molded shields.

C. Heat Shrink Sleeve: Comply with Section 6010, 2.11 for heat shrink sleeves.

D. Urethane Chimney Seal: Comply with the following table for the physical properties.

Table 6020.01: Physical Properties

Property	ASTM Test Method	Acceptable Value
Elongation	D 412	800%, minimum
Tensile Strength	D 412	1150 psi, minimum
Adhesive Strength	D 903	175 lb/in, minimum
Pressure Resistance	C 1244	2 minutes

2.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE

A. Forming System: Provide an internal forming system capable of forming a new and structurally independent manhole wall within the existing manhole, with the specified thickness and conforming to the general shape of the existing manhole.

B. Concrete: Type I/II portland cement with 5/8 inch minus coarse aggregate with fiber reinforcement and water reducer, 4,000 psi minimum 28 day compressive strength or as approved by the Engineer.

C. Plastic Liner: When specified, provide a PVC or PE plastic liner resistant to degradation by sulfuric acid. Use a liner capable of being attached to the exterior of the forming system during erection of the forms. Use a plastic liner with a ribbed or studded exterior surface suitable for anchoring to the newly formed interior wall.

D. Casting: Provide new casting. Comply with Section 6010, 2.10.

2.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL

A. Cementitious Lining:

1. Use a high-strength, high-build, corrosion-resistant mortar, based on Portland cement fortified with micro silica. Mixed mortar is to have a paste-like consistency that may be sprayed, cast, pumped, or gravity-flowed into any area 1/2 inch and larger.

2.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL (Continued)

2. Comply with the following table for physical properties.

Table 6020.02: Physical Properties

Property	Value
Unit Weight	102 to 130 pcf
Set Time at 70° F ASTM C 403 Initial Set / Final Set	240 minutes / 480 minutes
Modulus of Elasticity ASTM C 469 24 hours / 28 days	180,000 psi min. / 1,150,000 psi min.
Flexural Strength ASTM C 293 24 hours / 28 days	650 psi min. / 800 psi min.
Compressive Strength ASTM C 109 24 hours / 28 days	3,000 psi / 10,000 psi
Tensile Strength ASTM C 307	600 psi
Shear Bond ASTM C 882	>1,000 psi
Shrinkage ASTM C 157	None
Chloride Permeability ASTM C 1202	<550 Coulombs

3. Use a lining containing a liquid admixture for the prevention of micro-biologically induced corrosion.

B. Corrosion-Resistant Epoxy Lining:

1. Use a two-component 100% solids epoxy formulated for use in sewer systems.

2. Comply with the following table for physical properties.

Table 6020.03: Physical Properties

Property	Value
Dry Time	4-6 hours at 75° F; 50% Relative Humidity
Compressive Strength ASTM D 695	15,000 psi min.
Flexural Strength ASTM D 790	11,000 psi min.
Tensile Strength ASTM D 638	4,500 psi min.
Hardness ASTM D 2240	68 to 90 Shore D
Ultimate Elongation ASTM D 638	3.5 to 5.5 %
Adhesion ASTM D 7234	Substrate Failure

C. Casting: Provide new casting. Comply with Section 6010, 2.10.

3.02 PAVEMENT CONSTRUCTION (Continued)

b. Use freshly mixed concrete; do not store concrete in receptacles at side of pavement for use in curb at a later time; do not use concrete requiring retempering.
c. Consolidate curb concrete to obtain adequate bond with the pavement slab and to eliminate honeycomb in the curb. Avoid disturbing the alignment of forms or the gutter flow line.

H. PCC Railroad Crossing Approach: Construct according to Section 7010 and Figure 7010.903. Construct HMA section according to the full depth patch requirements of Section 7040.

I. Finishing:

1. Grade and Crown: Promptly after concrete has been placed and vibrated, strike off the surface to the true section by the screed. Finish the surface true to crown and grade.

2. Watering the Surface: The practice of lubricating the pavement surface by sprinkling water by spray, brush, or other methods to afford greater ease in finishing operation is not allowed.

3. Floats: Finish surface with wood or magnesium floats; finish from both sides simultaneously if pavement is placed to full width with one pass of paving machine.

4. Straightedging:
a. After the longitudinal floating has been completed and the excess water has been removed, and while the concrete is still plastic, test the pavement surface for trueness.
b. Immediately fill any depressions found with freshly mixed concrete, struck off, consolidated, and refinished.
c. Check surface longitudinally while concrete is still plastic; correct any surface deviations greater than 1/8 inch in 10 feet.

5. Surface Treatment:
a. Drag Surface Treatment: Unless otherwise specified, texture the finished surface with an artificial turf or burlap drag treatment.
1) Pull the artificial turf or burlap drag longitudinally over the finished surface to produce a tight, uniform, textured surface, and round the edges in a workmanlike manner.
2) Remove the artificial turf or burlap drag from the pavement surface at regular intervals and clean with water to remove accumulated concrete from the fabric in order to maintain a consistent finished texture.
3) When the desired texture is not attained, the Engineer may require the final finish be a broom finish.

b. Surface Tining: When surface tining is specified, use a longitudinal tining. Under special circumstances, when specified in the contract documents, transverse tining may be required.
1) Longitudinal:
a) Complete longitudinal surface tining using a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and uniformly spaced at 3/4 inch intervals. The depth of the grooves must be a minimum of 1/8 inch to a maximum of 3/16 inch in the plastic concrete.
b) Use equipment with horizontal and vertical string line controls to ensure straight grooves.
c) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.
d) At longitudinal joints, leave a 2 to 3 inch wide strip of pavement surface (centered along the joint) that is not grooved for the length of the joint.

3.02 PAVEMENT CONSTRUCTION (Continued)

2) Transverse:

a) If transverse surface tining is required or allowed, use a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and randomly spaced from 3/8 inch to 1 5/8 inch with no more than 50% of the spacing exceeding 1 inch. The depth of the grooves must be a minimum of 1/8 inch to a maximum of approximately 3/16 inch in the plastic concrete.

b) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.

c) Where abutting pavement is to be placed, the tining should extend as close to the edge as possible without damaging the edge.

d) If abutting pavement is not to be placed, do not tine the 6 inch area nearest the edge or 1 foot from the face of the curb.

6. Edge Finish: Before the concrete has taken its initial set, finish all edges of the pavement with an 1/8 inch radius edging tool.

7. Honeycomb Repair: When paving without forms, fill any honeycombed area immediately with freshly mixed concrete and work into the slab prior to initial set and the application of curing. Failure to do so may prompt the Engineer to declare the work defective and cause it to be removed and replaced at no additional cost to the Contracting Authority.

J. Surface Curing:

1. Apply liquid curing compound in a fine spray to form a continuous, uniform film on the horizontal surface and vertical edges of pavement, curbs, and back of curbs immediately after surface moisture has disappeared, but no later than 30 minutes after finishing. With approval of the Engineer, the timing of cure application may be adjusted due to varying weather conditions and concrete mix properties to ensure acceptable macrotexture is achieved.
   a. Use a white pigment liquid curing compound for concrete not receiving an asphalt overlay. When specified in the contract documents, use a linseed oil solution.
   b. Use a dark-colored curing compound for concrete receiving an asphalt overlay.

2. Apply compound with power sprayer; rate of application not less than 15 square yards per gallon (0.067 gallon per square yard); do not dilute compound. For concrete receiving an asphalt overlay, use a minimum rate for dark-colored cure of 12.5 square yards per gallon (0.08 gallon per square yards).

3. Ensure liquid curing materials are well agitated in the supply drum or tank immediately before transfer to the sprayer. Keep curing materials well agitated during application.

4. Hand operated sprayers may be used for small and irregular areas.

5. If forms are used, apply to pavement edges and back of curbs within 30 minutes after forms are removed.

6. If, due to other operations, the coating is damaged within 72 hours after being applied, immediately re-coat the affected areas. Coating of the sawed surface with curing compound will not be allowed on joints that are to be sealed. When pavement is opened to traffic prior to 72 hours after application of the curing coating, a re-coating will not be required.

K. Construction of Joints:

1. General:
   a. Construct joints of the type, dimensions, and at the locations specified in the contract documents. See the 7010 figures.
   b. Place longitudinal joints coincident with or parallel to the pavement centerline.

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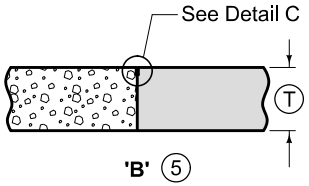
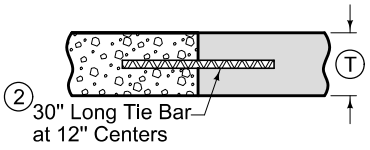
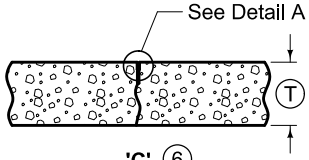


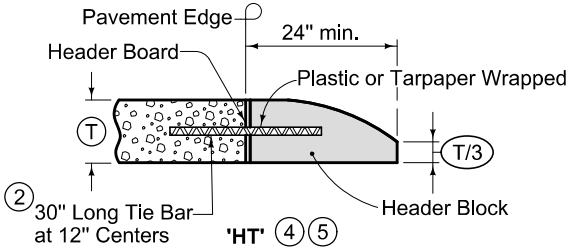
'B' (5)
PLAIN JOINT
(Abutting Pavement Slabs)



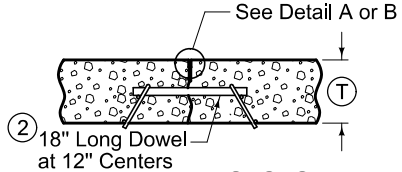
'DW' (3)(4)(7)
DAY'S WORK JOINT(Non-working)



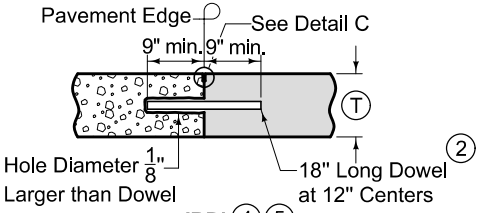
'C' (6)
CONTRACTION JOINT



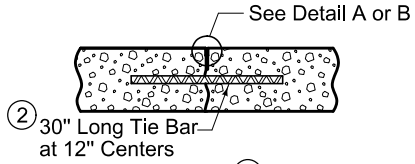
'HT' (4)(5)
HEADER JOINT
(End Rigid Pavement)



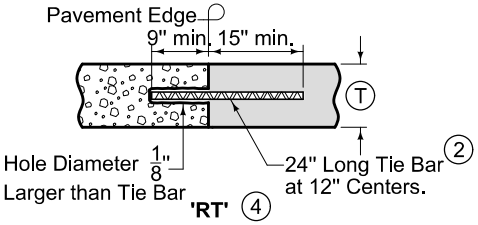
'CD' (1)(4)(6)
DOWELED CONTRACTION JOINT



'RD' (4)(5)
ABUTTING PAVEMENT JOINT

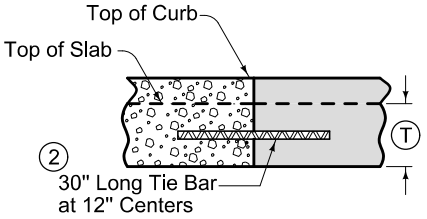


'CT' (4)
TIED CONTRACTION JOINT

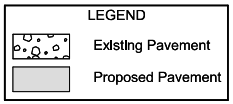


'RT' (4)
ABUTTING PAVEMENT JOINT
RIGID TIE

1. See dowel assemblies for fabrication details.
2. See Bar Size Table for Contraction Joints on Sheet 2.
3. Locate 'DW' joint at a mid-panel location between future 'C' or 'CD' joints. Place no closer than 5 feet to a 'C' or 'CD' joint.
4. Place bars within the limits shown under dowel assemblies.
5. Edge with 1/8 inch tool for length of joint. For HT joint, remove header block and board when second slab is placed.
6. Unless specified otherwise, use 'CD' transverse contraction joints in mainline pavement when (T) is greater or equal to 8 inches. Use 'C' joints when (T) is less than 8 inches.
7. 'RT' joint may be used in lieu of 'DW' joint at the end of the days work. Remove any pavement damaged due to the drilling at no additional cost to the Contracting Authority.



'DW - CG' (3)(4)
DAY'S WORK JOINT
CURB AND GUTTER UNIT



TRANSVERSE CONTRACTION JOINTS

FIGURE 7010.101 SHEET 1 OF 8

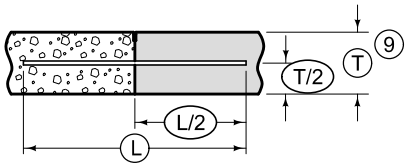
SUDAS | IOWA DOT

REVISION	
10	04-21-20

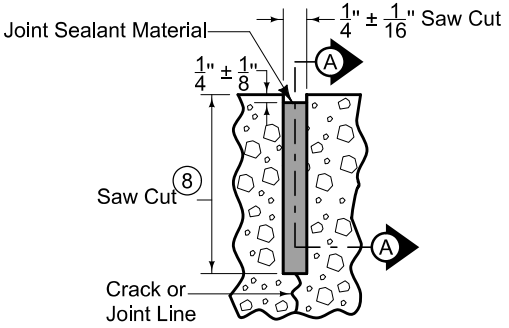
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 1 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14" pavements.

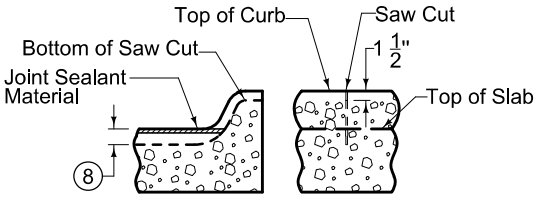
Paul D. Wigand, SUDAS DIRECTOR
DESIGN METHODS ENGINEER



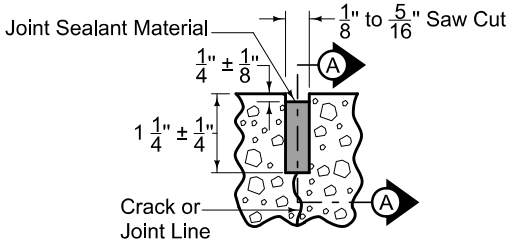
BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



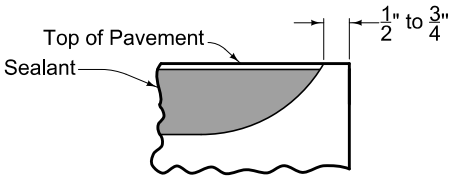
DETAIL A
(Saw cut formed by conventional concrete sawing equipment.)



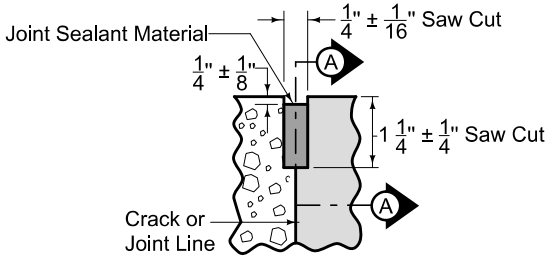
'C' JOINT IN CURB
(Match 'CT', 'CD', or 'C' joint in pavement.)



DETAIL B
(Saw cut formed by approved early concrete sawing equipment.)



SECTION A-A
(Detail at Edge of Pavement)

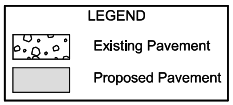


DETAIL C

(8) Saw 'CD' joint to a depth of T/3 ± 1/4"; saw 'C' joint to a depth of T/4 ± 1/4".

(9) When tying into old pavement, (T) represents the depth of sound PCC.

BAR SIZE TABLE FOR CONTRACTION JOINTS			
(T)	Solid Dowel Diameter	Tubular Dowel Diameter	Tie Bar Size
< 8"	3/4"	7/8"	#6
≥ 8" but < 10"	1 1/4"	1 3/8"	#10
≥ 10"	1 1/2"	1 5/8"	#11
Tubular Dowel Bars will not be allowed for RD joints.			



SUDAS | IOWADOT | REVISION 10 04-21-20

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 2 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14" pavements.

