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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 bedding material, placing bedding and backfill material, compaction, 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 bedding material, placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), concrete fillets, pipe connections, castings, and adjustment rings.

C. Drop Connection:

1. Measurement: Each drop connection will be counted.

2. Payment: Payment will be at the unit price for each drop connection.

3. Includes: Unit price includes, but is not limited to, the connection to the manhole and all pipe, fittings, concrete encasement, and bedding and backfill material.

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.

1.08 MEASUREMENT AND PAYMENT (Continued)

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

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[2]	Yes	No	Yes[1]
	6010.601	SW-601, B	3	Adjustable[3]	No	No	Yes[1]
	6010.601	SW-601, C	2	Fixed[2]	Yes	Yes	Yes[1]
	6010.601	SW-601, D	3	Adjustable[3]	No	Yes	Yes[1]
Storm Sewer	6010.602	SW-602, E[4]	2	Fixed[2]	Yes	No	No
	6010.602	SW-602, F[4]	3	Adjustable[3]	No	No	No
	6010.602	SW-602, G[4]	2	Fixed	No	No	No

[1] Machine bearing surfaces required.
[2] Typically used with non-paved or flexible surfaces, including HMA, seal coat, gravel, and brick.
[3] Typically used with PCC surfaces, including castings in concrete boxouts.
[4] 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. Provide steps in all circular, precast manholes unless otherwise specified in the contract documents.

B. Comply with ASTM C 478.

C. Manufacture using polypropylene encased steel.

D. Uniformly space steps at 12 to 16 inches.

E. Align with vertical side of eccentric top section.

F. 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 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 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 structure base or subbase.

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

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

C. Subbase:

1. **Cast-in-place Structures:** No subbase material is required.

2. **Precast Structures:** If precast structure is provided, 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.

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: Install the type of casting specified in the contract documents and adjust to proper grade. Where a manhole or intake is to be in a paved area, adjust the casting to match the slope of the finished surface. When specified in the contract documents, attach a casting frame to the structure with four anchor bolts.

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.

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

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.

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.

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

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.

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.

3.03 ADDITIONAL REQUIREMENTS FOR PRECAST CONCRETE STRUCTURES (Continued)

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.

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. 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.

3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE (Continued)

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:

b. Core new openings in existing manholes or intakes for all pipes less than 12 inches in diameter.
c. 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 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.

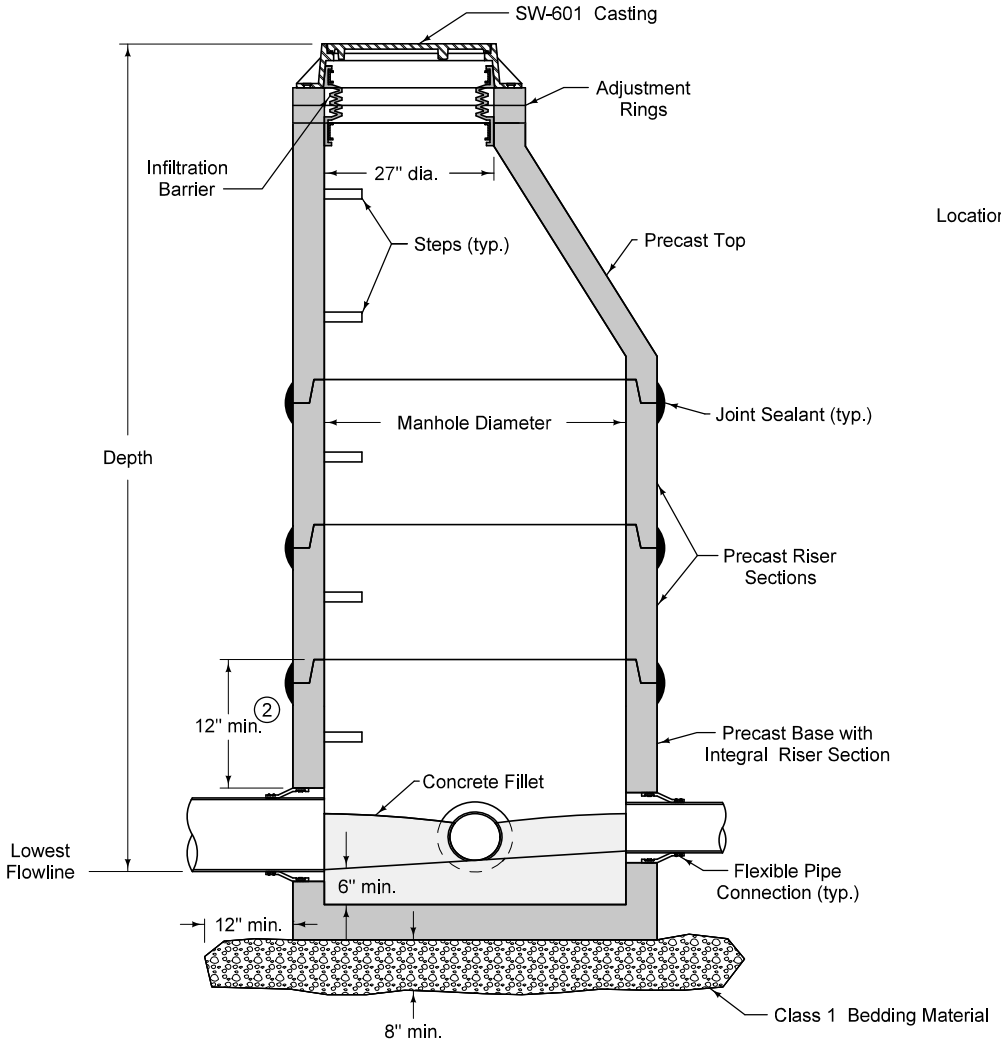
3.07 CLEANING, INSPECTION, AND TESTING

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

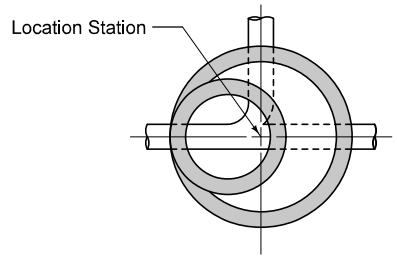
END OF SECTION

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

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

SUDAS | IOWADOT | REVISION 2 04-17-18

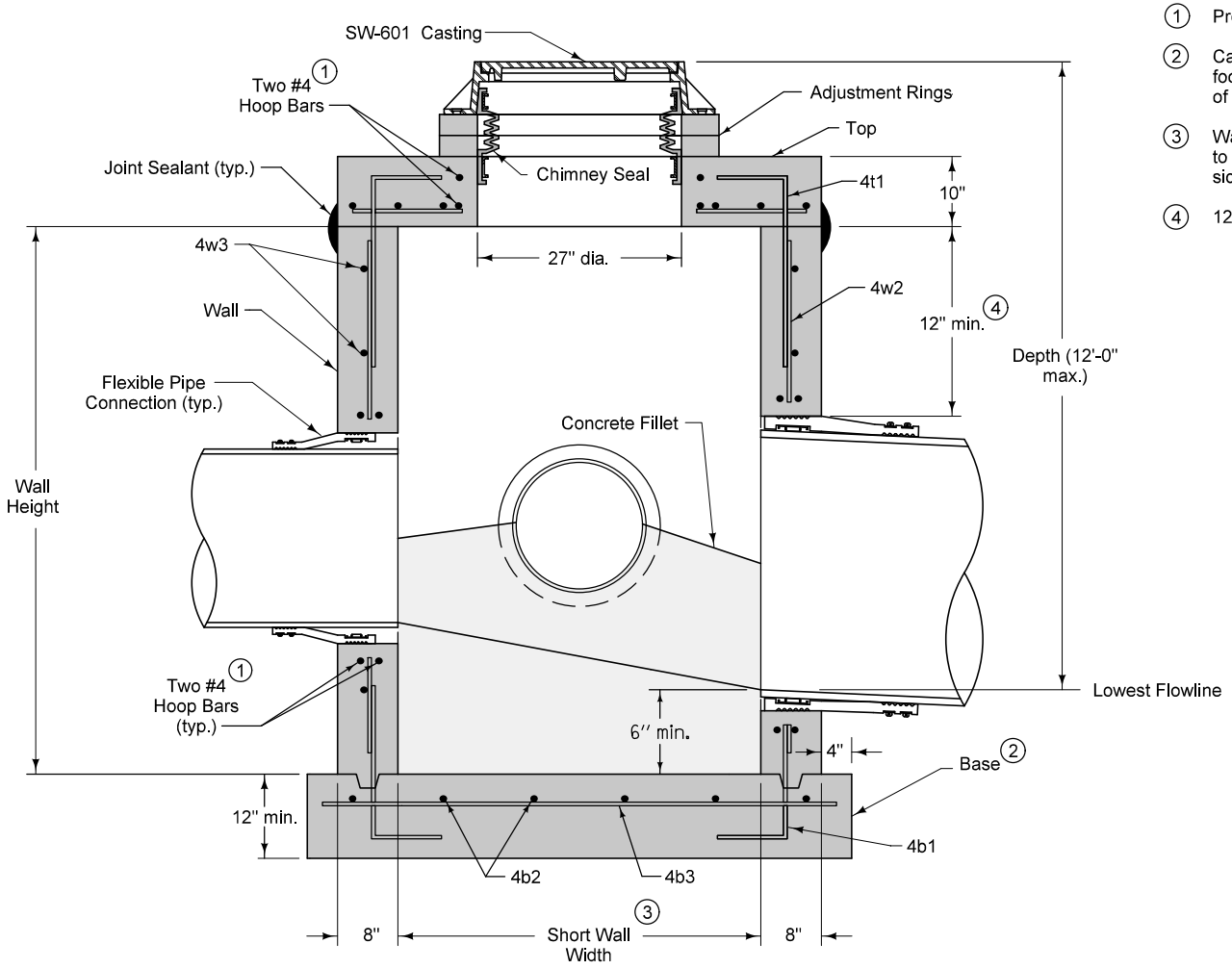
FIGURE 6010.301 | STANDARD ROAD PLAN | SW-301 | SHEET 1 of 1

REVISIONS: Changed "Invert" to "Concrete Fillet".

Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, 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.

FIGURE 6010.302 | SHEET 1 OF 2

SUDAS | IOWADOT

REVISION	
1	04-17-18

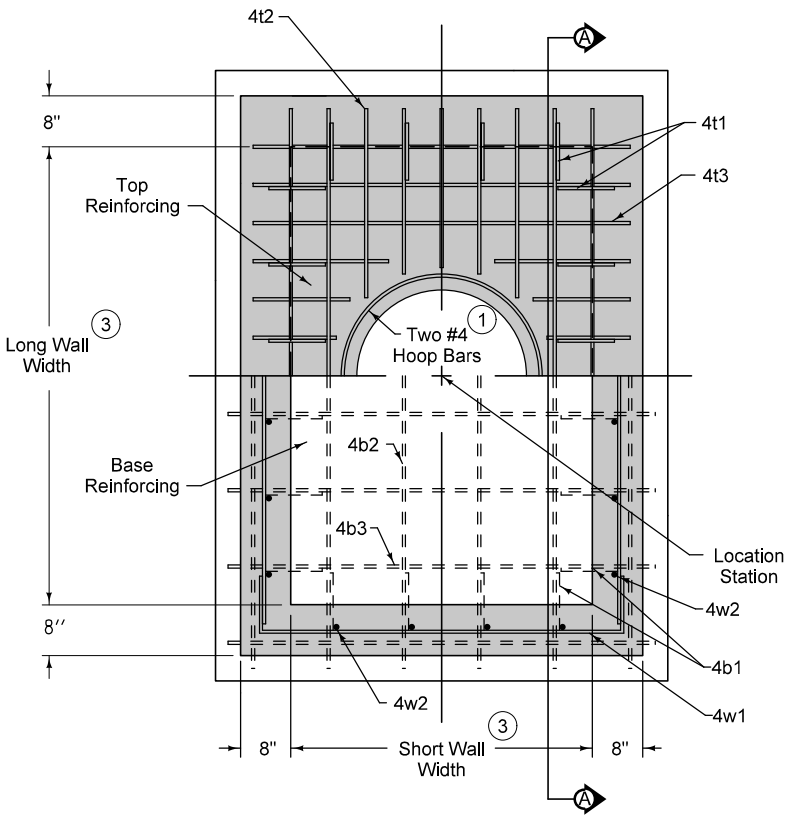
FIGURE 6010.302 | STANDARD ROAD PLAN | SW-302 | SHEET 1 of 2

REVISIONS: Replaced Iowa DOT and SUDAS logos. Changed "Invert" to "Concrete Fillet".

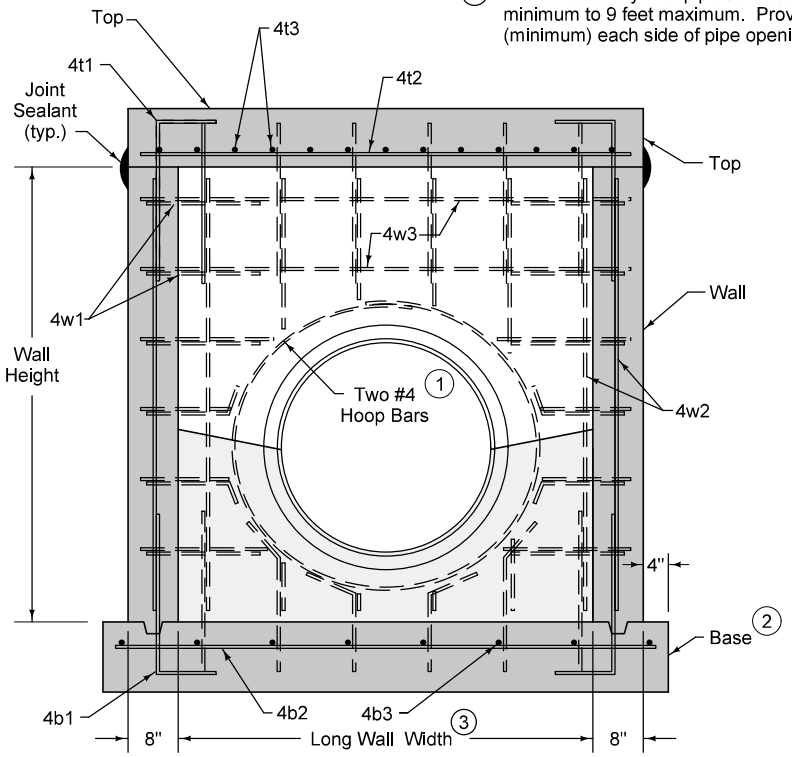
Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

RECTANGULAR SANITARY SEWER MANHOLE

1. Provide two #4 hoop bars at top opening and at all pipe openings.
2. Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.
3. Wall widths vary with pipe diameter and range from 4 feet minimum to 9 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.



PLAN



SECTION A-A

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

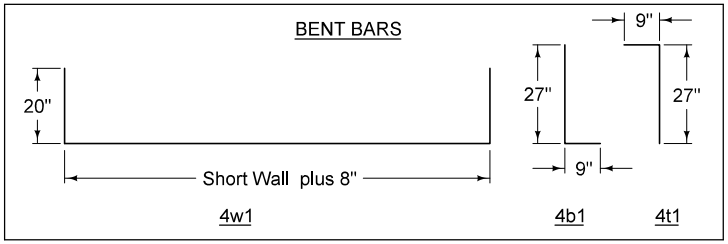


FIGURE 6010.302 SHEET 2 OF 2

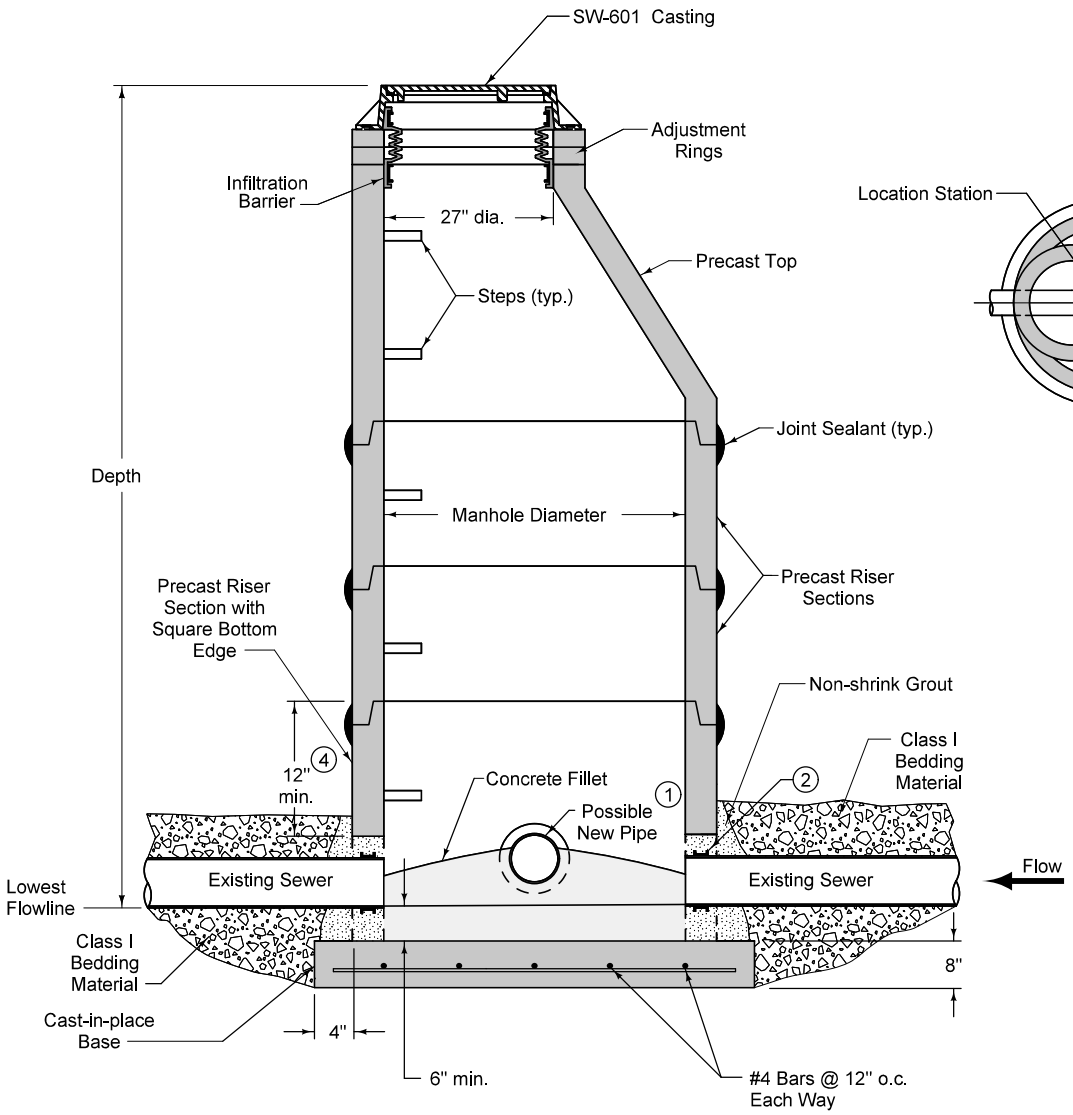
SUDAS | IOWADOT | REVISION 1 04-17-18

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

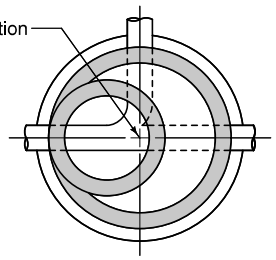
REVISIONS: Replaced Iowa DOT and SUDAS logos. Changed "Invert" to "Concrete Fillet".