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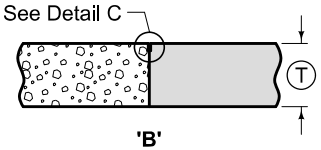
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

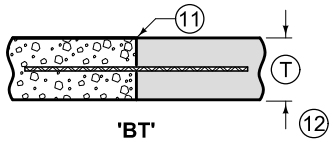
JOINTS

TRANSVERSE CONTRACTION

FIGURE 7010.101 | SHEET 2 OF 8

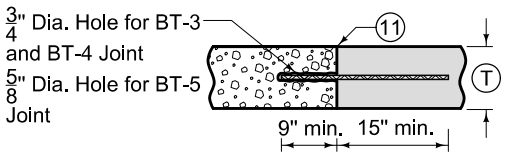


'B'
PLAIN JOINT
(Abutting Pavement Slabs)



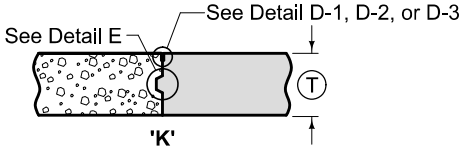
'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE

T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-1'	#4	36" Long at 30" Centers
		#5	30" Long at 30" Centers
≥ 8"	'BT-2'	#5	36" Long at 30" Centers

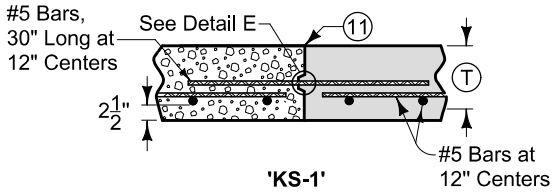


'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE (Drilled)

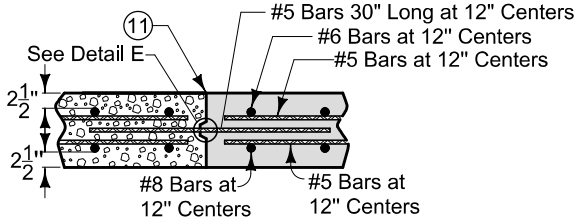
T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-5'	#4	24" Long at 30" Centers
≥ 8"	'BT-3'	#5	24" Long at 30" Centers
	'BT-4'		24" Long at 15" Centers



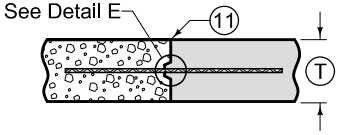
'K'
KEYED JOINT FOR ADJACENT SLABS
(Where T is 8" or more)



'KS-1'
[Single Reinforced Pavement (Bridge Approach)]



'KS-2'
[Double Reinforced Pavement (Bridge Approach)]



'KT' (10)(12)
ABUTTING PAVEMENT JOINT - KEYWAY TIE

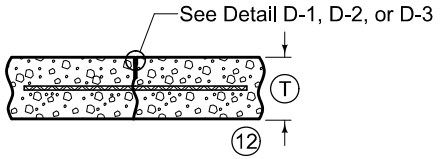
T	Joint	Bars	Bar Length and Spacing
< 8"	'KT-1'	#4	30" Long at 30" Centers
≥ 8"	'KT-2'	#5	30" Long at 30" Centers
	'KT-3'		30" Long at 15" Centers

LONGITUDINAL CONTRACTION

(10) Bar supports may be necessary for fixed form paving to ensure the bar remains in a horizontal position in the plastic concrete.

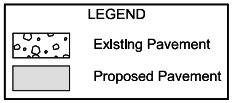
(11) Sawing or sealing of joint not required.

(12) The following joints are interchangeable, subject to the pouring sequence:
'BT-1', 'L-1', and 'KT-1'
'KT-2' and 'L-2'
'KT-3' and 'L-3'



'L'
CONTRACTION JOINT

T	Joint	Bars	Bar Length and Spacing
< 8"	'L-1'	#4	36" Long at 30" Centers
≥ 8"	'L-2'	#5	36" Long at 30" Centers
	'L-3'		36" Long at 15" Centers



SUDAS | IOWA DOT | REVISION 10 04-21-20

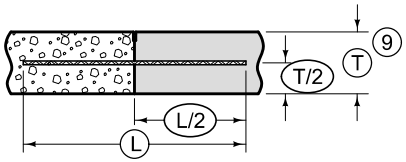
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 3 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14" pavements.

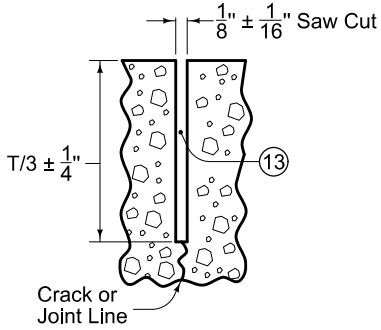
Paul D. Wiegand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 SHEET 3 OF 8



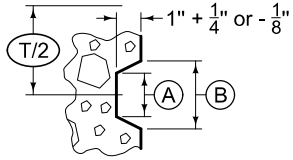
TIE BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



DETAIL D-1
(Required when specified in the contract documents.)

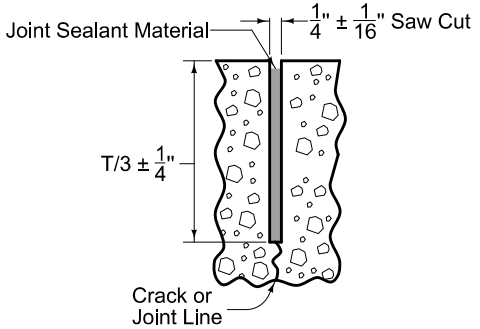
⑨ When tying into old pavement, Ⓣ represents the depth of sound PCC.

⑬ Sealant or cleaning not required.

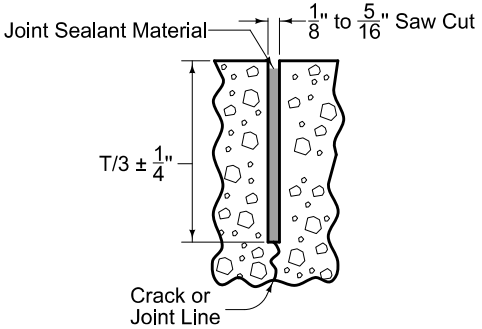


DETAIL E

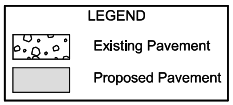
KEYWAY DIMENSIONS			
Keyway Type	Pavement Thickness Ⓣ	Ⓐ	Ⓑ
Standard	8" or greater	1 3/4"	2 3/4"
Narrow	Less than 8"	1"	2"



DETAIL D-2
(Required when the Department of Transportation is not the Contracting Authority, or when specified in the contract documents)



DETAIL D-3
(Required when the Department of Transportation is the Contracting Authority, or when specified in the contract documents)



SUDAS | IOWADOT | REVISION 10 04-21-20

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 4 of 8

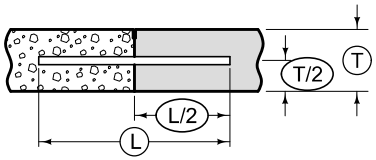
REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14" pavements.

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

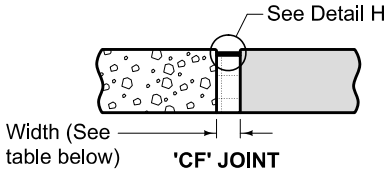
JOINTS

LONGITUDINAL CONTRACTION

FIGURE 7010.101 | SHEET 4 OF 8

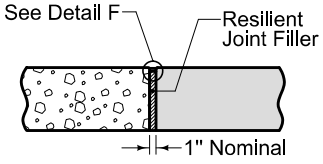


DOWEL PLACEMENT
(Applies to all joints unless otherwise detailed.)

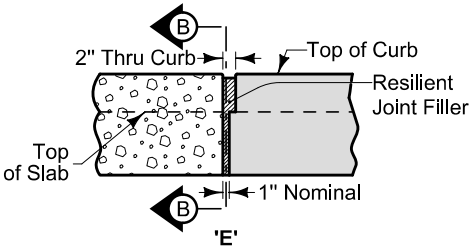


'CF' JOINT

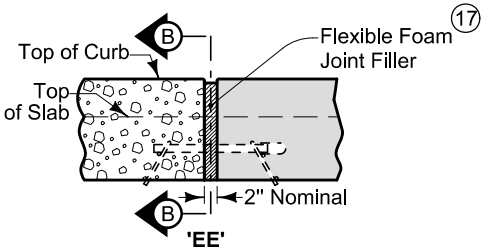
TYPE	WIDTH
CF-1	2"
CF-2	$2\frac{1}{2}$"
CF-3	3"
CF-4	$3\frac{1}{2}$"



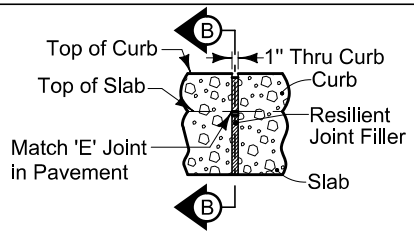
'E'
1" EXPANSION JOINT



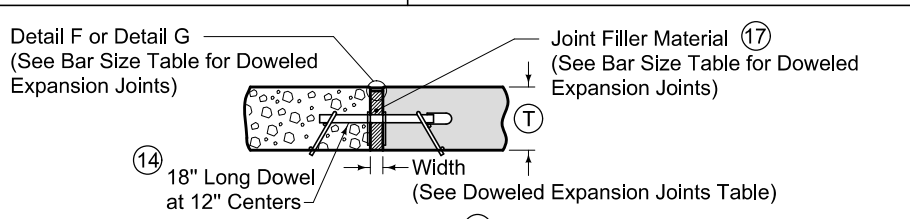
'E'
JOINT IN CURB
(View at Back of Curb)



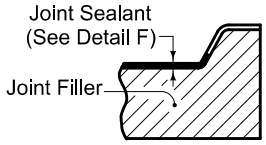
'EE'
JOINT IN CURB
(View at Back of Curb)



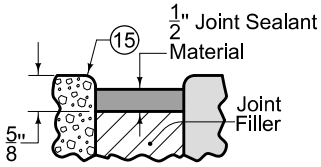
'ES'
JOINT IN CURB
(View at Back of Curb)



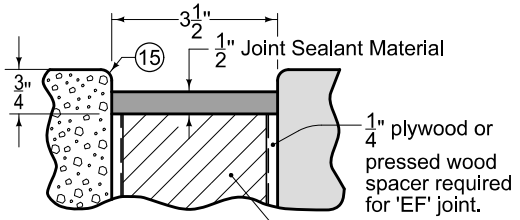
'ED', 'EE', 'EF' 16
DOWELED EXPANSION JOINT



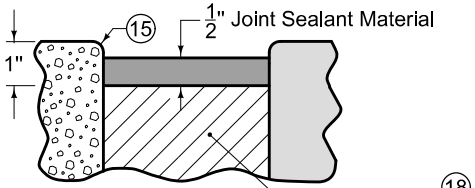
SECTION B-B



DETAIL F



DETAIL G



DETAIL H

EXPANSION

14 See Bar Size Table for Doweled Expansion Joints.

15 Edge with 1/4 inch tool for length of joint indicated if formed; edging not required when cut with diamond blade saw.

16 See Dowel Assemblies for fabrication details and placement limits. Coat the free end of dowel bar to prevent bond with pavement. At intake locations, dowel bars may be cast-in-place.

17 Predrill or preform holes in joint material for appropriate dowel size.

18 Compact tire buffings by spading with a square-nose shovel.

DOWELED EXPANSION JOINTS		
TYPE	WIDTH	FILLER MATERIAL 17
ED	1"	Resilient (Detail F)
EE	2"	Flexible Foam (Detail F)
EF	$3\frac{1}{2}$"	Flexible Foam (Detail G)

BAR SIZE TABLE FOR DOWELED EXPANSION JOINTS			
T	< 8"	≥ 8" but < 10"	≥ 10"
Dowel Diameter	$\frac{3}{4}$"	$1\frac{1}{4}$"	$1\frac{1}{2}$"
Tubular Dowel Bars will not be allowed for expansion joints.			

LEGEND
Existing Pavement
Proposed Pavement

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FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101
SHEET 5 of 8

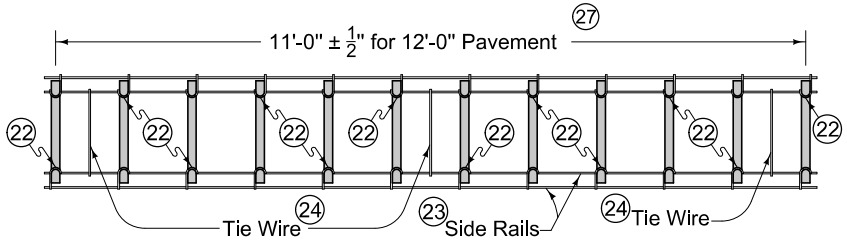
REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14" pavements.

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

JOINTS

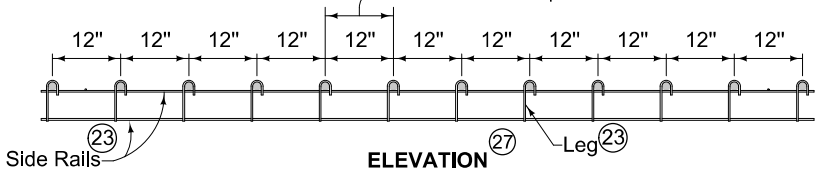
FIGURE 7010.101 SHEET 5 OF 8

CONTRACTION JOINTS

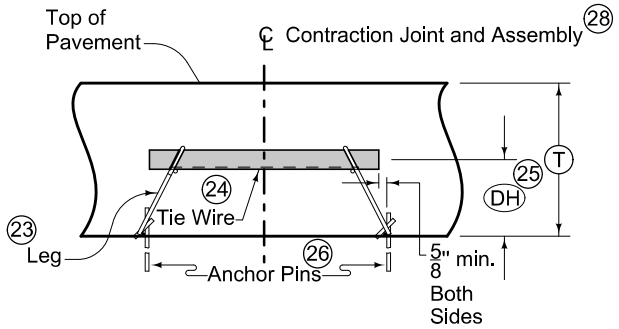


PLAN

Spaces between dowel bars are nominal dimensions with a $\frac{1}{4}$" allowable tolerance.



ELEVATION



LONGITUDINAL SECTION

DOWEL ASSEMBLIES (19) (20) (21)

DOWEL HEIGHT AND DIAMETER FOR DOWELED CONTRACTION JOINTS			
(T)	(DH) (25)	Diameter (Solid)	Diameter (Tubular)
7" to 7 1/2"	3 1/2"	3/4"	7/8"
8" to 9 1/2"	4 1/4"	1 1/4"	1 3/8"
10" to 11 1/2"	5 1/4"	1 1/2"	1 5/8"
12" to 13"	6 1/4"	1 1/2"	1 5/8"
Tubular Dowel Bars will not be allowed for RD joints.			

(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

(21) Details apply to both transverse contraction and expansion joints.

(22) Weld alternately throughout.

(23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.

(24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.

(25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

(26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

(27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

(28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

FIGURE 7010.101 | SHEET 6 OF 8

SUDAS | IOWADOT | REVISION 10 04-21-20

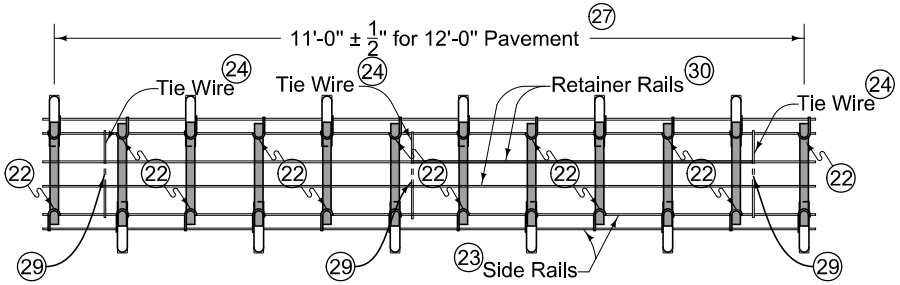
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 6 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

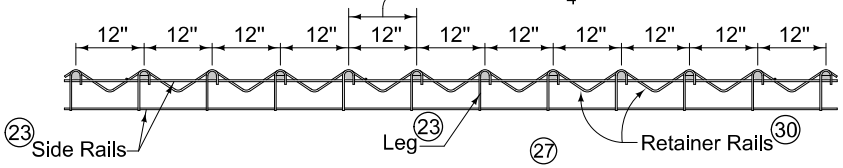
JOINTS

EXPANSION JOINTS

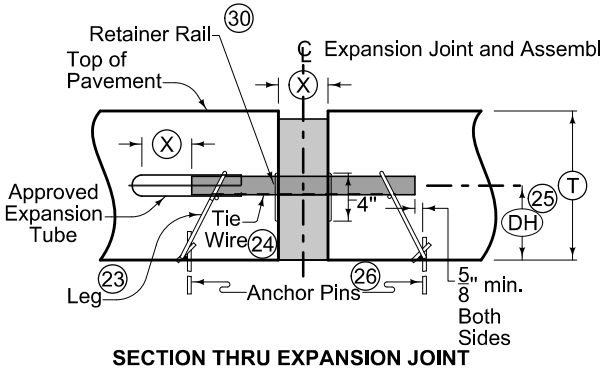


PLAN

Spaces between dowel bars are nominal dimensions with a 1/4" allowable tolerance.



ELEVATION



SECTION THRU EXPANSION JOINT

JOINT OPENING AND EXPANSION TUBE EXTENSION		
Joint Type	(X)	Minimum Tube Length
"ED"	1"	6"
"EE"	2"	7"
"EF"	3 1/2"	9"

DOWEL HEIGHT AND DIAMETER FOR DOWELED EXPANSION JOINTS		
(T)	(DH) (25)	Diameter
7" to 7 1/2"	3 1/2"	3/4"
8" to 9 1/2"	4 1/4"	1 1/4"
10" to 11 1/2"	5 1/4"	1 1/2"
12" to 13"	6 1/4"	1 1/2"
Tubular Dowel Bars will not be allowed for expansion joints.		

DOWEL ASSEMBLIES (19) (20) (21)

(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

(21) Details apply to both transverse contraction and expansion joints.

(22) Weld alternately throughout.

(23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.

(24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.

(25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

(26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

(27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

(28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

(29) Clip and remove center portion of tie during field assembly.

(30) 1/4 inch diameter wire.

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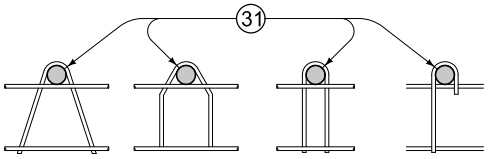
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 7 of 8

REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

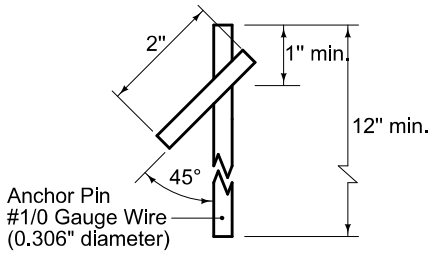
Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 | SHEET 7 OF 8



OPTIONAL LEG SHAPES



ANCHOR PIN

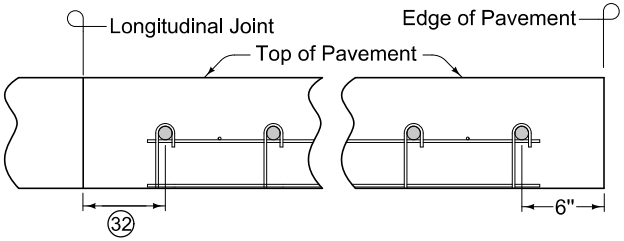
19 Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

20 Use wires with a minimum tensile strength of 50 ksi.

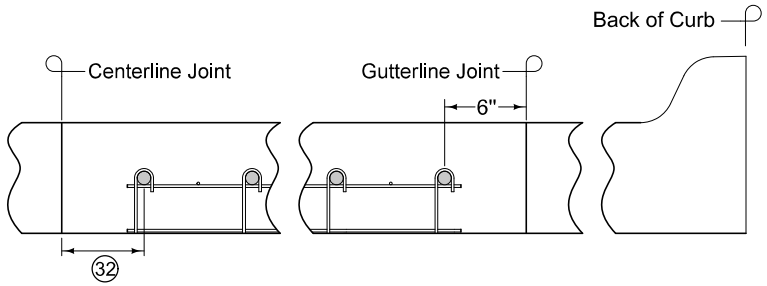
21 Details apply to both transverse contraction and expansion joints.

31 Diameter of bend around dowel is dowel diameter + 1/8 to 3/16 inches.

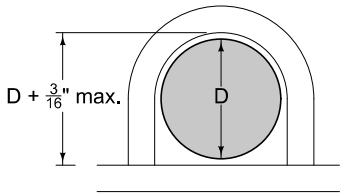
32 For uniform lane widths: 3" - 6". For taper and variable width pavements: 3" - 12".



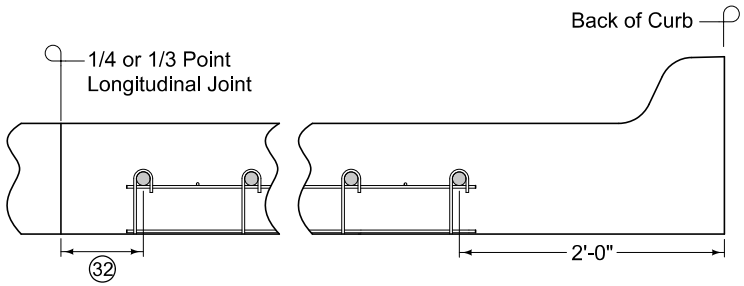
PLACEMENT LIMITS
(Rural Section)



PLACEMENT LIMITS
(Curb and Gutter - Gutterline Jointing)



BEND AROUND DOWEL 31



PLACEMENT LIMITS
(Curb and Gutter - 1/4 or 1/3 Point Jointing)

DOWEL ASSEMBLIES 19 20 21

SUDAS	IOWA DOT	REVISION 10 04-21-20
FIGURE 7010.101	STANDARD ROAD PLAN	PV-101
		SHEET 8 of 8

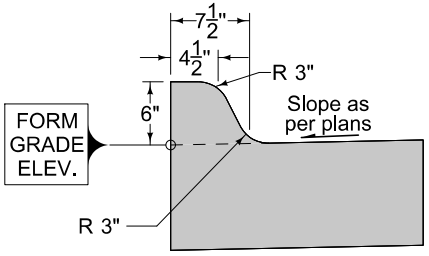
REVISIONS: Modified Dowel Assemblies on Sheets 6 and 7 to eliminate reference to 14' pavements.

Paul D. Wigand
SUDAS DIRECTOR

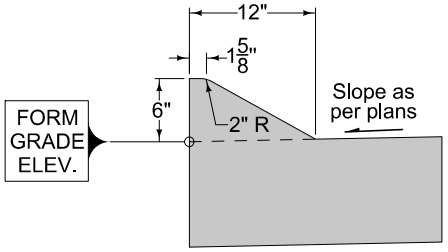
Stuart Nicholson
DESIGN METHODS ENGINEER

JOINTS

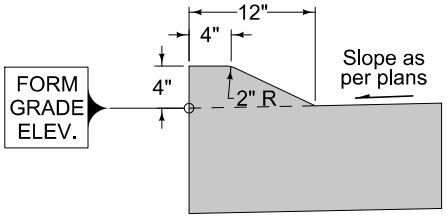
FIGURE 7010.101 | SHEET 8 OF 8



6" STANDARD CURB



6" SLOPED CURB



4" SLOPED CURB

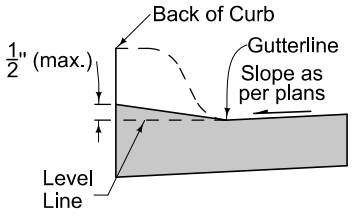
For joint details, see PV-101.

① 6 inch Standard Curb, 6 inch Sloped Curb, or 4 inch Sloped Curb as specified.

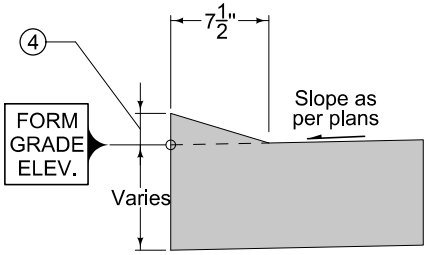
② ⅛ inch if Proposed Pavement is HMA. No elevation difference if Proposed Pavement is PCC.

③ 'BT' , 'KT', or 'L' joint if Proposed Pavement is PCC. 'B' joint if Proposed Pavement is HMA.

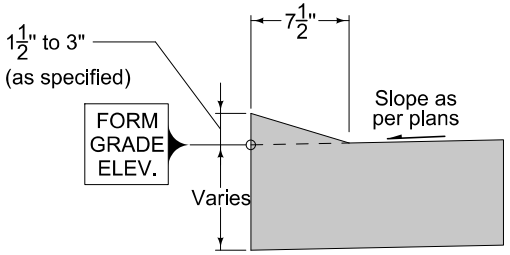
④ 0 to 2 inches for residential entrances. 1½ to 3 inches for industrial or commercial entrances.



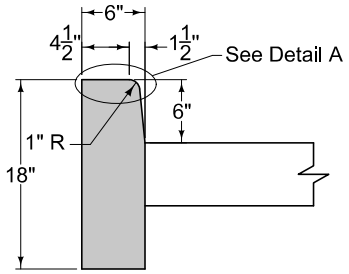
DROP CURB AT SIDEWALK



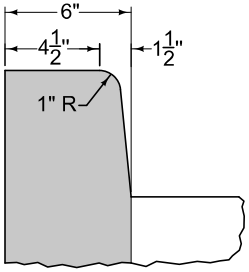
DRIVEWAY DROP CURB (IowaDepartment of Transportation is not the Contracting Authority)



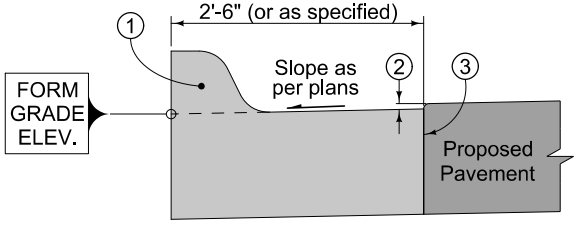
DRIVEWAY DROP CURB (Iowa Department of Transportation is the Contracting Authority)



BEAM CURB*
*For short replacement sections, match existing curb profile



DETAIL A



CURB AND GUTTER UNIT

FIGURE 7010.102

SHEET 1 OF 2

SUDAS | IOWA DOT

REVISION 5 04-21-20

PV-102

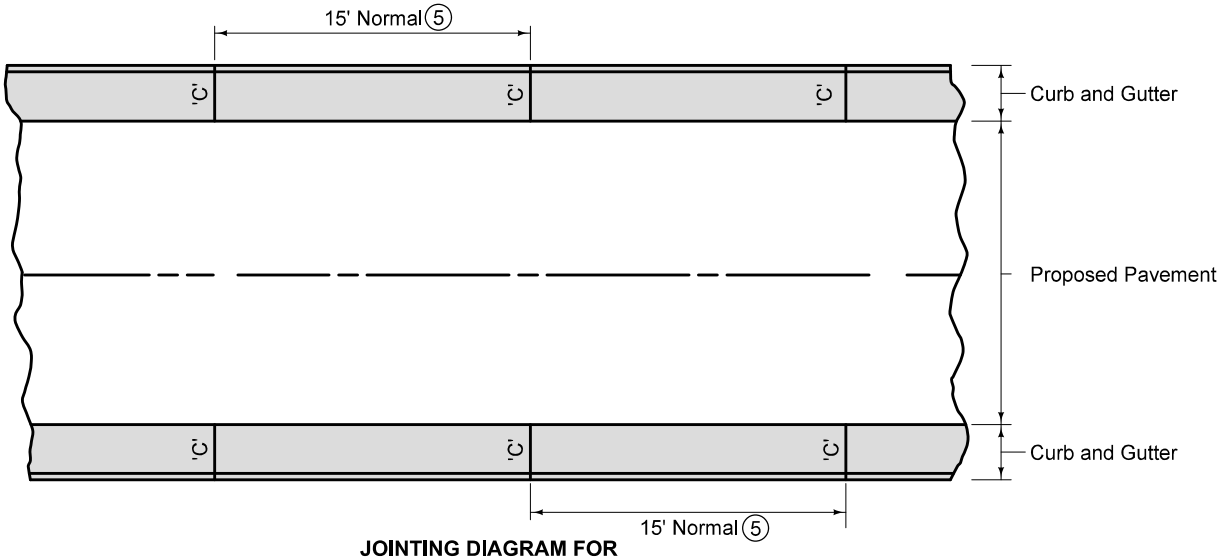
FIGURE 7010.102 | STANDARD ROAD PLAN | SHEET 1 of 2

REVISIONS: Split DRIVEWAY DROP CURB detail into two details. Added new circle note 4 on Sheet 1. Renumbered circle note on Sheet 5.

Paul D. Wigant — SUDAS DIRECTOR

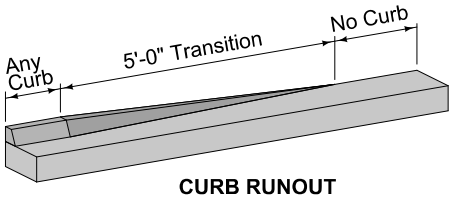
Stuart Nicholson — DESIGN METHODS ENGINEER

PCC CURB DETAILS

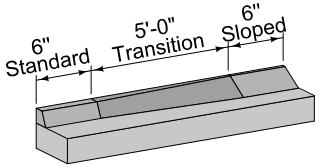


JOINTING DIAGRAM FOR CURB AND GUTTER UNIT

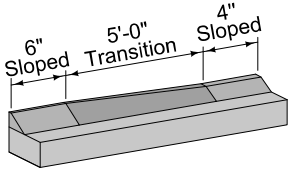
⑤ If proposed pavement is PCC, match joint spacing for proposed pavement. Place 'E' joints in curb and gutter section where expansion joints are to be placed in proposed pavement.



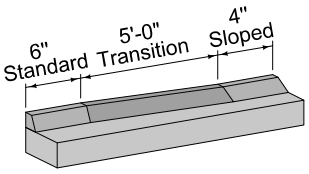
CURB RUNOUT FOR ALL CURBS



CURB TRANSITION FROM 6" STANDARD TO 6" SLOPED



CURB TRANSITION FROM 6" SLOPED TO 4" SLOPED



CURB TRANSITION FROM 6" STANDARD TO 4" SLOPED

FIGURE 7010.102 | SHEET 2 OF 2

SUDAS | IOWA DOT

REVISION	
5	04-21-20

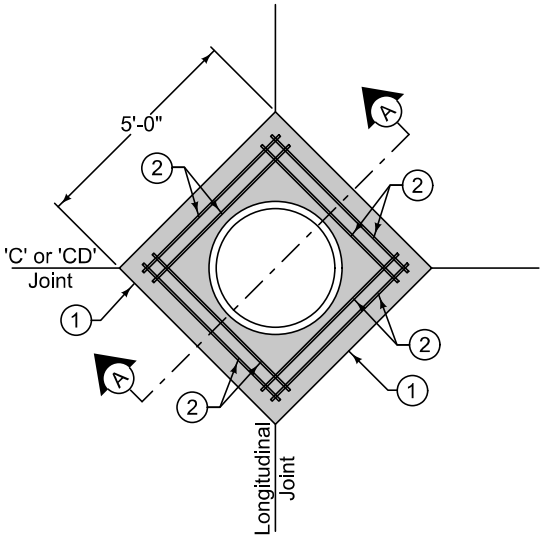
FIGURE 7010.102 | STANDARD ROAD PLAN | PV-102 | SHEET 2 of 2

REVISIONS: Split DRIVEWAY DROP CURB detail into two details. Added new circle note 4 on Sheet 1. Renumbered circle note on Sheet 5.