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

RECTANGULAR SANITARY SEWER MANHOLE



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 | IOWADOT | REVISION 2 04-17-18

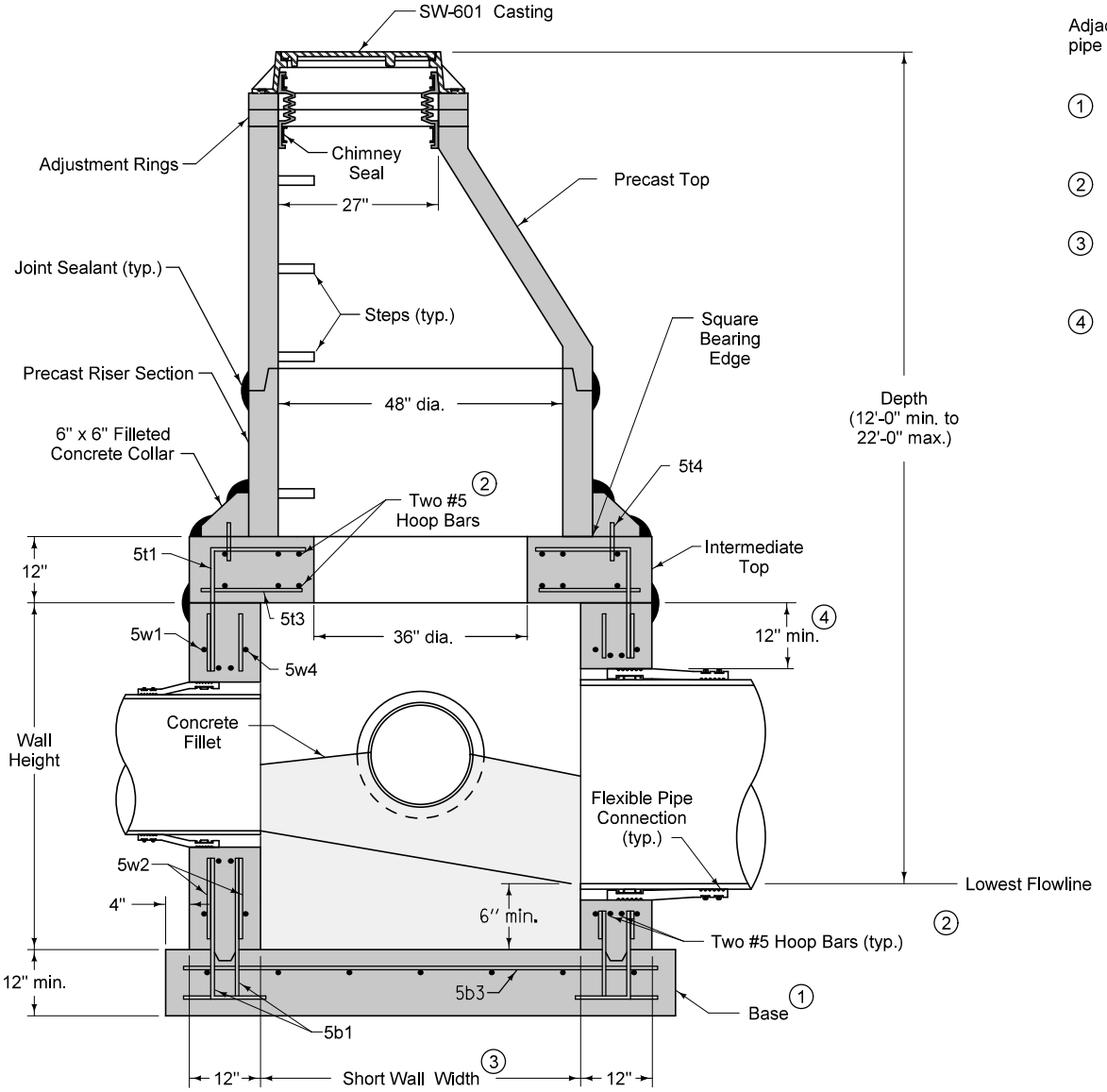
FIGURE 6010.303 | STANDARD ROAD PLAN | SW-303 | SHEET 1 of 1

REVISIONS: Changed "Invert" to "Concrete Fillet".

Paul D. Wigant, SUDAS DIRECTOR — Brian Smith, 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

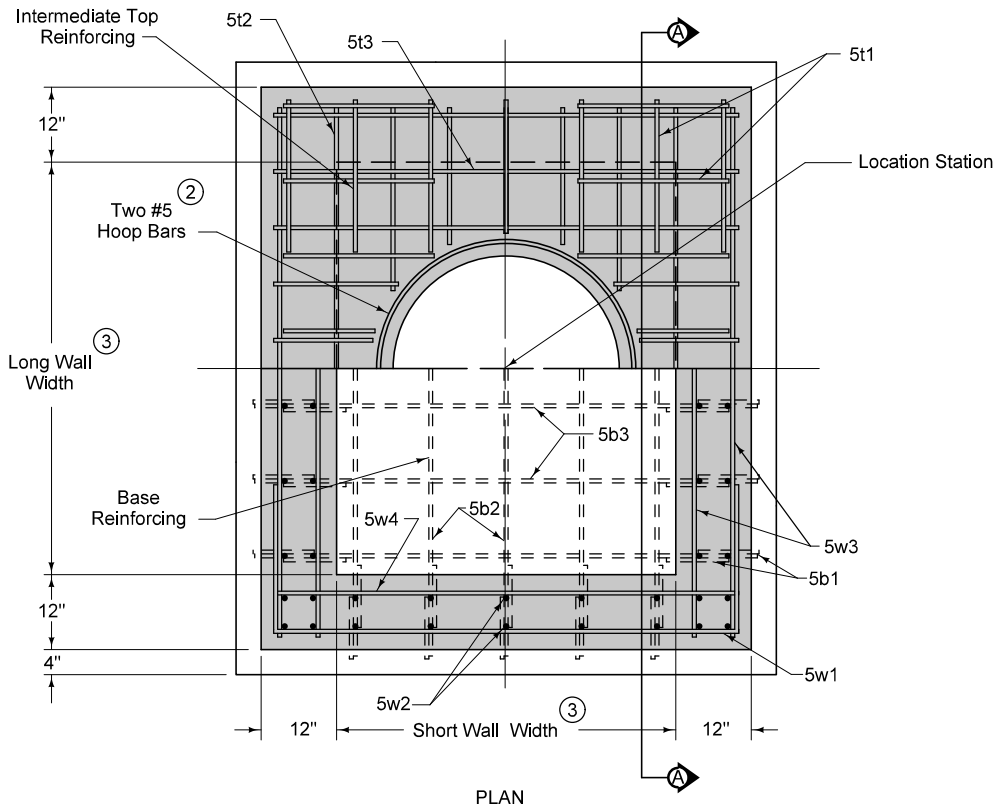
SUDAS | IOWADOT | REVISION 2 04-17-18

FIGURE 6010.304 | STANDARD ROAD PLAN | SW-304 | SHEET 1 of 2

REVISIONS: Replaced Iowa DOT and SUDAS logos. Changed "Invert" to "Concrete Fillet".

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

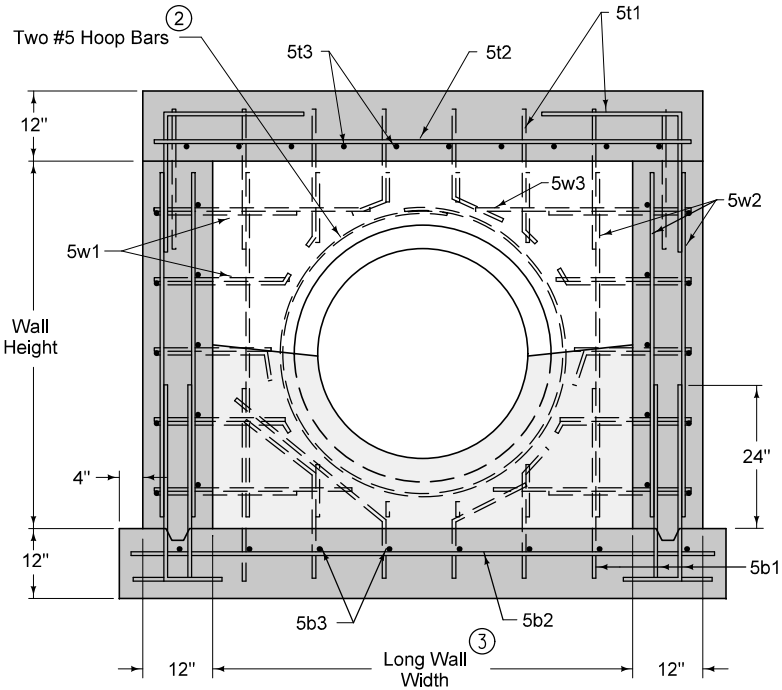
RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE



PLAN

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

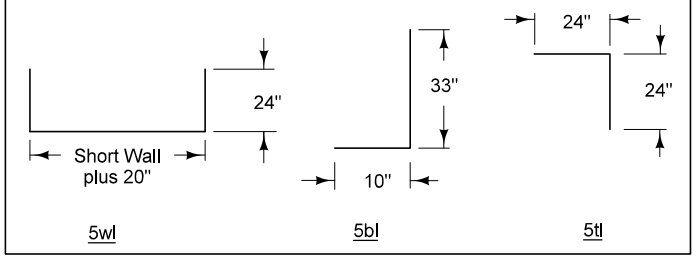
3 Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall opening (minimum) each side of pipe opening.