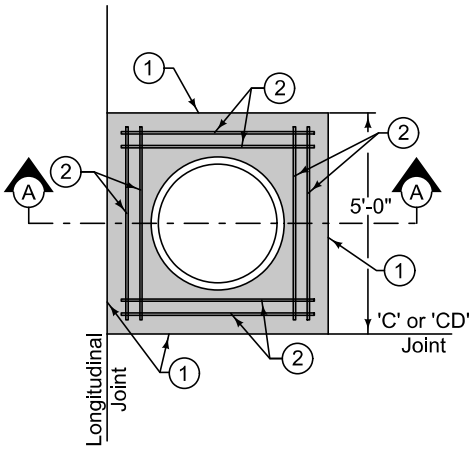
Paul D. Wigand — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

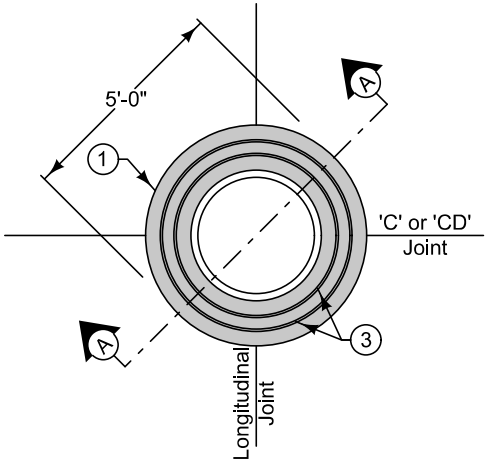
PCC CURB DETAILS



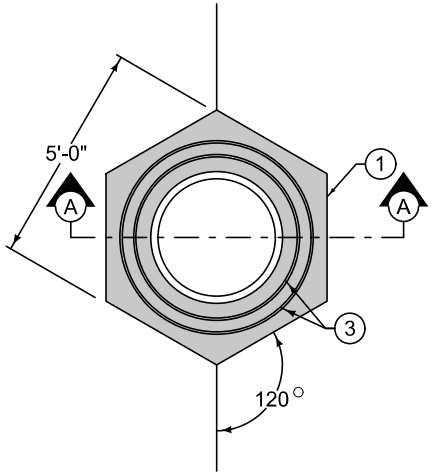
AT JOINT INTERSECTION



OFFSET AT JOINT INTERSECTION



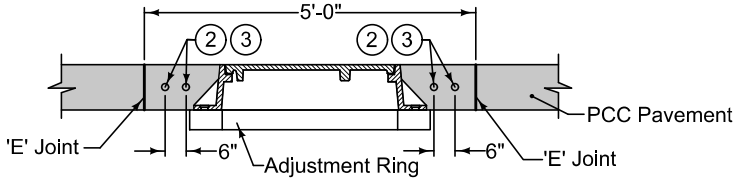
CIRCULAR



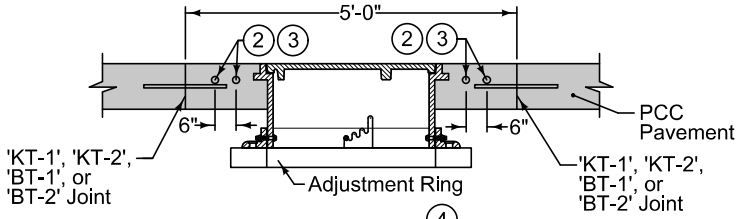
AT A SINGLE JOINT

Construct boxout with Class C concrete or match pavement class. Minimum 2 inches clear on reinforcement. Center casting within boxout area.

1. 'KT-1', 'KT-2', 'BT-1', or 'BT-2' joint if three-piece floating casting (SW 601 Type B and D or SW-602 Type F) is used. 'E' joint if two-piece fixed casting (SW 601 Type A and C or SW-602 Type E) is used.
2. 4 foot 8 inch (typ.) #4 bar. Place at mid-slab.
3. #4 hoops (variable length). Place at mid-slab.
4. No boxout is required for three-piece floating castings (SW 601 Type B and D or SW-602 Type F). If a boxout is used with a three-piece casting, construct as detailed in Section A-A for three-piece floating casting.



SECTION A-A
(For two-piece fixed casting)



SECTION A-A (4)
(For three-piece floating casting)

FIGURE 7010.103 | SHEET 1 OF 1

SUDAS | IOWADOT

REVISION: 1 | 04-21-20

FIGURE 7010.103 | STANDARD ROAD PLAN

PV-103

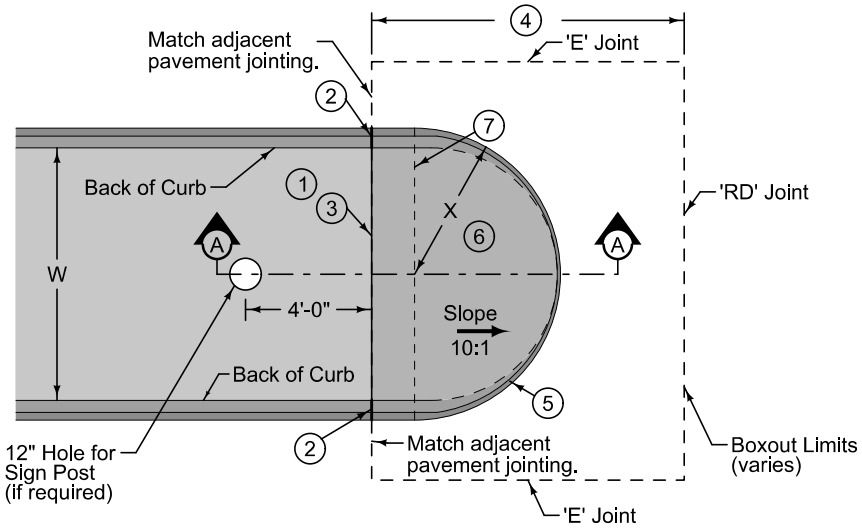
SHEET 1 of 1

REVISIONS: New logo.

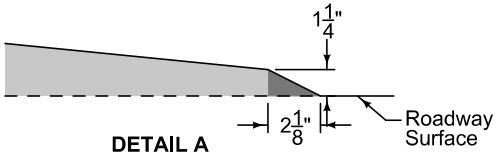
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

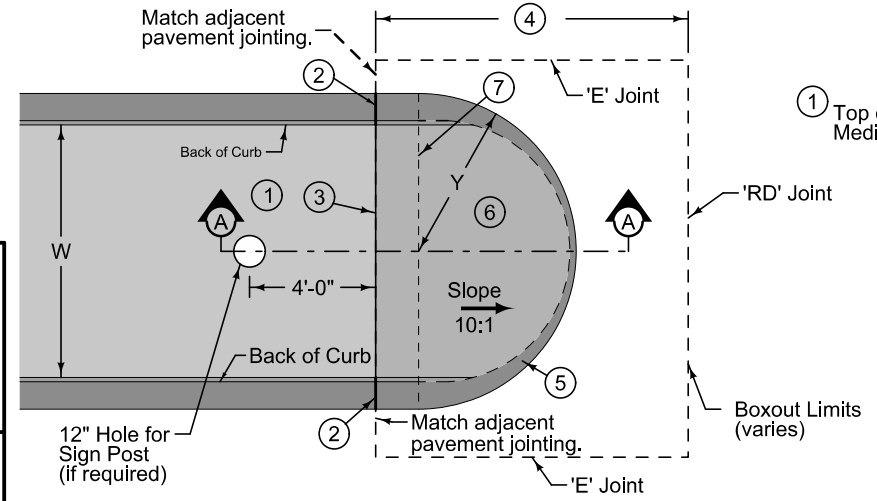
MANHOLE BOXOUTS IN PCC PAVEMENT



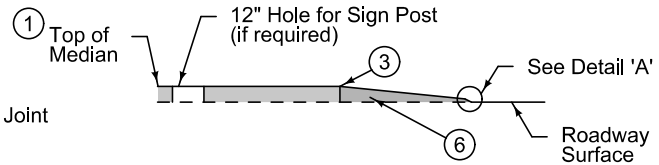
6" STANDARD
PLAN



DETAIL A



6" SLOPED
PLAN



SECTION A-A

1. For details of paved median, see contract documents.
2. 'EE' Joint. Expansion joints located at the end of normal curb.
3. 'E'Joint. If median is paved, place expansion joints at the end of normal curb.
4. If boxout length is less than or equal to 12 feet, provide 'C' Joint. If boxout length is greater than 12 feet, provide 'RD' joint.
5. Special shaping of curb.
6. Quantities for ramped median nose area is included in roadway pavement quantities.
7. When X or Y is 4 feet or greater the expansion joints will be at the begining of the rounded median.

W = Width from back of curb to back of curb

X = W/2 + 7.5"

Y = W/2 + 12"

RAMPED MEDIAN NOSE
(Median Width 8'-0" or Less)

FIGURE 7010.104 | SHEET 1 OF 1

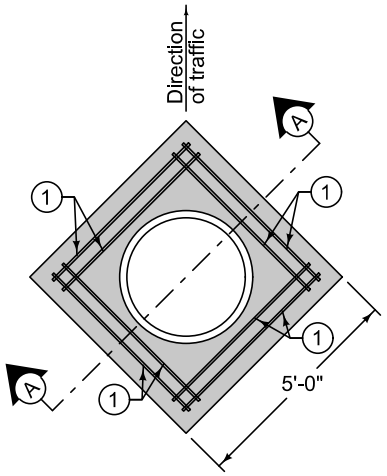
SUDAS | IOWADOT | REVISION 1 04-21-20

FIGURE 7010.104 | STANDARD ROAD PLAN | PV-104 | SHEET 1 of 1

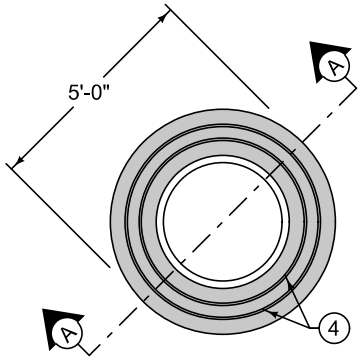
REVISIONS: New logo.

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

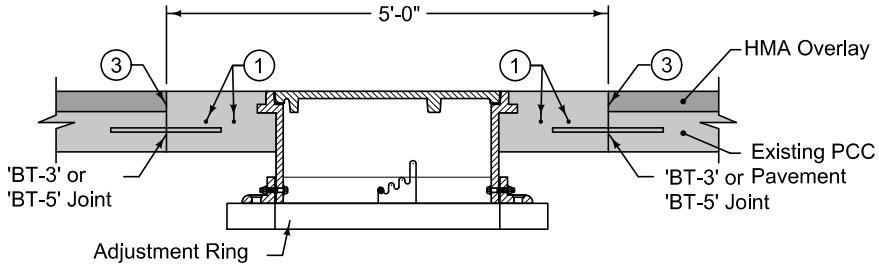
RAMPED MEDIAN NOSE



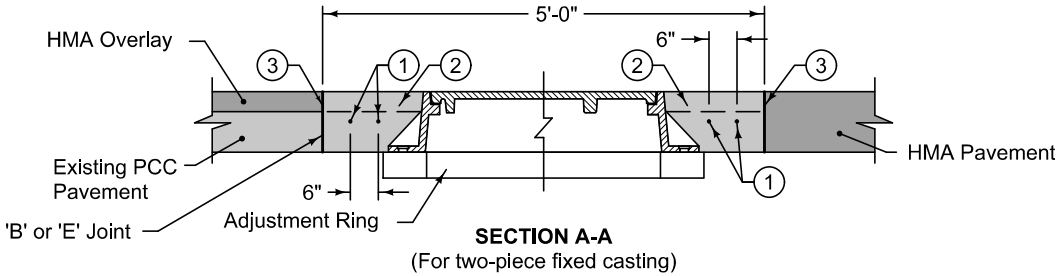
RECTANGULAR



CIRCULAR



SECTION A-A
(For three-piece floating casting)



SECTION A-A
(For two-piece fixed casting)

Construct boxout with Class C concrete. Minimum 2 inches clear on reinforcement. Center casting within boxout area.

(1) 4 foot 8 inch (typ.) #4 bar. Place at mid-slab.

(2) If boxout is constructed prior to placement of HMA overlay or final lift of HMA pavement, boxout may be constructed low, with a 'B' joint in place of the 'E' joint, and then final lift or overlay placed.

(3) Apply tack coat.

(4) #4 hoops (variable length). Place at mid-slab.

FIGURE 7020.201 | SHEET 1 OF 1

SUDAS | IOWADOT

REVISION	
1	10-15-19

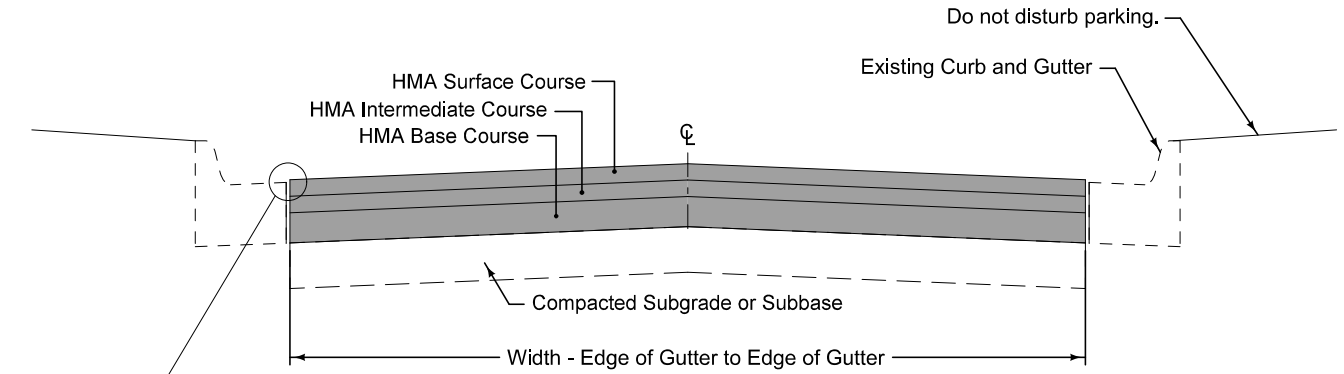
FIGURE 7020.201 | STANDARD ROAD PLAN | PV-201 | SHEET 1 of 1

REVISIONS: Modified circle note 2 to allow 'B' joint in place of 'E' joint for two-piece casting constructed low.

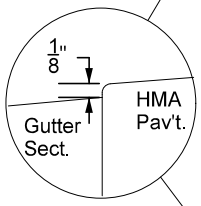
Paul D. Wigand
SUDAS DIRECTOR

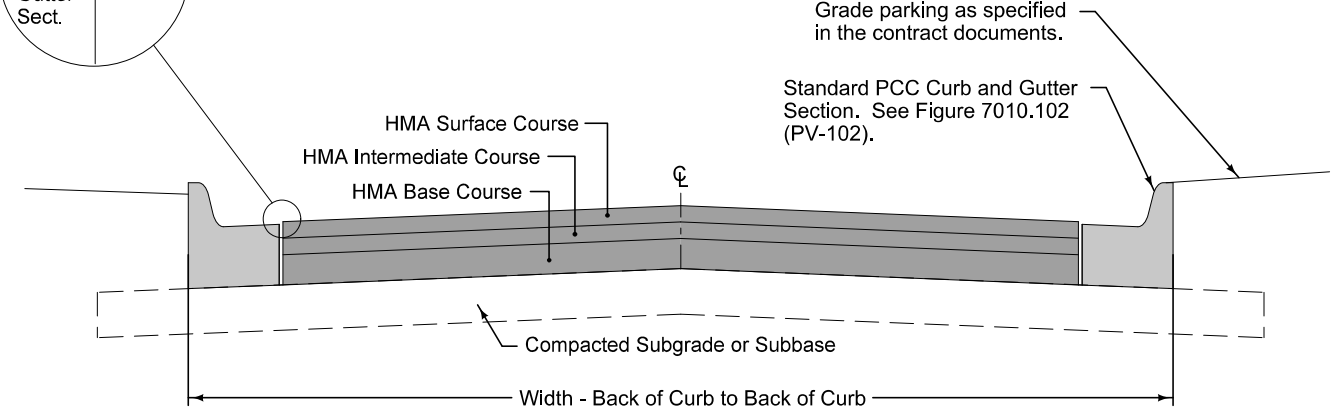
DESIGN METHODS ENGINEER

MANHOLE BOXOUTS IN HMA PAVEMENT AND HMA OVERLAYS



HMA PAVEMENT SECTION
(With Existing Curb and Gutter)





HMA PAVEMENT SECTION
(With New Curb and Gutter)

FIGURE 7020.901

SHEET 1 OF 2

SUDAS

REVISION	
New	10-19-10

7020.901

SHEET 1 of 2

SUDAS Standard Specifications

HMA PAVEMENT

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.

C. Hamburg Testing: Compact to 3.5% air voids. No more than 8 mm rutting in first 8,000 passes.

SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of Sidewalks, Shared Use Paths, and Driveways

B. Installation of Sidewalks, Shared Use Paths, and Driveways

1.02 DESCRIPTION OF WORK

A. Remove existing sidewalks, shared use paths, and driveways.

B. Install shared use paths.

C. Install sidewalk.

D. Install driveway.

1.03 SUBMITTALS

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

A. PCC mix design.

B. HMA mix design.

C. Brick source, absorption, compressive strength; samples of brick showing texture and color.

D. Submit type and color of detectable warnings.

E. Results of required testing.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

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

A. Portland Cement Concrete: See Section 7010.

B. Hot Mix Asphalt: See Section 7020.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Provide 10 calendar days advance notification of a pedestrian path closure to the Engineer and the National Federation of the Blind of Iowa (www.nfbi.org).