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 2 04-17-18

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

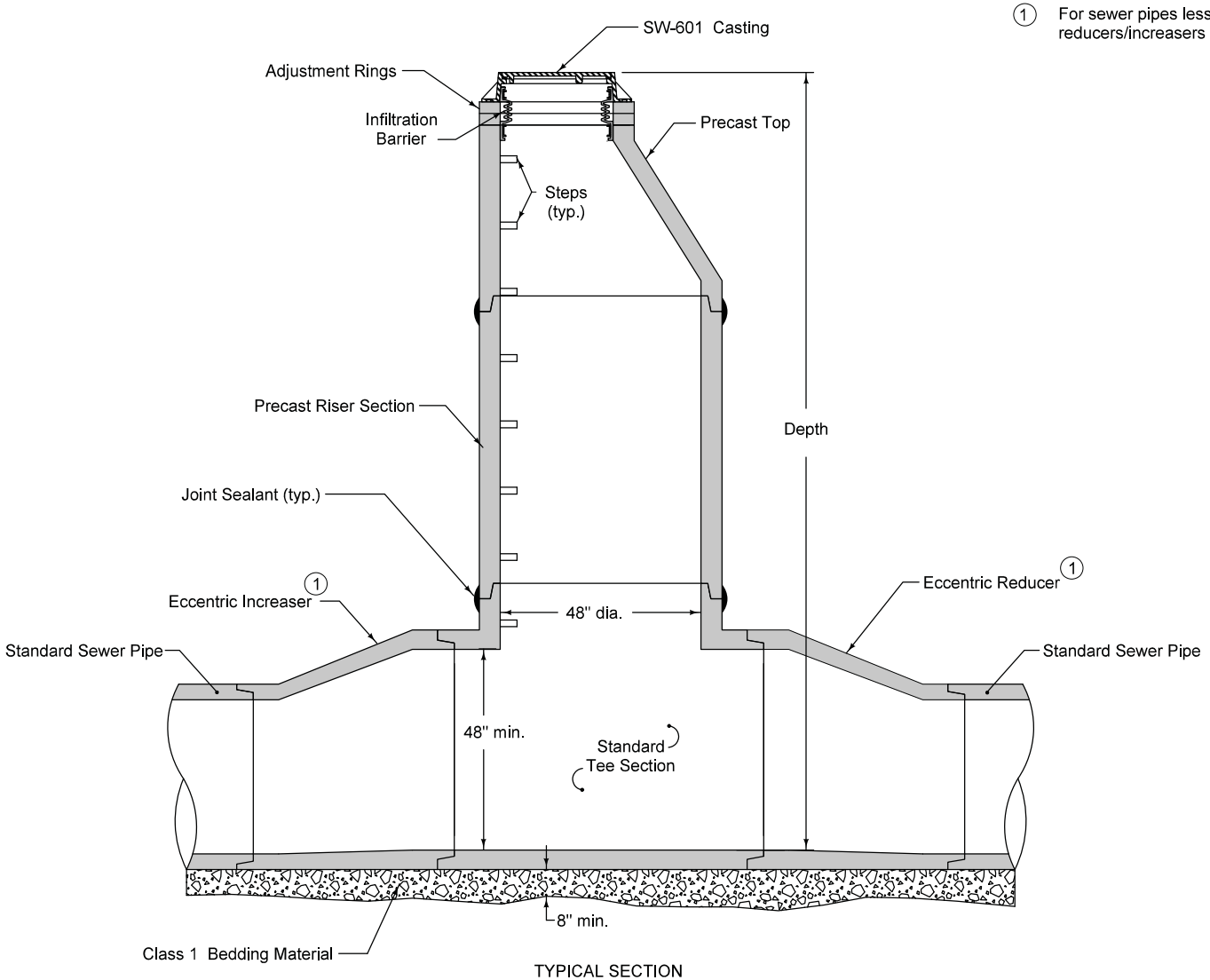
REVISIONS: Replaced Iowa DOT and SUDAS logos. Changed "Invert" to "Concrete Fillet".

Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, 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

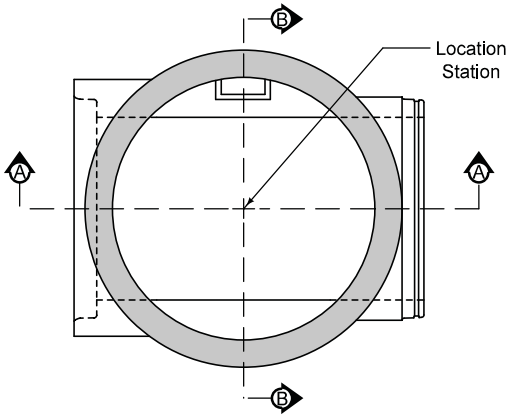
FIGURE 6010.305 SHEET 1OF 2

SUDAS	IOWADOT	REVISION 1 10-21-14
FIGURE 6010.305	STANDARD ROAD PLAN	SW-305
		SHEET 1 of 2

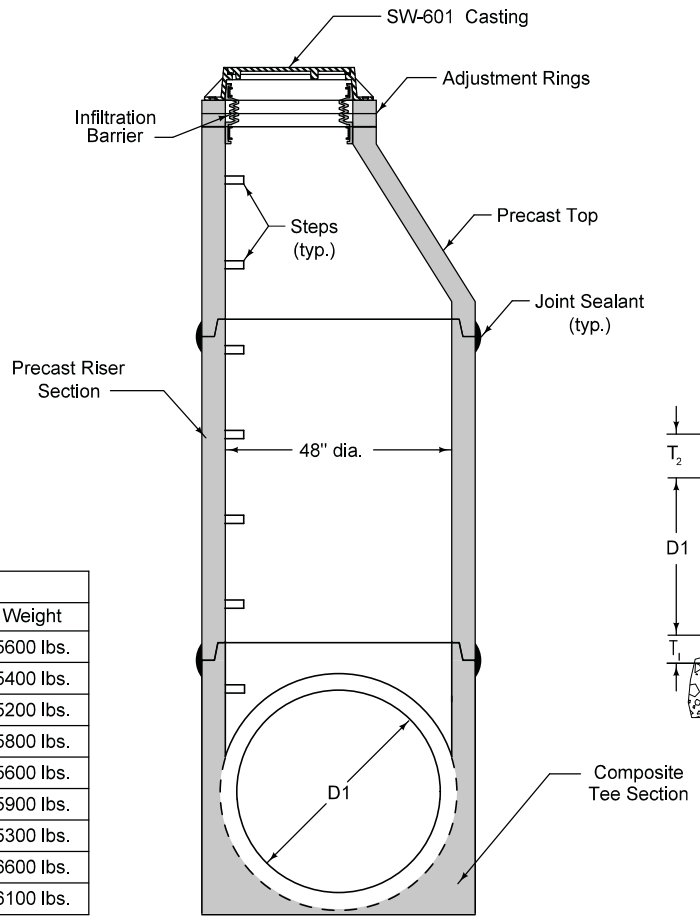
REVISIONS: Replaced "Chimney Seal" with "Infiltration Barrier". Removed flow arrow.

Paul D. Wigant — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

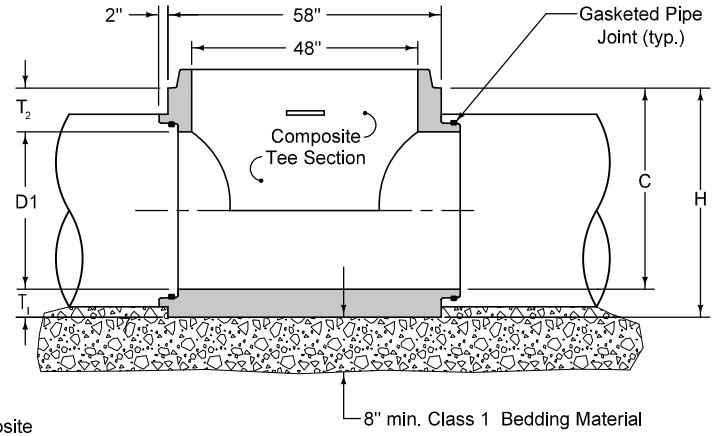
TEE-SECTION
SANITARY SEWER MANHOLE



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 | IOWA DOT

REVISION: 1 | 10-21-14

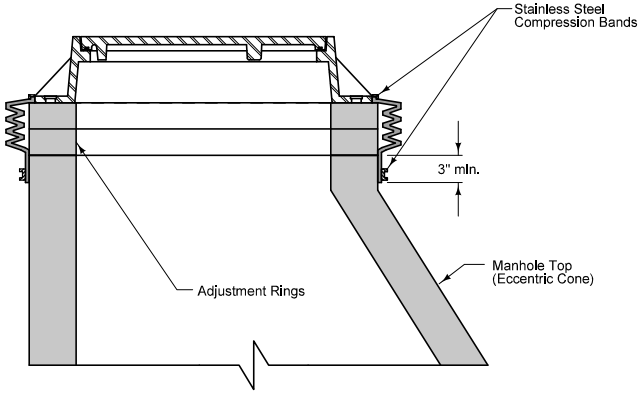
FIGURE 6010.305 | STANDARD ROAD PLAN | SW-305 | SHEET 2 of 2

REVISIONS: Replaced "Chimney Seal" with "Infiltration Barrier". Removed flow arrow.

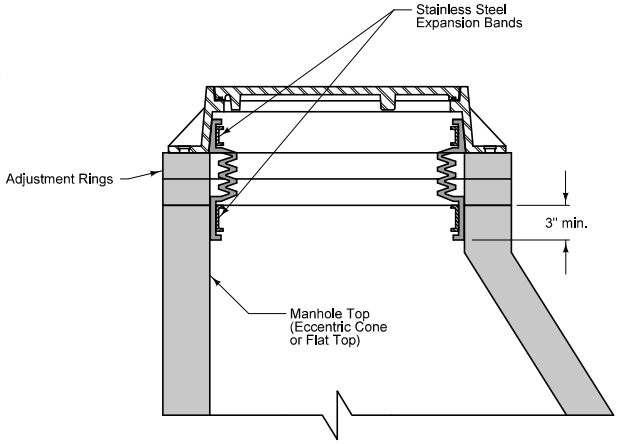
Paul D. Wigant, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

TEE-SECTION
SANITARY SEWER MANHOLE

CHIMNEY SEALS FOR 2-PIECE CASTINGS

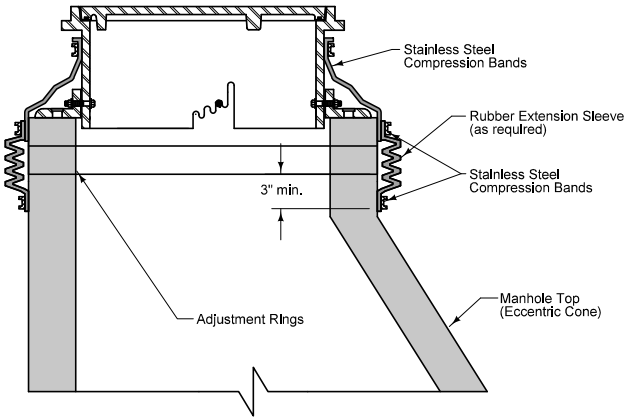


EXTERNAL SEAL

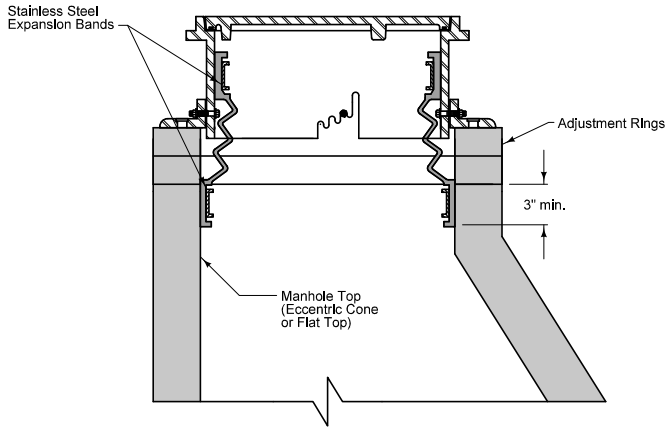


INTERNAL SEAL

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 1 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.

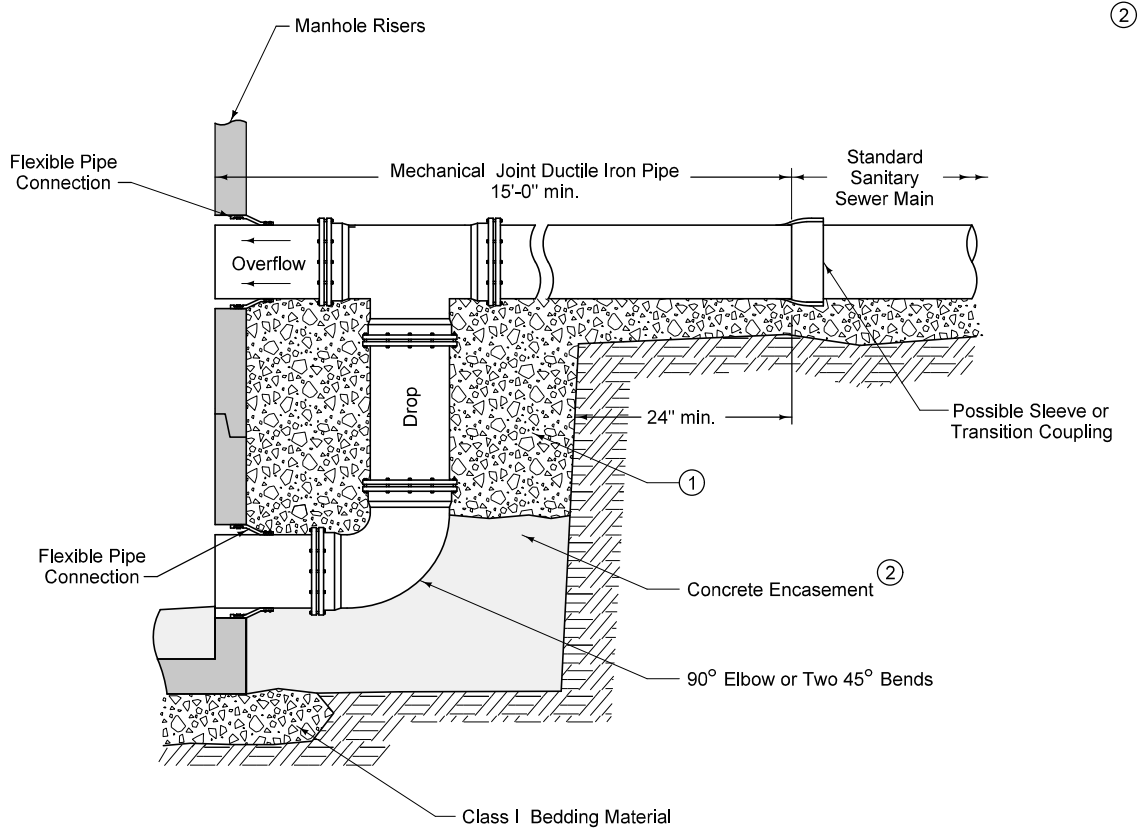


FIGURE 6010.307 SHEET 1 OF 1

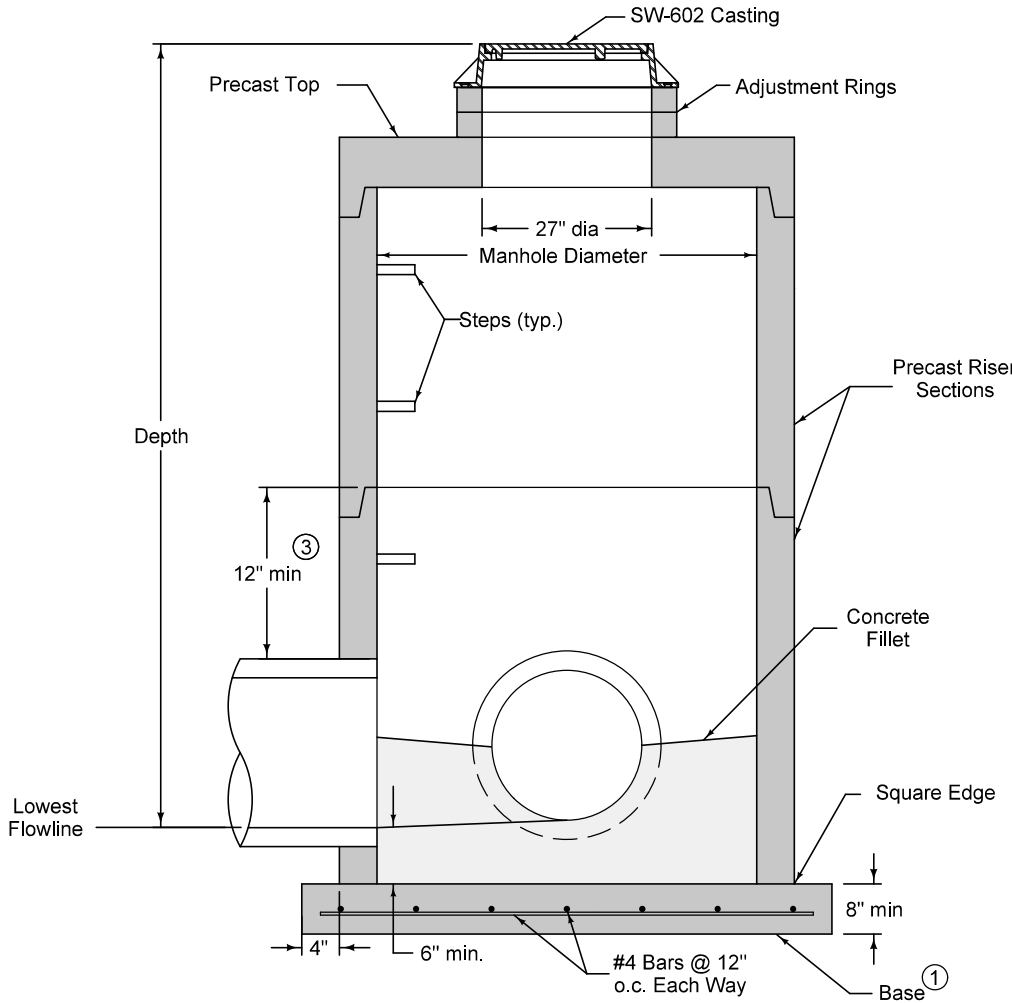
SUDAS | IOWADOT | REVISION 1 04-17-18

FIGURE 6010.307 | STANDARD ROAD PLAN | SW-307 | SHEET 1 of 1

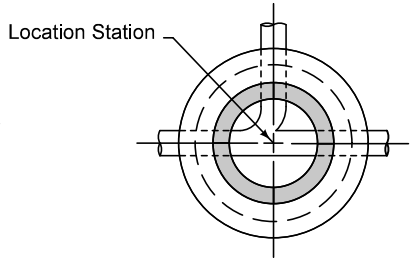
REVISIONS: Replaced Iowa DOT and SUDAS logos.

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

DROP CONNECTION FOR SANITARY SEWER MANHOLE



TYPICAL SECTION



PLAN

① Cast-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.

② For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings.