1.08 MEASUREMENT AND PAYMENT

A. Removal of Sidewalk, Shared Use Path, or Driveway:

1. **Measurement:** Measurement will be in square yards for the area of sidewalks, shared use paths, or driveways removed.

2. **Payment:** Payment will be at the unit price per square yard for the area of sidewalk, shared use path, or driveway removal.

3. **Includes:** Unit price includes, but is not limited to, sawing, hauling, and disposal of materials removed.

B. Removal of Curb:

1. **Measurement:** Measurement will be in linear feet for removal of curb by grinding or sawing, measured along the back of curb.

2. **Payment:** Payment will be at the unit price per linear foot for the removal of curb.

3. **Includes:** Unit price includes, but is not limited to, hauling and disposal of materials removed.

C. Shared Use Paths:

1. **Measurement:** Each type and thickness of shared use paths will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each type and thickness of shared use path.

3. **Includes:** Unit price includes, but is not limited to, subgrade preparation, jointing, sampling, slope and smoothness testing and correction, and testing.

D. Special Subgrade Preparation for Shared Use Paths:

1. **Measurement:** Measurement will be in square yards for special subgrade preparation. Measured area will include 2 feet outside of the pavement on either side of the path.

2. **Payment:** Payment will be at the unit price per square yard for the area of special subgrade preparation.

3. **Includes:** Unit price includes, but is not limited to, water required to bring subgrade moisture content to within the required limits.

1.08 MEASUREMENT AND PAYMENT (Continued)

E. PCC Sidewalk:

1. **Measurement:** Each thickness of PCC sidewalk will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of PCC sidewalk.

3. **Includes:** Unit price includes, but is not limited to, minor grade adjustments at driveways and other intersections, subgrade preparation, formwork, additional thickness at thickened edges, jointing, sampling, slope and smoothness testing and correction, and testing.

F. Brick/Paver Sidewalk with Pavement Base:

1. **Measurement:** Measurement will be in square yards for the area of brick/paver sidewalk placed on a pavement base. The area of pavement base will not be measured separately.

2. **Payment:** Payment will be at the unit price per square yard for the area of brick/paver sidewalk.

3. **Includes:** Unit price includes, but is not limited to, subgrade preparation, pavement base, setting bed, neoprene asphalt adhesive for asphalt setting bed, setting the bricks/pavers, installing weep holes and associated materials, and sand/cement joint filler.

G. Detectable Warnings:

1. **Measurement:** Measurement will be in square feet for the area of detectable warnings installed. Paved area beneath detectable warnings will be measured with sidewalk or shared use path item.

2. **Payment:** Payment will be at the unit price per square foot for the area of detectable warnings installed.

3. **Includes:** Unit price includes, but is not limited to, steel bar supports and manufactured detectable warning panels.

1.08 MEASUREMENT AND PAYMENT (Continued)

H. Driveways:

1. **Paved Driveways:**
   - **a. Measurement:** Each type and thickness will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
   - **b. Payment:** Payment will be at the unit price for each type and thickness of driveway.
   - **c. Includes:** Unit price includes, but is not limited to, excavation, subgrade preparation, jointing, sampling, and testing.

2. **Granular Surfacing for Driveways:**
   - **a. Measurement:** Measurement will be in square yards or tons, as specified in the contract documents, for the quantity of granular surfacing placed.
   - **b. Payment:** Payment will be at the unit price per square yard or ton, as specified.
   - **c. Includes:** Unit price includes, but is not limited to, excavation and preparation of subgrade.

I. Sidewalk, Shared Use Path, and Driveway Assurance Testing:

1. The Contractor will not be responsible for concrete compression or HMA density testing unless otherwise specified in the contract documents.

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

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

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT CONCRETE

A. Class B or C concrete with materials complying with Section 7010. Use coarse aggregate of Class 2 durability or better.

B. Comply with the following for PCC mixes for sidewalks, shared use paths, and driveways unless otherwise approved by the Engineer.

Table 7030.01: PCC Mixes

	Machine Finish	Hand Finish
Type of Concrete	Class B or C	Class B or C
Slump Minimum	1/2 in.	1/2 in.
Slump Maximum	2 1/2 in.	4 in.
Percent Air Content		
• Target	7%	7%
• Minimum	6%	6%
• Maximum	8 1/2%	8 1/2%

2.02 HOT MIX ASPHALT

Comply with Section 7020 for mix design.

A. Use Low Traffic (LT), 1/2 inch or 3/8 inch mix.

B. For shared use paths adjacent to pavement that also functions as the pavement shoulder, use Low Traffic (LT), 1/2 inch mix.

C. Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28S or 58-34S.

2.03 BRICKS/PAVERS

A. Clay Bricks: Use 8 inch by 4 inch by 2 1/4 inch thick clay paving bricks with straight edges or a maximum chamfer of 1/8 inch manufactured to comply with ASTM C 902, Class SX, Type I. Color selection and surface texture as approved by the Engineer.

B. Concrete Pavers: Supply as specified in the contract documents. Use pavers with straight edges or a maximum chamfer of 1/8 inch.

2.04 SETTING BED FOR BRICKS/PAVERS

A. HMA:

1. Mixture: Proportion mix using 7% asphalt binder and 93% fine aggregate. Apportion each ton in the approximate ratio of 145 pounds asphalt binder to 1,855 pounds sand. Maintain mix temperature at approximately 250°F during placement.

2. Asphalt Binder: Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28 or 64-22.

3. Fine Aggregate: Use clean, hard sand with durable particles free from adherent coating, lumps of clay, alkali salts, and organic matter. Use sand that is uniformly graded from coarse to fine with all passing the No. 4 sieve and meeting AASHTO T 27.

2.04 SETTING BED FOR BRICKS/PAVERS (CONTINUED)

B. Pre-mixed High Performance Cold Mix: If allowed, substitute a pre-mixed high performance cold mix product for the HMA setting bed generally meeting the HMA mixture requirements noted above.

C. Sand: Use clean, hand sand free from deleterious materials. Use sand meeting ASTM C 33 that is uniformly graded with all passing the No. 4 sieve and 3% or less passing the No. 200 sieve.

2.05 NEOPRENE MODIFIED ASPHALT ADHESIVE FOR BRICKS/PAVERS

A. Mastic (Asphalt Adhesive):

Solids (Base):	74% to 76%
Pounds per Gallon:	8 to 8 1/2 pounds
Solvent:	Mineral spirits with a flash point above 100° F

B. Base (2% Neoprene, 10% Asbestos-free Fiber, 88% Asphalt):

Melting Point:	200° F minimum according to ASTM D 36
Penetration:	23 to 27 according to ASTM D 5
Ductility:	1250 mm minimum according to ASTM D 113 @ 25° C, and a rate of 50 mm/minute

2.06 BRICK/PAVER JOINT FILLER

Dry sand-cement mixture consisting of one part masonry cement complying with ASTM C 91 and three parts sand complying with ASTM C 144 and passing the No. 16 sieve. Provide colored cement as specified in the contract documents.

2.07 DETECTABLE WARNINGS

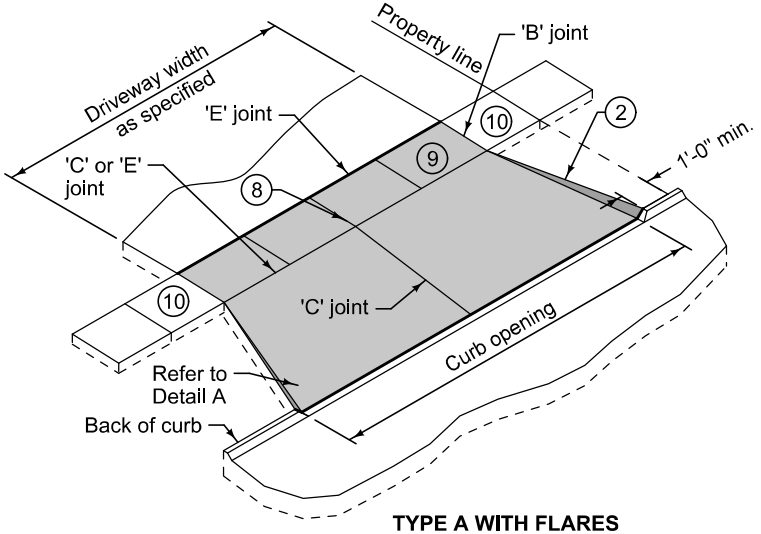
Use manufactured detectable warning panels with a non-slip surface and raised truncated domes. Comply with the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (also known as PROWAG) for contrast and dimension requirements. Also comply with Iowa DOT Materials I.M. 411.

2.08 GRANULAR DRIVEWAY SURFACING

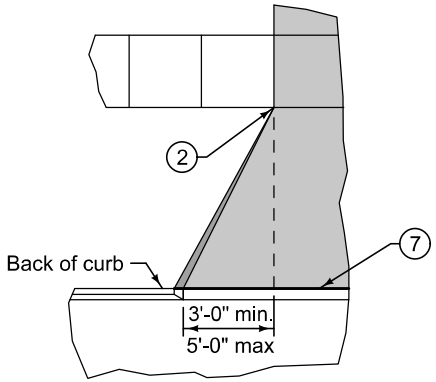
Class A crushed stone or Class C gravel complying with Iowa DOT Section 2315.

2.09 ISOLATION AND EXPANSION JOINT SEALANT

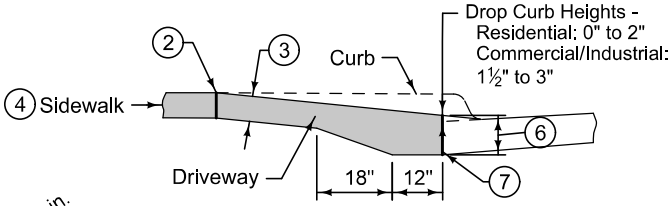
Use a polyurethane, self-leveling sealant complying with ASTM C 920. Application temperature range of 40 to 120°F. Minimum elongation 700%.



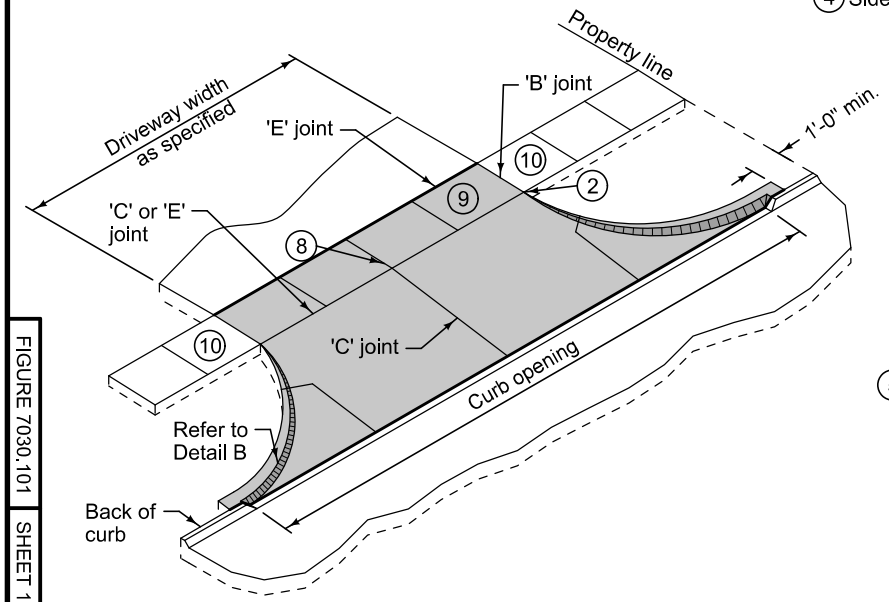
TYPE A WITH FLARES



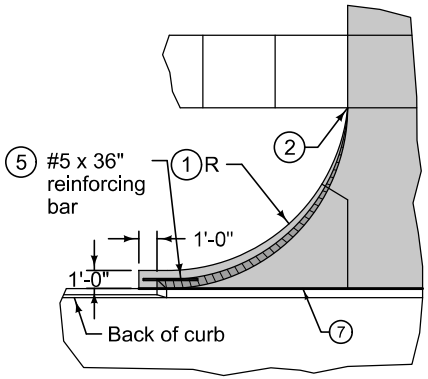
DETAIL A
(Residential/Agricultural Only)



TYPICAL SECTION



TYPE A WITH RADII



DETAIL B

1. Driveway radius (R).
   Residential: 10 foot minimum,15 foot maximum.
   Commercial and industrial: As specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb across sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. Center reinforcing bar vertically in the pavement.
6. Match thickness of adjacent roadway, 8 inches minimum.
7. Provide 'E' joint at back of curb unless 'B' joint is specified.
8. For alleys, invert the pavement crown 2% toward center of alley.
9. Target cross slope of 1.5% with a maximum cross slope of 2.0%. If specified in the contract documents, construct the sidewalk through the driveway 5 feet wide to serve as a passing space.
10. If cross slope of adjacent sidewalk panel exceeds 2.0%, remove and replace to transition from existing sidewalk to sidewalk through driveway. If elevation change requires a curb ramp, comply with Figure 7030.205; verify need for detectable warning panel with Engineer.

FIGURE 7030.101 | SHEET 1 OF 1

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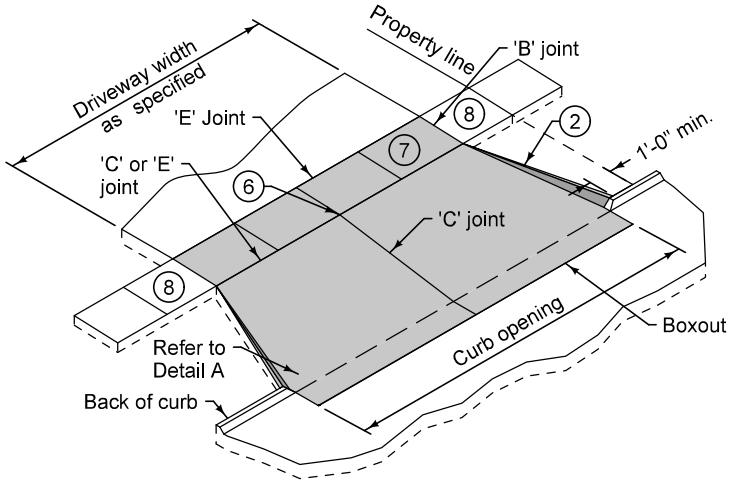
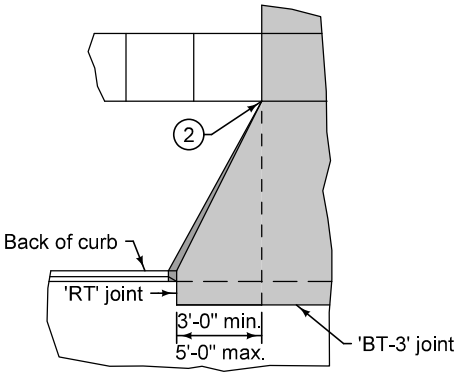
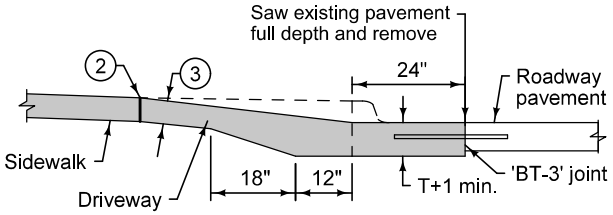
CONCRETE DRIVEWAY, TYPE A



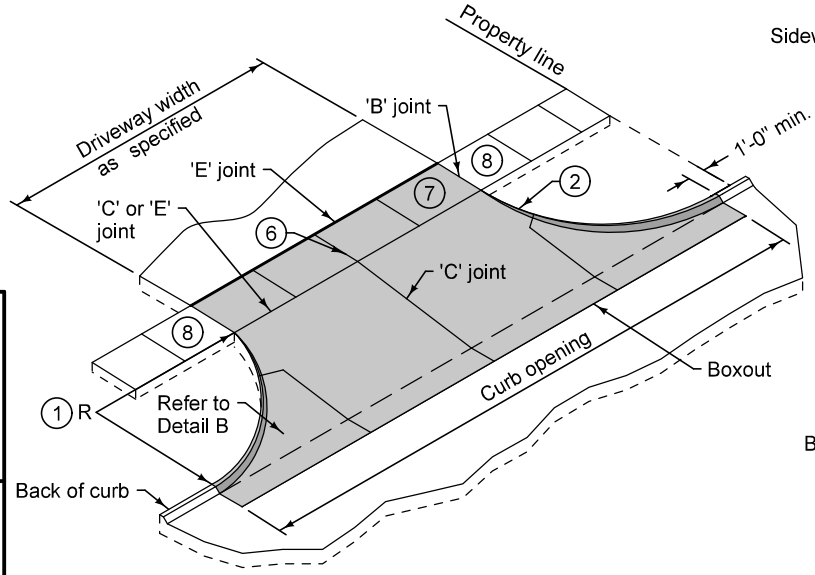
TYPE B WITH FLARES



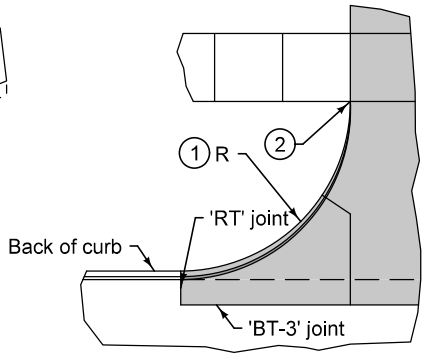
DETAIL A
(Residential/Agricultural Only)



SECTION A-A



TYPE B WITH RADII



DETAIL B

1. Driveway radius (R).
   Residential: 10 foot minimum, 15 foot maximum.
   Commercial and industrial: As specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb cross sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. If longitudinal joint is located 48 inches or less from the back of curb, extend boxout to joint line. Full depth saw cut is still required.
6. For alleys, invert the pavement crown 2% toward the center of the alley.
7. Target cross slope of 1.5% with a maximum cross slope of 2.0%. If specified in the contract documents, construct the sidewalk thorugh the driveway 5 feet wide to serve as a passing space.
8. If cross slope of adjacent sidewalk panel exceeds 2.0%, remove and replace to transition from existing sidewalk to sidewalk through driveway. If the elevation change requires a curb ramp, comply with Figure 7030.205; verify need for detectable warning panel with Engineer.