③ 12 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: 1 — 04-17-18

FIGURE 6010.401 | STANDARD ROAD PLAN | SW-401

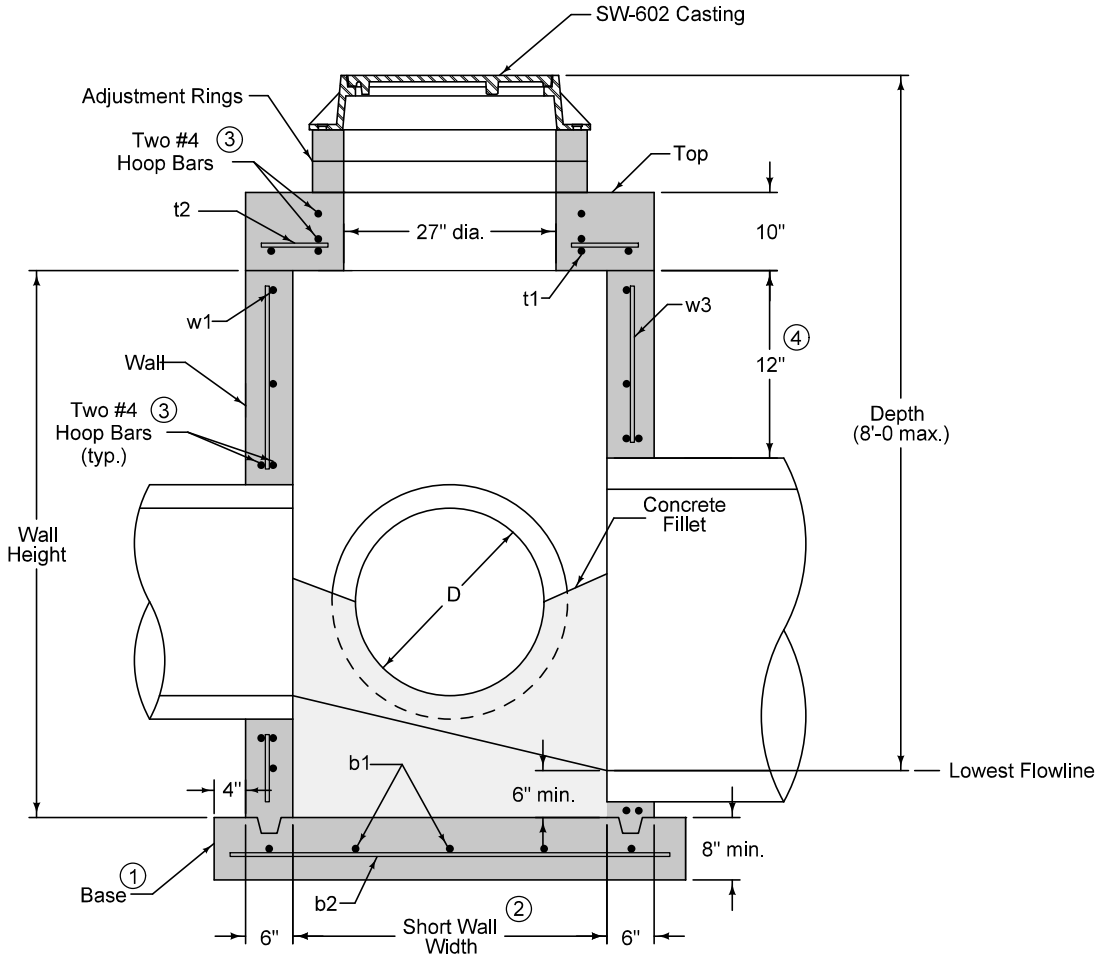
SHEET 1 of 1

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated linework and Sudas and DOT logo.

Paul D. Wigand, SUDAS DIRECTOR

Brian Smith, DESIGN METHODS ENGINEER

CIRCULAR STORM SEWER MANHOLE



TYPICAL SECTION

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

① Cast-in-place base shown. If base is precast integral with walls, the footprint of the base is not required to extend beyond the outer edge of the walls.

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

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

④ 12 inch minimum wall height above all pipes.

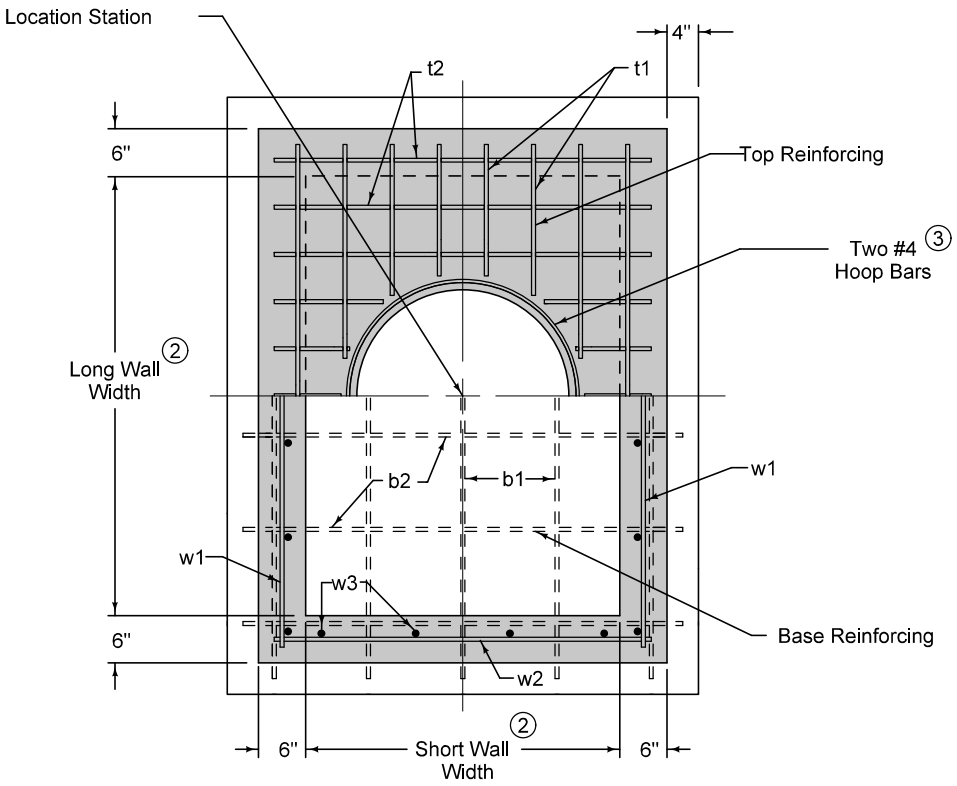
SUDAS	IOWADOT	REVISION 1 04-17-18
FIGURE 6010.402	STANDARD ROAD PLAN	SW-402
		SHEET 1 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and Dot and Sudas Logo.

Paul D. Wigant — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

RECTANGULAR STORM SEWER MANHOLE

FIGURE 6010.402 SHEET 1 OF 2



PLAN

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

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

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

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

FIGURE 6010.402 SHEET 2 OF 2

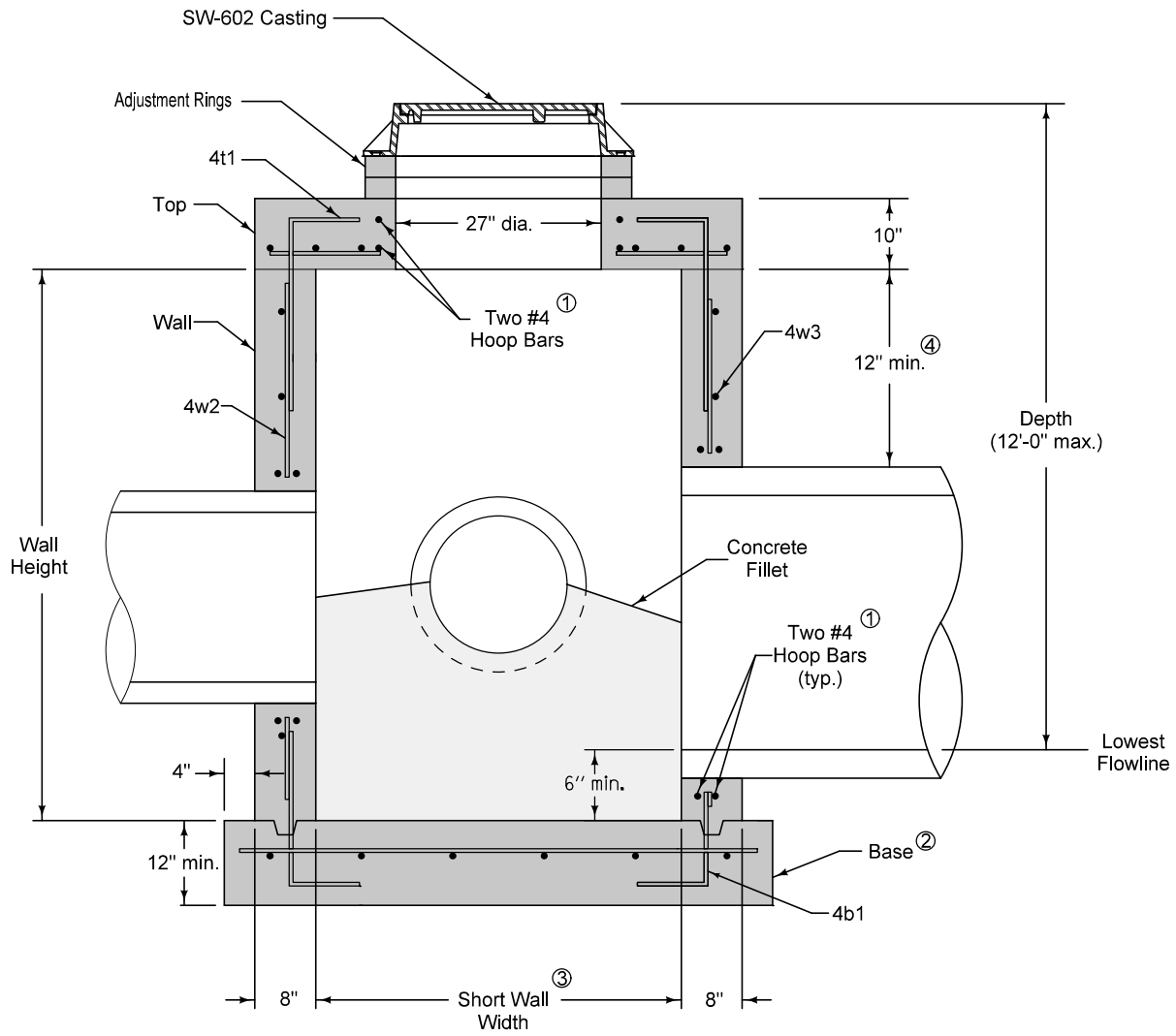
SUDAS | IOWADOT | REVISION 1 04-17-18

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

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and Dot and Sudas Logo.

Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, 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 1 04-17-18
FIGURE 6010.403	STANDARD ROAD PLAN	SW-403
		SHEET 1 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and DOT and SUDAS logo.

Paul D. Wigant — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

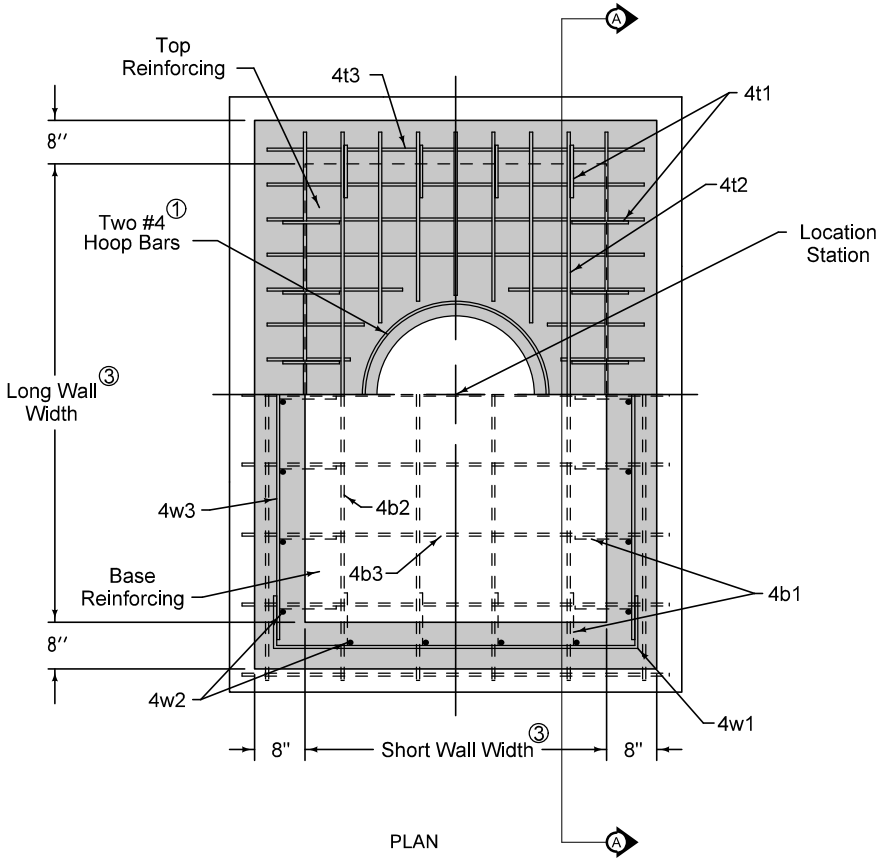
DEEP WELL RECTANGULAR STORM SEWER MANHOLE

FIGURE 6010.403 SHEET 1 OF 2

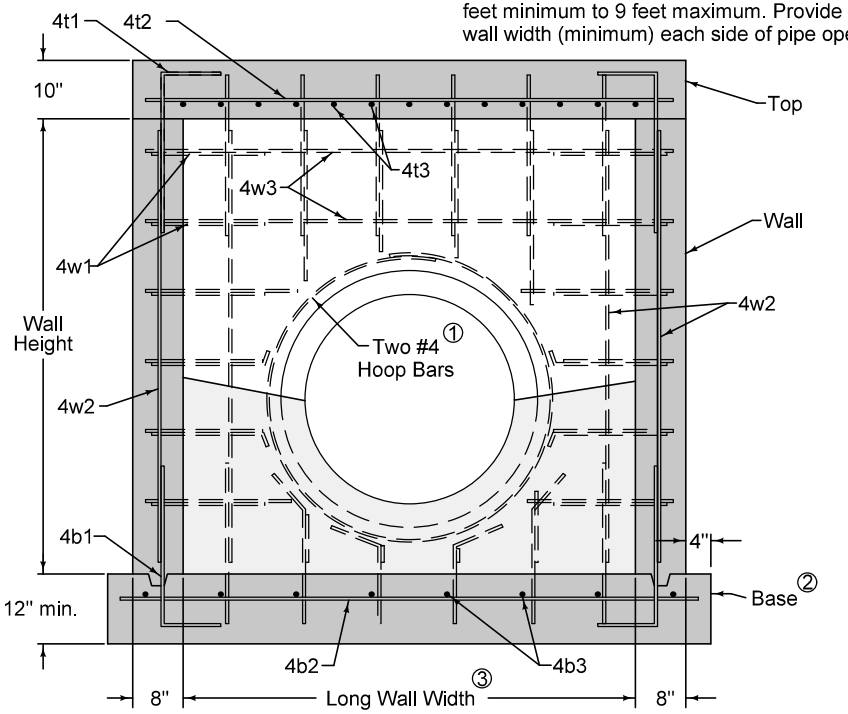
① Provide two #4 hoop bars at top opening and at all pipe openings.

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.



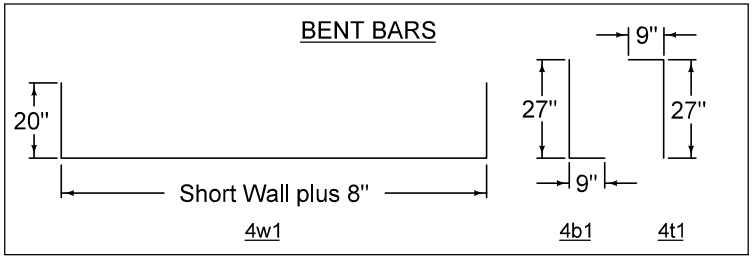
PLAN



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	⌊	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 1 04-17-18

FIGURE 6010.403 | STANDARD ROAD PLAN | SW-403

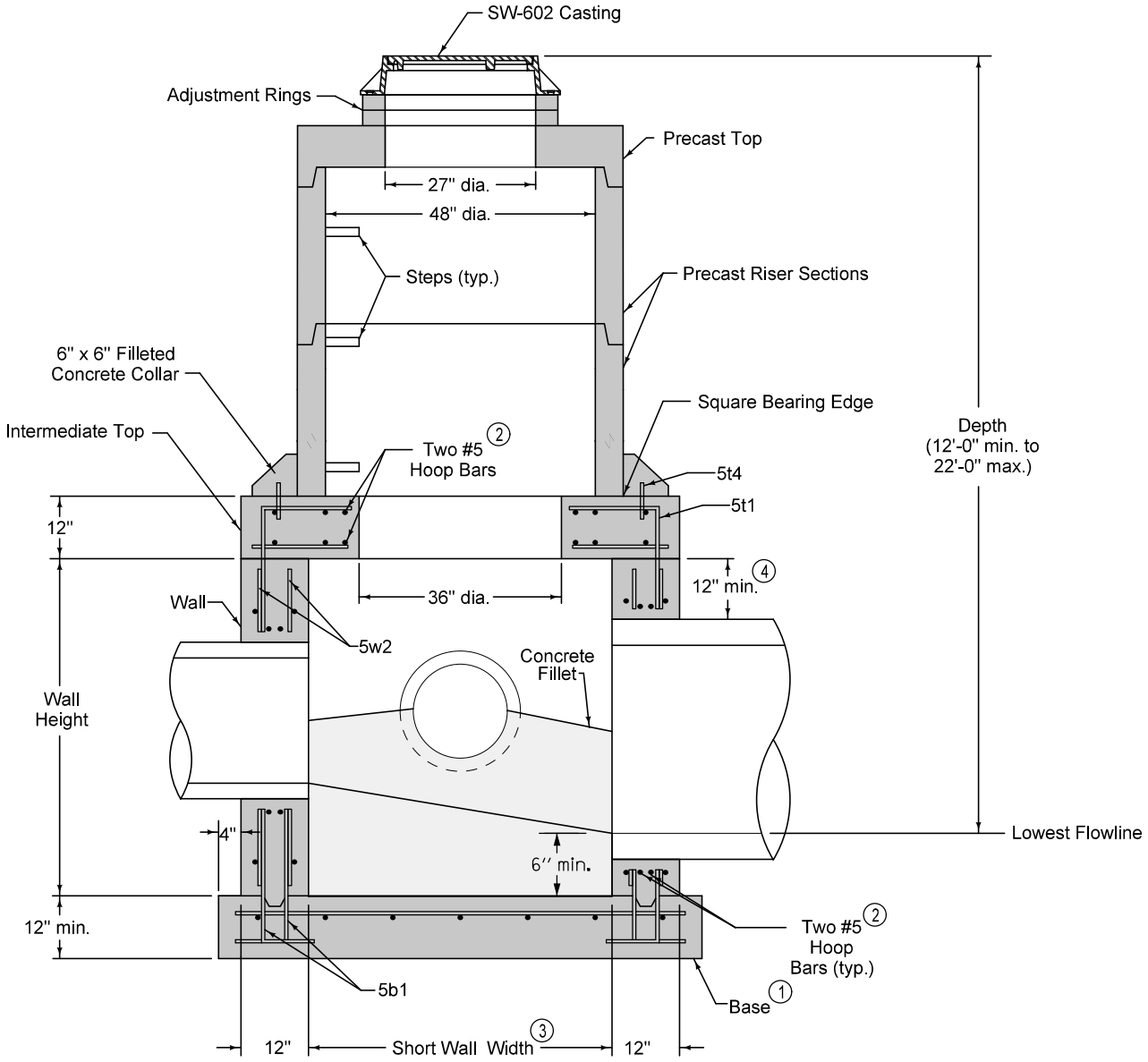
SHEET 2 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and DOT and SUDAS logo.

Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, 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.