FIGURE 7030.102 | SHEET 1 OF 1

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SUDAS Standard Specifications

CONCRETE DRIVEWAY, TYPE B

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. 13, Class 2 durability (AASHTO M 43/ASTM D 448, Size 2).

B. Filter Aggregate: Aggregate complying with Iowa DOT Section 4115, Gradation No. 3, Class 2 durability (AASHTO M 43/ASTM D 448, Size 57).

C. Bedding/Joint/Void Filler Aggregate: Crushed stone complying with Iowa DOT Section 4125, Gradation No. 29 (AASHTO M 43/ASTM D 448, Size 8).

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.

TRAFFIC SIGNALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Underground

B. Detection

C. Communications

D. Cabinet and Controller

E. Poles, Heads, and Signs

1.02 DESCRIPTION OF WORK

This part of the specifications includes the furnishing of all material and equipment necessary to complete, in place and operational, traffic control signal(s) as described in the project plans.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the additional requirements listed below. All of the following must be submitted within 30 days after awarding of the contract for the project. Verify the method of submittal with the Jurisdiction.

A. Schedule of Unit Prices: Submit a completed schedule of unit prices. Estimates of the work performed on the project will be made by the Jurisdiction and the unit costs will be used to prepare progress payments to the Contractor.

B. Material and Equipment List: Submit a completed list of materials and equipment to the Jurisdiction for written approval before any equipment or materials are ordered.

C. Contractor Certification: Submit the name(s) and contact information of the International Municipal Signal Association (IMSA) Level II Certified Traffic Signal Technician(s) working on the project and a copy of their IMSA certificate.

D. Shop Drawings: Submit shop drawings for traffic signal poles and structures to be furnished on the project. Submit catalog cuts and manufacturer's specifications for all items in the equipment list.

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

Comply with the current edition of the MUTCD as adopted by the Iowa DOT.

1.08 MEASUREMENT AND PAYMENT

A. Traffic Signal:

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

2. Payment: Payment will be at the lump sum price for traffic signal installation.

B. Temporary Traffic Signal:

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

2. Payment: Payment will be at the lump sum price for temporary traffic signal. 50% of the lump sum bid amount will be paid upon completion of the installation and successful initial operation of the signal; the final 50% will be paid upon removal of the temporary traffic signal and cleanup of the site.

3. Includes: Lump sum price includes but is not limited to furnishing, installing, maintaining, and removing poles; wiring; traffic signal control equipment including pedestrian equipment if specified; all modifications of signal timing due to changes in construction staging; relocation of trailer mounted temporary traffic signal systems; placement in another physical location to address changes in construction staging; and all appurtenances.

3.05 POLES, HEADS, AND SIGNS

A. Vehicle and Pedestrian Traffic Signal Heads:

1. Inspect each signal head assembly while still on the ground for the following:
   a. Physical defects
   b. Visor type
   c. LED wattage
   d. Lens orientation
   e. Wiring connections

2. Attach signal head mounting hardware according to the manufacturer's recommendations. Apply anti-seize compound to all mechanical fasteners.

3. Adjust each signal head both vertically and horizontally to approximate a uniform grade of all like signal heads.

4. During the course of construction and until the signals are placed in operation, cover signal faces or turn away from approaching traffic. When ready for operation, plumb and aim the heads.

B. Traffic Signal and Pedestal Poles and Pedestrian Push Button Posts:

1. Erect all poles and posts vertically under normal load.

2. Securely bolt the bases to the cast-in-place concrete foundations using the following procedures. Perform this work only on days with winds less than 15 mph. Tighten all of the nuts in the presence of the inspector. Once the tightening procedure is started, complete on all of the base plate nuts without pause or delay.
   a. Use properly sized wrenches or sockets, or both, designed for tightening nuts or bolts, or both, to avoid rounding or other damage to the nuts. Do not use adjustable end or pipe wrenches.
   b. Ensure base plates, anchor rods, and nuts are free of all dirt or debris.
   c. Apply stick wax or bees wax to the threads and bearing surfaces of the anchor bolt, nuts, and washers.
   d. Tighten top nuts so they fully contact the base plate. Tighten leveling nuts to snug tight condition. Snug tight is defined as the full effort of one person on a wrench with a length equal to 14 times the bolt diameter but not less than 18 inches. Apply full effort as close to the end of the wrench as possible. Perform tightening by leaning back and using entire body weight to pull firmly on the end of the wrench until the nut stops rotating. Perform a minimum of two separate passes of tightening. Sequence tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all of the nuts in that pass have been tightened.
   e. Tighten top nuts to snug tight as described for the leveling nuts.
   f. Match-mark the top nuts and base plate using paint, crayon, or other approved means to provide a reference for determining the relative rotation of the nut and base plate during tightening. Further tighten the top nuts tightened in two passes, as listed in Table 8010.01, using a striking or hydraulic wrench. Follow a sequence of tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all nuts in that pass have been turned. Do not allow the leveling nut to rotate during the top nut tightening.
   g. Lubricate the jam nuts, place, and tighten to snug tight.

3.05 POLES, HEADS, AND SIGNS (Continued)

Table 8010.01: Bolt Tightening

Anchor Bolt Size	First Pass	Second Pass	Total Rotation
Less than or equal to 1 1/2 inch diameter	1/6 turn	1/6 turn	1/3 turn
Greater than 1 1/2 inch diameter	1/12 turn	1/12 turn	1/6 turn

3. A torque wrench should be used to verify that a torque at least equal to the computed verification torque, T_v, according to paragraph 6.9 of FHWA *Guidelines for the Installation, Inspection, Maintenance, and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, is required to additionally tighten the top nuts. An inability to achieve this torque should be interpreted to indicate that the threads have stripped and should be reported to the Engineer.

4. After leveling the poles, use non-shrink grout or a rodent guard between the pole base and the foundation. When non-shrink grout is used, neatly finish exposed edges of grout to present a pleasing appearance, and place a weep hole in the grout.

5. Apply anti-seize compound to all mechanical fasteners on pole access doors.

6. Install pedestrian push button post caps with tamper-proof set screws per manufacturer's direction or by driving the cap a minimum of 1/2 inch onto the post.

C. Traffic Signs: Install signs using universally adjustable sign brackets banded to the pole. Apply anti-seize compound to all mechanical fasteners.

3.06 TEMPORARY TRAFFIC SIGNAL

Construct according to Figure 8010.107 and to the configuration specified in the contract documents. Remove the temporary traffic signal as directed by the Engineer.

3.07 SURFACE RESTORATION

A. Replace or reconstruct features removed as a part of the work, such as sidewalks, driveways, curbs, roadway pavement, unpaved areas, or any other items.

B. Complete restoration according the applicable sections of the SUDAS Standard Specifications or as directed by the Engineer.

3.08 TESTING

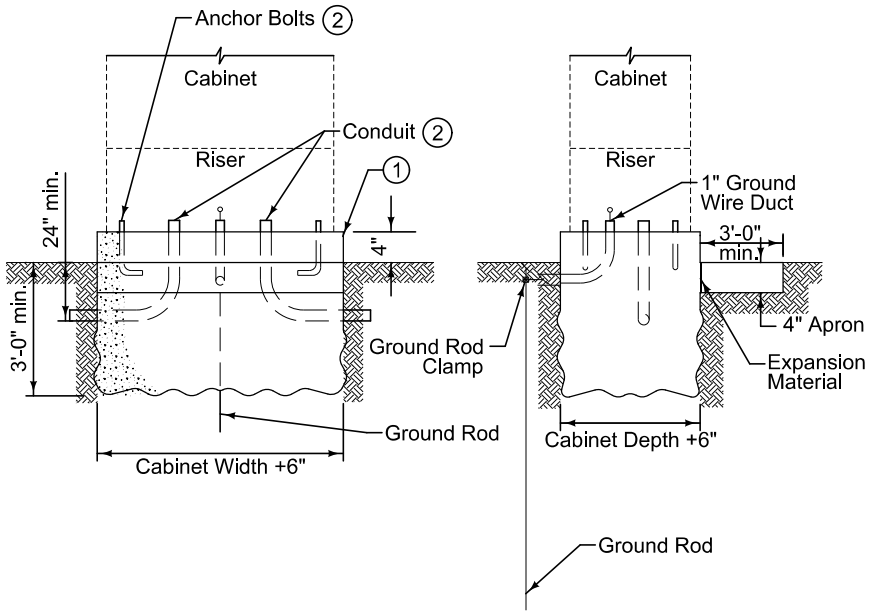
A. Notify the Engineer 48 hours in advance of the time and date the signal or signal system will be ready for turn on. Do not turn on the signal or signal system without authorization of the Engineer.

B. Ensure a representative from the manufacturer and/or supplier of signal controller or other authorized person is at the project site when the signal controllers are ready to be turned on to provide technical assistance including, as a minimum, programming of all necessary input data.

C. All required signal timing data will be provided by the Engineer.

(1) Shape top 11 inches with forms.

(2) Bolt spacing and conduit locations as specified by the manufacturer.



NEMA CONTROLLER CABINET FOOTING

FIGURE 8010.101

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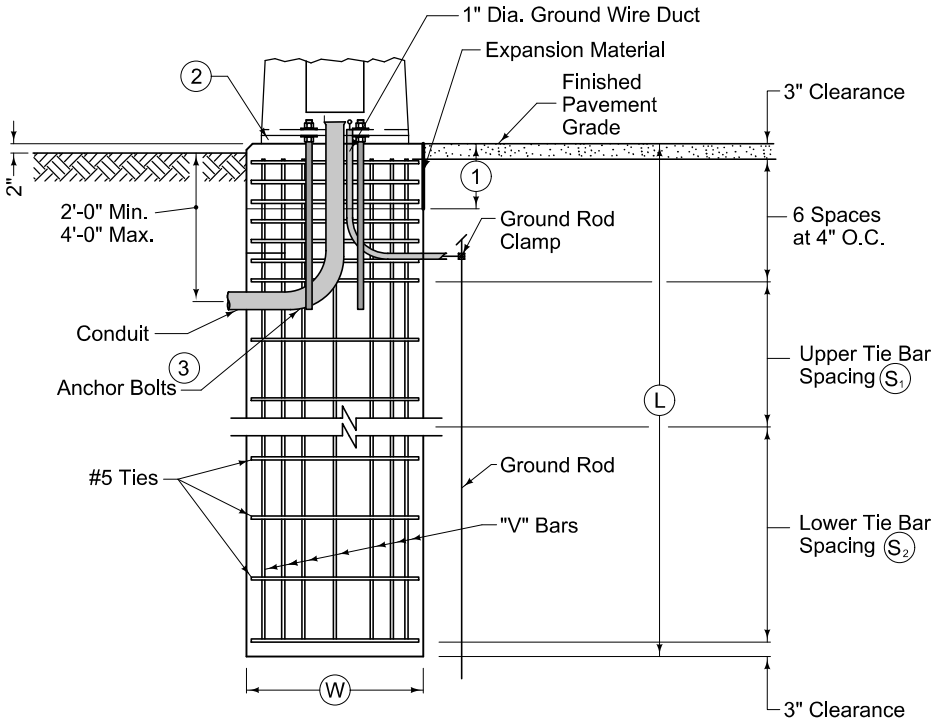
SUDAS Standard Specifications

CABINET FOOTING DETAILS



MAST ARM POLE FOUNDATION IN SOIL
TYPE A FOUNDATION

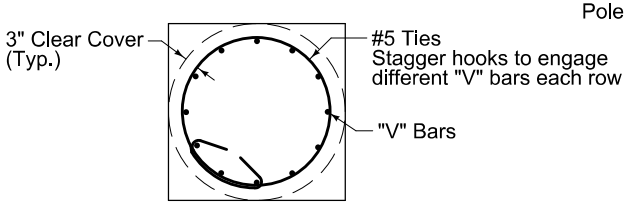
The Type A Foundation is the normally required foundation construction. Where rock is encountered, the Engineer may approve the use of the Type B or C Foundation. Prior to installing a foundation in rock, obtain a subsurface investigation certified by a geotechnical engineer licensed in the State of Iowa.

(1) Shape top 11 inches with forms. See Detail 'A'.

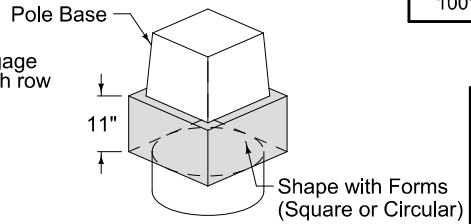
(2) Install rodent guard or non-shrink grout with weep hole.

(3) Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.

Max. Mast Arm Length	Foundation		"V" Bars			Tie Bars				
	W	L	Count	Size	Length	Count	Upper Spacing		Lower Spacing	
							# Spaces	S_1	# Spaces	S_2
35'-0"	3'-0"	12'-0"	12	#8	11'-6"	17	9	12"	N/A	N/A
45'-0"	3'-0"	14'-0"	12	#8	13'-6"	19	11	12"	N/A	N/A
55'-0"	3'-0"	16'-0"	12	#8	15'-6"	25	12	8"	5	12"
60'-0"	3'-0"	18'-0"	13	#8	17'-6"	28	15	8"	5	12"
70'-0"	3'-6"	18'-0"	12	#10	17'-6"	28	15	8"	5	12"
80'-0"	3'-6"	21'-0"	14	#10	20'-6"	40	22	6"	10	8"
90'-0"	4'-0"	22'-0"	16	#10	21'-6"	42	24	6"	10	8"
100'-0"	4'-0"	24'-0"	18	#10	23'-6"	47	32	6"	7	8"

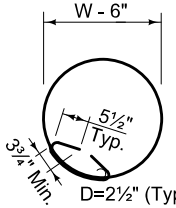


PLAN VIEW



DETAIL 'A'

BENT BAR DETAIL



Note: All dimension are out to out.

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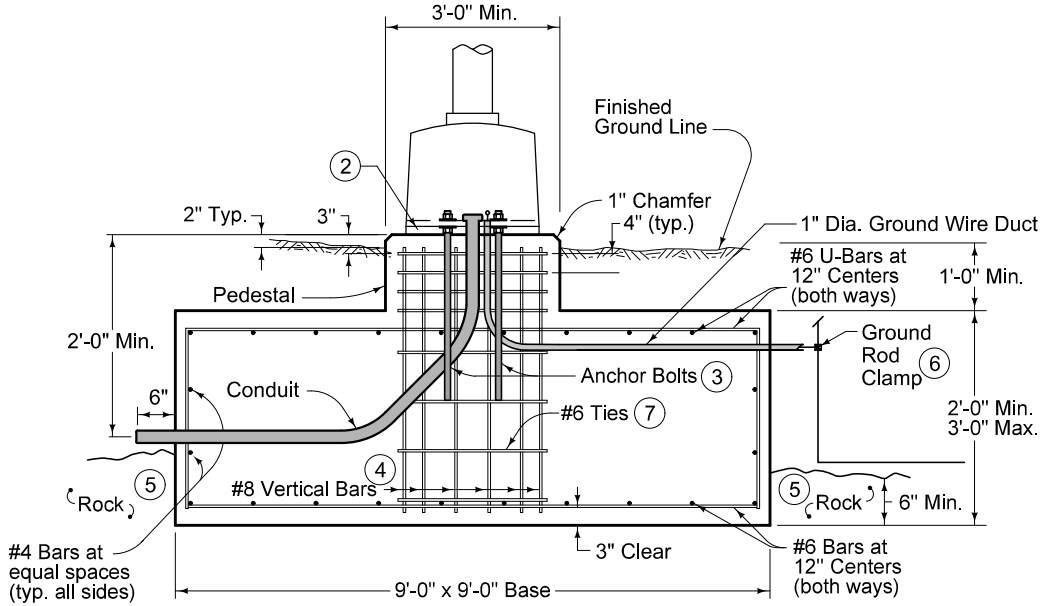
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 1 of 4

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

Paul D. Wigant, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION

FIGURE 8010.102 | SHEET 1 OF 4



MAST ARM POLE FOUNDATION IN ROCK
TYPE B FOUNDATION

Type B Foundation is applicable for traffic signal poles with mast arm lengths up to 60 feet.

If the excavation for a Type B Foundation is left open for more than 1 calendar day, install temporary barrier rail if any part of the excavation is located within the clear zone. Temporary barrier rail layout requires the Engineer's approval.

Competent rock has an average unconfined compressive strength (q_u) of at least 2.0 ksi and rock quality designation of at least 90%. Conditions not meeting minimum requirements will require either:
- A site specific design, or
- Using the parameters for Mast Arm Pole Foundation in Soil.

(2) Install rodent guard or non-shrink grout with weep hole.

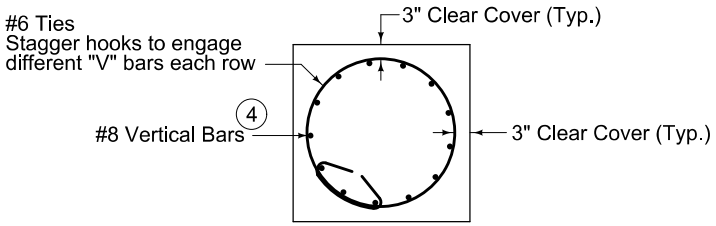
(3) Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.

(4) Place 13 equally spaced #8 vertical bars.

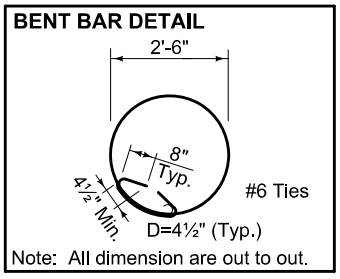
(5) Cast foundation concrete against competent rock. If foundation is formed, place backfill with concrete cast against rock.

(6) When in contact with rock, place ground rods as specified in National Electrical Code, current edition.

(7) #6 bars spaced at 8 inch maximum. Ties may be welded to vertical bars.



PLAN VIEW



SUDAS | IOWADOT | REVISION 4 04-21-20

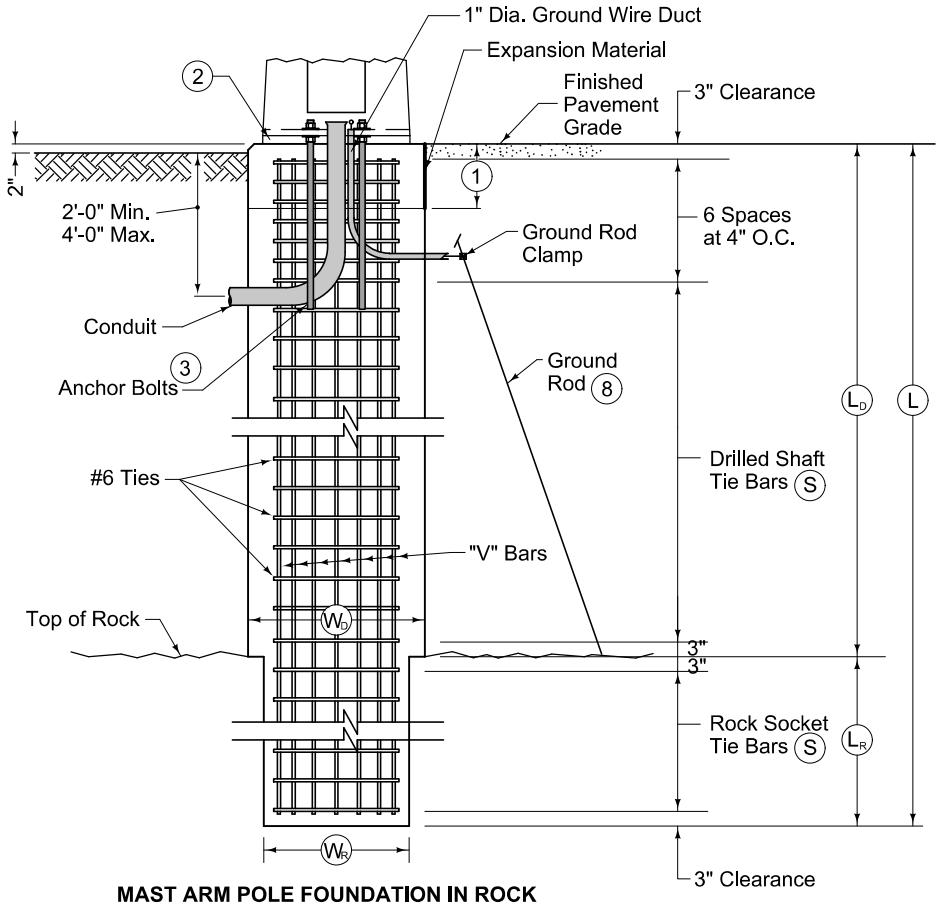
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 2 of 4

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

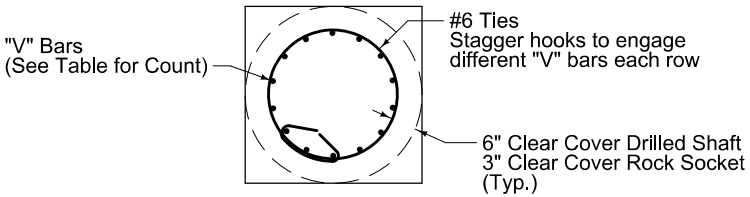
Paul D. Wigant, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION

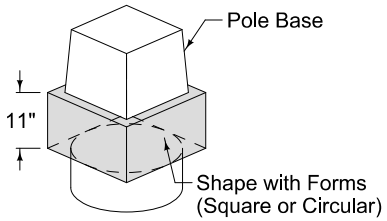
FIGURE 8010.102 | SHEET 2 OF 4



MAST ARM POLE FOUNDATION IN ROCK TYPE C FOUNDATION



MAST ARM POLE FOUNDATION



DETAIL 'A'

(1) Shape top 11 inches with forms. See Detail 'A'.

(2) Install rodent guard or non-shrink grout with weep hole.

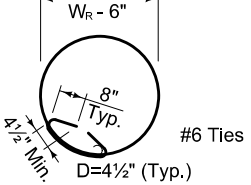
(3) Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.

(8) When in contact with rock, place ground rods as specified in National Electrical Code, current edition.

Max. Mast Arm Length	Foundation						"V" Bars			Tie Bars
	W_D Min.	W_R Min.	L*** Max.	L_D	L_R**** Broken Rock*	L_R**** Competent Rock**	Count	Size	Length	S Spacing
35'-0"	3'-0"	2'-6"	12'-0"	VARIES $L_D = (L - L_R)$	4'-6"	3'-0"	13	#8	L - 6"	6"
45'-0"	3'-0"	2'-6"	14'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
55'-0"	3'-0"	2'-6"	16'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
60'-0"	3'-0"	2'-6"	18'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
70'-0"	3'-6"	3'-0"	18'-0"		5'-6"	3'-6"	14	#9	L - 6"	5½"
80'-0"	3'-6"	3'-0"	21'-0"		5'-6"	3'-6"	14	#9	L - 6"	5½"
90'-0"	4'-0"	3'-6"	22'-0"		6'-0"	4'-0"	15	#10	L - 6"	5½"
100'-0"	4'-0"	3'-6"	24'-0"		6'-0"	4'-0"	15	#10	L - 6"	5½"

*Broken rock has an average unconfined compressive strength (q_u) of at least 1.0 ksi and rock quality designation of at least 20%.
**Competent rock has an average unconfined compressive strength (q_u) of at least 2.0 ksi and rock quality designation of at least 90%.
***Total foundation length L must be sufficient to provide a 3 inch clearance between the bottom of the traffic signal pole anchor bolts and the bottom of the rock socket.
****The Rock Socket Length L_R can be decreased if the total length of the shaft is L long as shown in the table.
Conditions not meeting minimum requirements will require site specific designs or shall use theType A Foundation Soil parameters.

BENT BAR DETAIL



Note: All dimension are out to out.

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FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 3 of 4

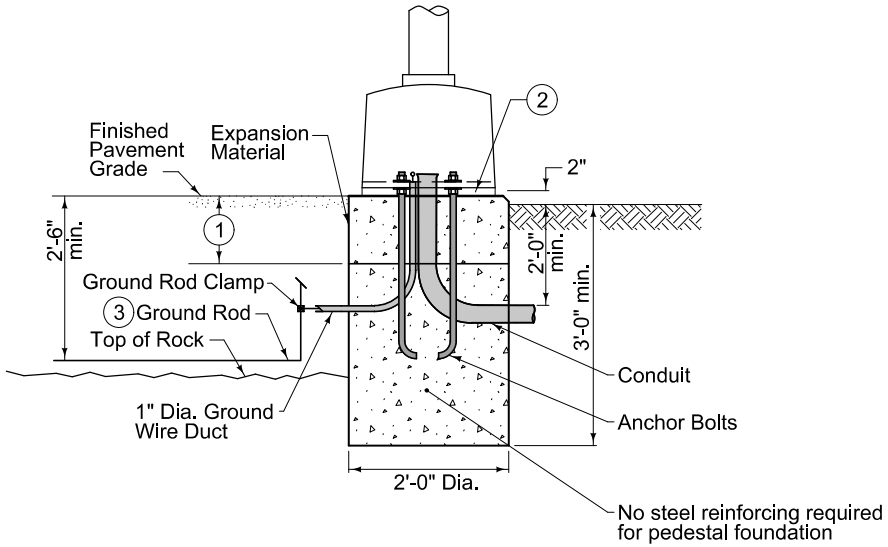
REVISIONS: Modified conduit details in MAST ARM POLE FOUNDATION drawings on Sheets 1, 2, and 3.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

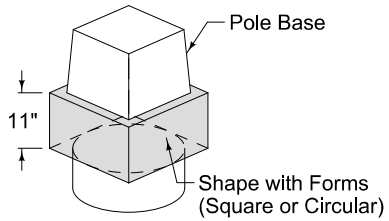
TRAFFIC SIGNAL POLE FOUNDATION

FIGURE 8010.102 SHEET 3 OF 4

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

3.02 CONSTRUCTION (Continued)

F. Raised Pavement Markers: Ensure markers continually exposed to traffic do not extend more than 3/4 inch above the pavement surface.

G. Pavement Marking Layout and Location:

1. **Permanent Markings:** Place all lines within 2 inches of reference location. The location of edge lines may be referenced to the pavement edge. The locations of other longitudinal lines may be referenced to accurately locate longitudinal joints. Where reference locations do not exist or are not reliable, locate the lines as follows:
   a. For straight or nearly straight lines, reference the locations to a string line set between marking line points.
   b. For curves, reference the locations to closely spaced marking line points. For sharp curves, a spacing of 10 feet may be required.
   c. Other equally effective systems the Engineer approves.

2. **Temporary Markings:** The location of temporary pavement marking will be specified in the contract documents or as directed by the Engineer to maximize the effectiveness of the traffic control plan.

H. Removal of Pavement Markings:

1. **Staging:**
   a. At the start of construction and at each change in staging, remove all existing pavement markings that conflict with the pavement marking plan.
   b. Prior to final pavement marking, remove all temporary pavement markings.
   c. The Engineer may designate other pavement markings for removal to maximize the effectiveness of the traffic control plan.

2. **Process:**
   a. Remove existing painted pavement markings so that 90% or more of the pavement is visible. Tightly adhering markings may remain in the bottom of the tining and other depressions on the pavement surface, but ensure they are not visible to the motorist during daytime or nighttime. Remove tape markings according to the manufacturer's recommendations. Ensure removal processes do not cause functional damage to the transverse or longitudinal joint sealant materials.
   b. Conduct pavement marking removal operations in a manner so that the finished pavement surface is not damaged or left in a pattern that may mislead or misdirect the motorist. When the operations are completed, power broom the pavement surface. Remove all marking removal debris from the pavement surface before the pavement is open to public traffic.
   c. Perform pavement marking removal to a width no less than the width of the existing or new pavement markings plus 1 inch. Remove the entire area of the existing symbol, legend, or marking in a rectangular shape so no directionality may be observed from the removed symbol, legend, or marking.
   d. Removal of pavement markings may be performed by vacuum blasting, vacuum dry grinding, wet grinding, shot blasting, or high pressure water blasting. Open abrasive blasting or dry grinding without containment is not allowed.

I. Markings Obliterated During Construction:

1. On sections of pavement open to traffic, place pavement markings where construction or traffic operations have obliterated existing markings.

3.02 CONSTRUCTION (Continued)

2. Replace markings obliterated during construction within 3 calendar days after the operation that obliterated the markings has been completed. At intersections with Iowa DOT highways, replace all obliterated edge lines, lane lines, no passing zones, and centerlines prior to opening to traffic.

3. Place symbols and legends within 3 calendar days from the day the road is open to traffic.

J. Grooving for Pavement Markings: When specified in the contract documents, place pavement markings in a groove cut into the pavement surface. Dry or wet cut the groove in a single pass.

1. Groove Depth: Construct groove according to pavement marking material manufacturer's recommendations with the following minimums.
- **a. Paint:** Minimum groove depth of 60 mils.
- **b. Tape:** Minimum groove depth of 100 mils.

2. Groove Width: Marking width plus 1 inch with a tolerance of minus 0.0 inches and plus 0.2 inches.

3. Groove Length: Full length of tape plus 3 inches minimum grooving transition on either end. Do not use a continuous groove for dash markings. When replacing existing dash markings, start cycle so most of the existing marking is removed with the groove. No additional removal of existing markings is required.

4. Groove Position: Locate grooves a minimum of 2 inches from edge of longitudinal joints.

5. Finished Surface: Ensure the bottom of the groove has a fine corduroy-like texture. The maximum allowable rise between the high and low points across the width of the groove is 10 mils.

6. Groove Cleaning: Ensure the surface to receive the marking is free from dust, dirt, or other contaminates that may interfere with the marking properly bonding.
- **a. Dry Cutting:** Vacuum and broom grooves using a high pressure air blast for the final cleaning.
- **b. Wet Cutting:**
  1) Immediately flush the groove with high pressure water and recover the removed material.
  2) Allow the surface to dry a minimum of 24 hours to a visibly dry condition.

K. Limitations:

1. General:
- a. Coordinate pavement marking application with other construction work and associated traffic control changes.
- b. Complete the placement of pavement markings before the lane, road, on-site detour, or diversion is open to traffic.
- c. If unavoidable circumstances result in not being able to complete the pavement marking placement or removal specified for that day, provide traffic control until the pavement marking placement or removal work is completed.
- d. Follow the manufacturer's written recommendations for all details of application.

Table of Contents

3.09 CLEAN UP

All work related to clean up throughout the project and upon completion is the responsibility of the Contractor, at no additional cost to the Contracting Authority.

A. Remove all excess materials, debris, and equipment upon completion of work.

B. Clean all paved surfaces open for public use at the end of each day and prior to forecasted precipitation.

C. Repair any damage resulting from seeding operations.

D. Remove hydraulic slurry and other excess debris related to seeding operations from buildings, landscaping, mulch, pavement, signs, sign posts, and any other areas not specified for application, at the end of each day.

3.10 ACCEPTANCE AND WARRANTY

A. Acceptance:

1. Guarantee in writing that all work has been completed as specified and provide the date that all activities were completed. When a warranty is a separately-bid item, this also establishes the beginning of the warranty period.

2. Acceptance will occur, provided seeded areas are in a live, healthy, growing, and well-established condition without eroded areas, bare spots, weeds, undesirable grasses, disease, or insects.
   a. Projects without a separately-bid warranty will be accepted no sooner than 60 days from the date that all activities were completed.
   b. When a warranty is established as a bid item and the warranty period exceeds 60 days, projects may be accepted after all specified work, excluding the warranty, is satisfactorily completed, and a supplemental contract for the warranty is executed according to the Code of Iowa Section 573.27.

B. Warranty:

1. Required only when established as a bid item by the Engineer.

2. The warranty is to guarantee completed seeding areas for a maximum period of twelve months.

3. During the warranty period, correct and reseed any defects in the seeded areas and grass stand, such as weedy areas, eroded areas, and bare spots, until all affected areas are accepted by the Engineer.

4. Replace or repair to original condition, all damages to property resulting from the seeding operation or from the remedying of defects, at the Contractor’s expense.

5. Replacement costs are the Contractor’s responsibility, except for those resulting from loss or damage due to occupancy of the project in any part, vandalism, civil disobedience, acts of neglect on the part of others, physical damage by animals, vehicles, fire, or losses due to curtailment of water by local authority, or by "Acts of God.”

END OF SECTION

PART 2 - PRODUCTS

2.01 SOD

A. Provide a well-established (no less than 12 months old), well rooted, healthy, nursery-grown sod blend of improved Kentucky Bluegrass with a uniform color, leaf texture, density, and varieties consisting of a minimum of two and no more than four cultivars selected from the following list:

Allowed Kentucky Bluegrass Cultivars:

4-Seasons	Concerto	Prosperity
Arrowhead	Everest	Ridgeline
Award	Everglade	Rubicon
Bewitched	Liberator	Rugby II
Beyond	Midnight	Rush
Blue Chip Plus	NuBlue	Skye
Blueberry	NuDestiny	
Bluenote	NuGlade	

B. Sod grown in peat bedded soil will not be accepted.

C. Ensure sod is free from objectionable grasses and broadleaf weeds, roots of trees or shrubs, stones, thatch, and other objectionable materials, nematodes and soil-born insects, and free from disease. Sod will be considered free of weeds if less than two such plants are found per 100 square feet of area.

D. Mow at a height of 2 inches prior to cutting.

E. Cut sod with a sod machine in strips of uniform width and length, with square ends. Cut to a uniform soil thickness of approximately 1/2 inch to 1 inch; thickness measurement excludes top growth.

F. Ensure sod is moist when placed.

2.02 FERTILIZER

Comply with Iowa DOT Article 4169.03.

2.03 STAKES

A. Softwood Stakes: 3/4 inch diameter and 8 inches long.

B. Steel Pins: Tee shaped with a 4 inch head and 8 inch leg.

2.04 WATER

Unless otherwise specified in the contract documents, provide water and watering equipment such as hoses and sprinklers. Provide water free of substances harmful to plant growth.

PART 3 - EXECUTION

3.01 PREPARATION OF SODBED

A. Limit preparation to areas that will be immediately sodded.

B. Where weed growth has developed, remove all weeds and weed debris.

C. Shape and fine grade sodbed to remove washes or gullies, water pockets, and irregularities. Provide an even surface, true to grade and cross-section.

D. Rototill and cultivate sodbed to a fine and mellow condition to a minimum depth of 3 inches. Clear the top 3 inches of soil lumps, stones over 3/4 inch, and foreign material using hand labor as required.

3.02 FERTILIZING - FIRST APPLICATION

A. Provide a guaranteed analysis of 20-26-6 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) by weight at the rate of 200 pounds per acre.

B. Incorporate fertilizer into soil to a depth of 1 1/2 inches prior to placing sod.

3.03 SOD INSTALLATION

A. Do not install sod between the dates of June 15 and August 15, unless authorized by the Engineer.

B. Do not lay frozen sod; do not lay sod on frozen soil or when freezing conditions are forecasted within 24 hours.

C. Dampen dry soil prior to placing sod.

D. Firm or heal in soil along the edges of the sodded areas.

E. Carefully place sod in rows or strips evenly, with the longest edge parallel to the finished contours, and at right angles to the centerline of ditches and channels. On slopes, begin placing sod at the bottom and progress upward.

F. Minimize traffic on newly laid sod during installation. Provide plank or wood sheets to protect sod already laid from equipment and vehicles.

G. Tightly fit each strip against each other without voids. Do not overlap edges. Stagger joints at the ends of sod strips with adjacent strips of sod.

H. Finish sod edges at walks, curbs, planting, mulch edges, and other vertical surface by cutting and fitting tightly to edge.

I. Place sod mat approximately 1 inch below finished surface of walks, pavement, curbs, or other permanent features. Remove any sod not conforming to this requirement, adjust the subgrade, and re-lay the sod.

J. Where new sod joins existing lawns, cut straight and neatly into existing lawn and level subgrade to match height.

K. Stake sod on grades exceeding 4:1 and in drainage channels. Stake each roll at 2 foot intervals or as required to prevent movement during rainfall and stormwater runoff events.

L. Roll lightly-watered sod with a small mechanical or hand sod roller to sufficiently set or heal sod into soil and remove lumps. Roll as required to firm and level the sodded areas.

3.04 WATERING

A. Water sod within 1 hour of placement. During initial watering, thoroughly wet sod and sodbed.

B. Water all sodded areas during the maintenance period as necessary to maintain sod and soil moisture, supplement rainfall, promote growth and proper rooting, ensure sod survival, and prevent dormancy. As a guideline, watering of sod should provide a minimum of the following:

1. Week 1: 1/4 inch per day

2 Week 2: 1/4 inch every other day

3. Week 3: 1/4 inch every third day

4. Week 4: 1/4 inch every fourth day

C. Actual watering quantities depend upon weather conditions during the maintenance period. Ensure waterings are sufficient to thoroughly saturate sod, sodbed, and adjacent disturbed areas to a depth of approximately 4 inches.

D. Apply water uniformly and consistently on all sodded areas to prevent damage to sod, trees, and shrubs.

3.05 FERTILIZING - SECOND APPLICATION

Apply second application of fertilizer with a guaranteed analysis of 10-10-10 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) at the rate of 300 pounds per acre 3 weeks after laying sod and prior to final acceptance.

3.06 MAINTENANCE

A. Begin maintenance immediately following installation of sod and continue for a period until the sod is well established with sod rooted in place. The maintenance period will be for 30 days.

B. Maintenance of sodded areas includes:

1. Watering.

2. Weeding.

3. Mowing. Each time sod has grown to a height between 3 and 4 inches, mow to a 2 to 2 1/2 inch height.

4. Remove and replace sodded areas that fail to survive.

3.07 CLEAN UP

A. Remove all excess materials, debris, and equipment from site.

B. Clean all paved surfaces.

C. Repair any damage resulting from sodding operations.

3.08 ACCEPTANCE

A. Sod acceptance will be based on the following criteria:

1. All requirements for the completed installation and maintenance have been met.

2. Sodded areas are healthy and even-colored, and a viable lawn is established, free from weeds, undesirable grass species, disease, and insects.

3. Sod is knit down to the soil so that it cannot be pulled up.

4. Sodded areas are without scattered bare spots and dead or dormant sod.

5. Clean up operations are completed.

B. Replacement sod work will be re-inspected before acceptance.

END OF SECTION

2.07 CHECK DAMS (Continued)

C. Rock Check Dam:

1. Aggregate: Erosion stone complying with Iowa DOT Article 4130.04.

2. Engineering Fabric: Comply with Section 9040, 2.20.

2.08 LEVEL SPREADERS

A. Provide 2 inch by 8 inch (minimum) pressure-treated timber of the length specified.

B. Use timbers that are relatively straight and have a minimum length of 5 feet each.

2.09 RIP RAP

A. Class A Revetment: Comply with Iowa DOT Section 4130.

B. Class B Revetment: Comply with Iowa DOT Section 4130.

C. Class D and E Revetment: Comply with Iowa DOT Section 4130.

D. Erosion Stone: Comply with Iowa DOT Section 4130.

2.10 TEMPORARY PIPE SLOPE DRAINS

A. PVC, HDPE, and metal pipes as specified in Section 4020, 2.01.

B. HDPE, Type C (corrugated interior).

C. All pipes listed are allowed for use within the right-of-way.

2.11 SEDIMENT BASIN OUTLET STRUCTURES

A. Base: Class C concrete unless otherwise specified in the contract documents.

B. Riser: CMP complying with Section 4020; diameter as specified in the contract documents.

C. Dewatering Device:

1. Drill holes in the riser of the number, diameter, and at the elevation specified in the contract documents.

2. 1/4 inch by 1/4 inch or 1/2 inch by 1/2 inch wire mesh for hardware cloth.

D. Barrel: CMP complying with Section 4020; diameter as specified in the contract documents.

E. Anti-Vortex Device: CMP complying with Section 4020; diameter according to Figure 9040.116 and riser diameter as specified in the contract documents.

F. Anti-Seep Collar:

1. Corrugated metal sheet of same material and gage as barrel section.

2. Size according to Figure 9040.117.

2.12 SEDIMENT TRAPS

A. Erosion Stone: Comply with Section 9040, 2.09.

B. Engineering Fabric: Comply with Section 9040, 2.20.

2.13 SILT FENCE

A. Fabric: Comply with Iowa DOT Article 4196.01.

B. Posts: 4 foot minimum steel (T-section) weighing at least 1.25 pounds per foot, exclusive of anchor plate. Painted posts are not required.

C. Fastener: Wire or plastic ties with a minimum tensile strength of 50 pounds.

2.14 STABILIZED CONSTRUCTION ENTRANCE

A. Entrance Stone: Comply with Iowa DOT Section 4122, Gradation 13, Macadam crushed stone.

B. Subgrade Stabilization Material: Use woven, UV-stabilized geotextile with a minimum tensile strength of 135 lb/ft.

2.15 DUST CONTROL

A. Water: Use potable water or water from a source approved by the engineer.

B. Calcium Chloride: Comply with Iowa DOT Article 4194.01.

C. Lignosulfonate (Tree Sap): Use a commercially-available product with known lignin content.

D. Soapstock (Soybean Oil):

1. Use a commercially-available, undiluted, soybean oil soapstock emulsion.

2. Comply with manufacturer's recommendations for storage, transportation, temperature, and application equipment requirements.

2.16 EROSION CONTROL MULCH

A. Conventional Mulch:

1. Use dry cereal straw (oats, wheat, barley, or rye) or native grass straw.

2. Use material that is free of noxious weeds, seed-bearing stalks, or roots, and will be inspected and approved by the Engineer prior to use.

3. Other materials, subject to the approval of the Engineer, may be used.

B. Hydromulch:

1. Wood Cellulose Mulch: Comply with Section 9010, 2.07.

2. Bonded Fiber Matrix (BFM): Comply with Section 9010, 2.07.

3. Mechanically Bonded Fiber Matrix (MBFM): See Section 9010, 2.07.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Modular Block Walls:

1. Dry-cast Concrete Wall Units:
a. Comply with ASTM C 1372 and Iowa DOT Section 2430. Test units and provide samples according to ASTM C 140.
b. Provide certification that the blocks comply with the freeze-thaw durability requirements of ASTM C 1262 and Iowa DOT Materials I.M. 445.04.
c. Furnish from an approved supplier listed in Iowa DOT Materials I.M. 445.04, Appendix A (MAPLE).
d. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
1) Iowa DOT Materials I.M. 445.04, Appendix B (MAPLE) lists approved systems.
2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.04.
3) Submit results of test data to the Engineer.

2. Wet-cast Concrete Wall Units: Comply with Iowa Section 2430.
a. Furnish from an approved supplier listed in Iowa DOT Materials I.M. 445.05, Appendix A (MAPLE).
b. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.
1) Iowa DOT Materials I.M. 445.05, Appendix B (MAPLE) lists approved systems.
2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.05.
3) Submit results of test data to the Engineer.

B. Limestone: Furnish limestone slabs with a flat bottom and top and a clean face. Provide slabs with a minimum depth of 8 inches, or as specified in the contract documents, to ensure stability of the wall.

C. Landscape Timbers:

1. Minimum 6 inch by 6 inch (nominal) pressure-treated landscape timbers rated for ground contact. Ensure timbers are straight, solid, have at least three good sides, and are free of visible dry rot, with only a minor amount of splitting or cracking. Ensure all timbers used in a wall have the same cross-sectional area.

2. Provide 3/8 inch diameter galvanized spikes, 10 to 12 inches long.

D. Leveling Pad: Provide material recommended by the wall manufacturer or supplier.

1. Granular Material: Comply with Iowa DOT Section 4132.

2. Concrete: Comply with Section 6010. Provide Class C Concrete.

E. Subdrain: Comply with Section 4040, 2.02. Minimum 4 inch diameter pipe.

F. Porous Backfill Material (for Subdrain): Comply with Section 4040, 2.04.

G. Engineering Fabric: Provide fabric complying with Iowa DOT Article 4196.01 for subsurface drainage.

H. Unit Fill Material: Comply with Iowa DOT Section 4131.

2.01 MATERIALS (Continued)

I. Backfill Material:

1. Granular Backfill Material: Comply with Iowa DOT Section 4133 when granular backfill material is necessary according to the manufacturer's requirements. Crushed stone meeting the requirements of Iowa DOT Section 4131 maybe substituted for granular backfill.

2. Suitable Backfill Material: Comply with Section 2010.

J. Fence: If the contract documents require a fence, comply with Section 9060.

K. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Segmental Block Walls:

1. Dry-cast Concrete Wall Units:

a. Comply with ASTM C 1372 and Iowa DOT Section 2431. Test and provide samples according to ASTM C 140.

b. Provide certification that the blocks comply with the freeze-thaw durability requirements of ASTM C 1262 and the additional requirements for concrete units of Iowa DOT Materials I.M. 445.04.

c. Furnish from an approved supplier.

1) Iowa DOT Materials I.M. 445.04, Appendix A (MAPLE) lists approved suppliers.

2) Provide written certification that blocks comply with ASTM C 1372 and the additional materials requirements of Iowa DOT Materials I.M. 445.04, Appendix A (MAPLE).

d. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.

1) Iowa DOT Materials I.M. 445.04, Appendix B (MAPLE) lists approved systems.

2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.04.

3) Submit results of test data to the Engineer.

2. Wet-cast Concrete Wall Units: Comply with the materials and compressive strength requirements of Iowa DOT Section 2431 and Materials I.M. 445.05.

a. Furnish from an approved supplier.

1) Iowa DOT Materials I.M. 445.05, Appendix A (MAPLE) lists approved suppliers.

2) Provide written certification that blocks comply with Iowa DOT Materials I.M. 445.05.

b. In lieu of furnishing blocks from an approved supplier, provide blocks from an approved system.

1) Iowa DOT Materials I.M. 445.05, Appendix B (MAPLE) lists approved systems.

2) Test the required number of blocks from the lot to be installed according to Iowa DOT Materials I.M. 445.05.

3) Submit results of test data to the Engineer.

3. Geogrid: Provide geogrid as specified in the retaining wall design.

B. Leveling Pad: Provide material recommended by the wall manufacturer or supplier.

1. Granular Material: Comply with Iowa DOT Section 4132.

2. Concrete: Comply with Section 6010. Use Class C Concrete.

C. Subdrain: Comply with Section 4040, 2.02. Minimum 4 inch diameter pipe.

D. Porous Backfill Material (for Subdrain): Comply with Section 4040, 2.04.

E. Engineering Fabric: Provide fabric complying with Iowa DOT Article 4196.01 for subsurface drainage.

F. Unit Fill Material: Comply with Iowa DOT Section 4131.

2.01 MATERIALS (Continued)

G. Backfill Material:

1. Granular Backfill Material: Comply with Iowa DOT Section 4133 within the reinforced earth zone of segmental block retaining walls. Crushed stone meeting the requirements of Iowa DOT Section 4131 may be substituted for granular backfill.

2. Suitable Backfill Material: Comply with Section 2010.

H. Fence: If the contract documents require a fence, comply with Section 9060.

I. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.