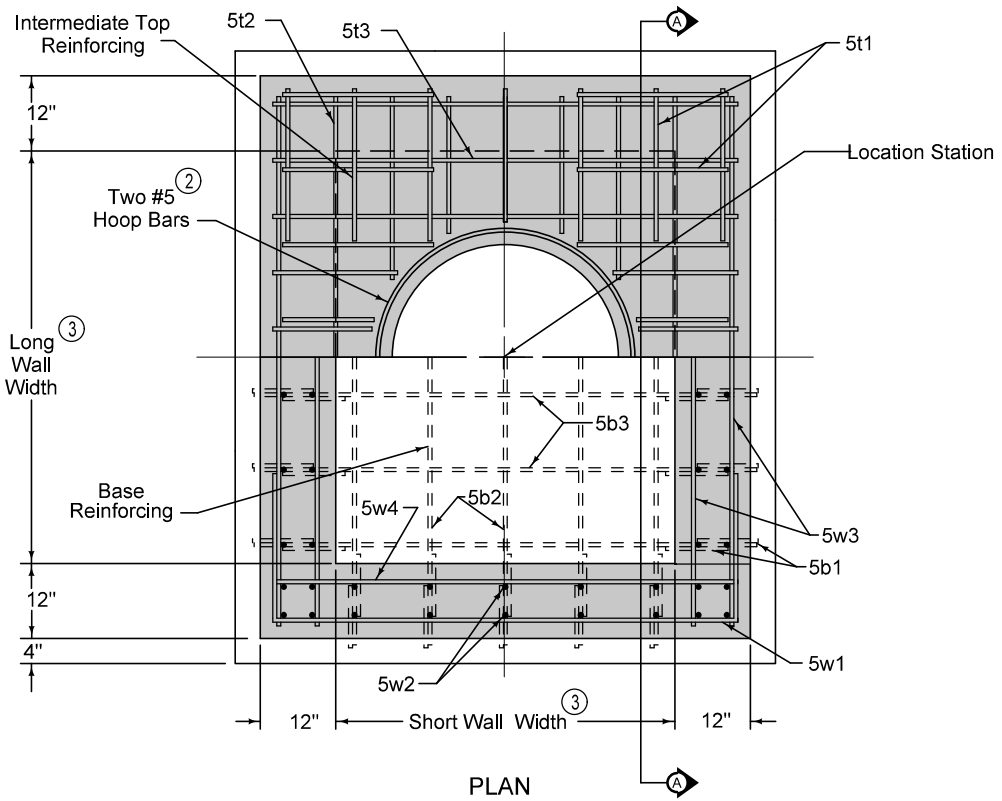
FIGURE 6010.404 SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 2 04-17-18
FIGURE 6010.404	STANDARD ROAD PLAN	SW-404
		SHEET 1 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and DOT and SUDAS logo.

Paul D. Wigant — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

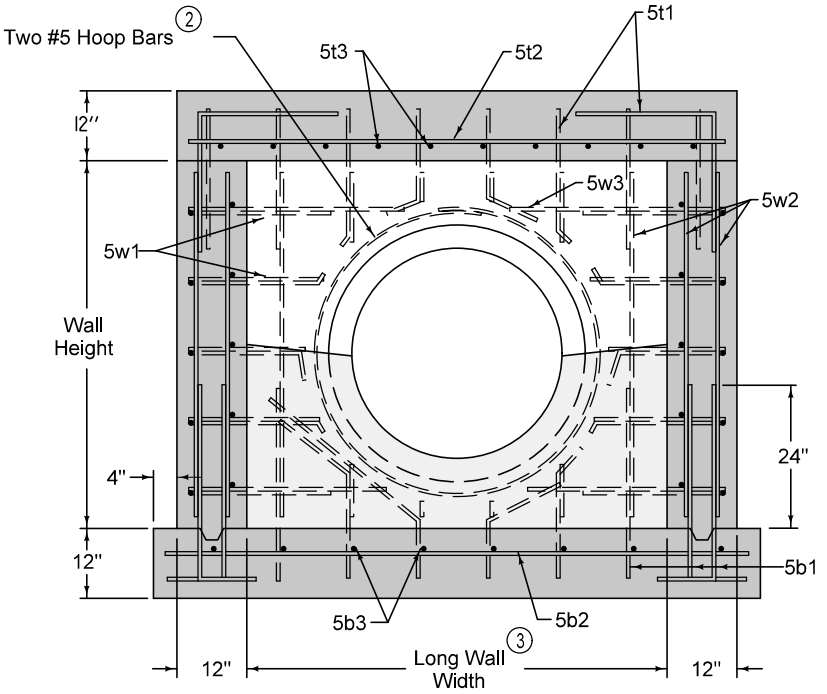
RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE



PLAN

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

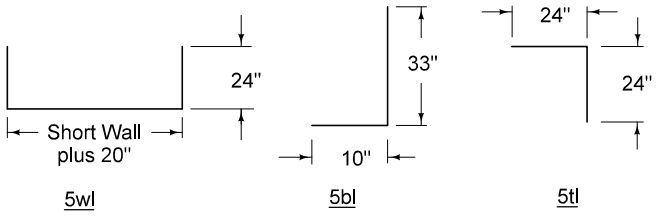
③ Wall widths vary with pipe diameter and range from 4 feet minimum to 12 feet maximum. Provide 12 inches of wall width (minimum) each side of pipe opening.



SECTION A-A

REINFORCING BAR LIST					
Mark	Size	Location	Shape	Length	Spacing
5t1	5	Top	L	48"	12"
5t2	5	Top	—	Long Wall plus 20"	9"
5t3	5	Top	—	Short Wall plus 20"	9"
5t4	5	Top	—	8"	12"
5b1	5	Base	L	43"	12"
5b2	5	Base	—	Long Wall plus 26"	12"
5b3	5	Base	—	Short Wall plus 26"	12"
5w1	5	Wall	⌐	Short Wall plus 68"	12"
5w2	5	Wall	—	Wall Height minus 4"	12"
5w3	5	Wall	—	Long Wall plus 20"	12"
5w4	5	Wall	—	Short Wall plus 20"	12"

BENT BARS



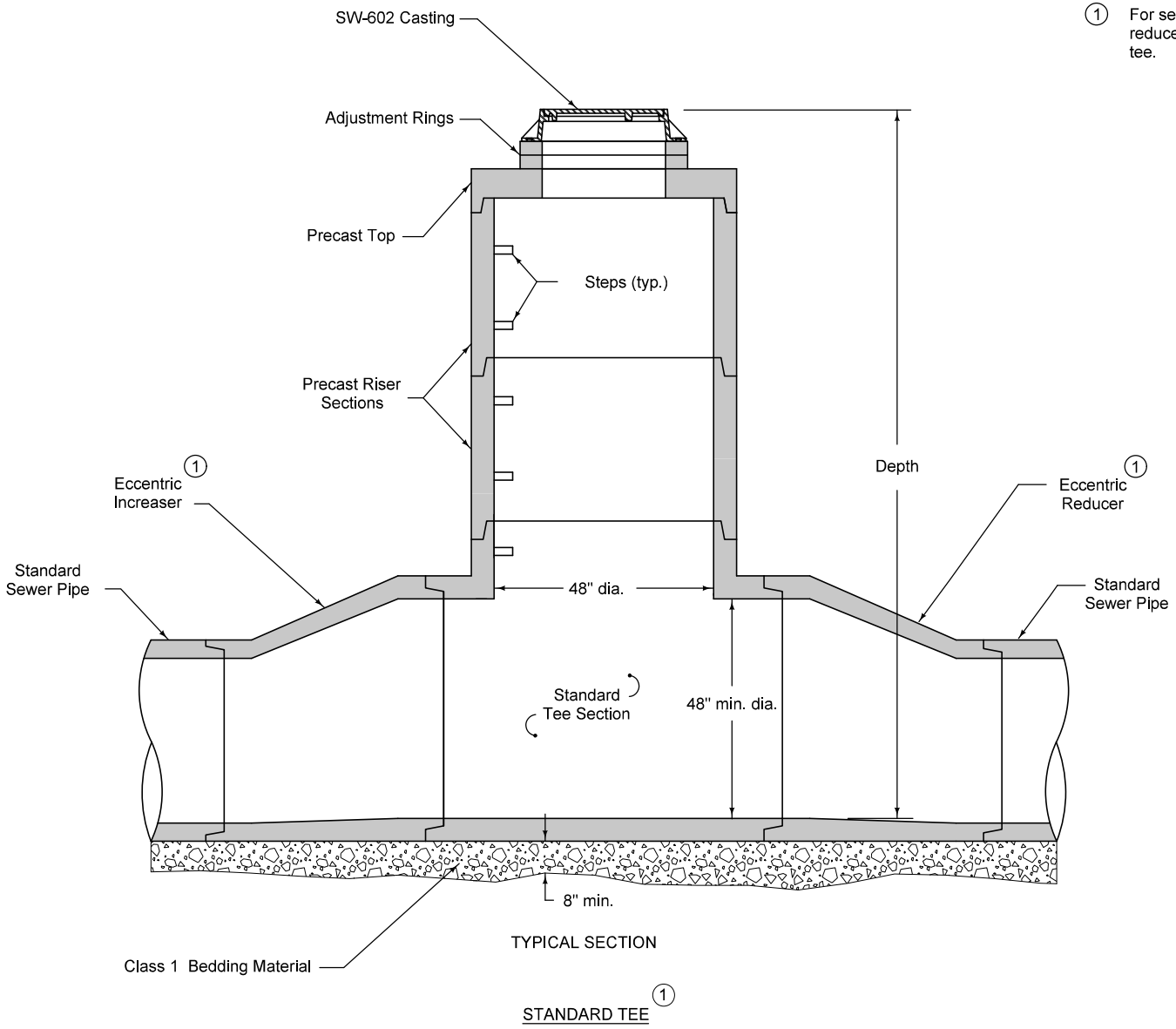
SUDAS | IOWADOT | REVISION 2 04-17-18

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

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and DOT and SUDAS logo.

Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, 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.

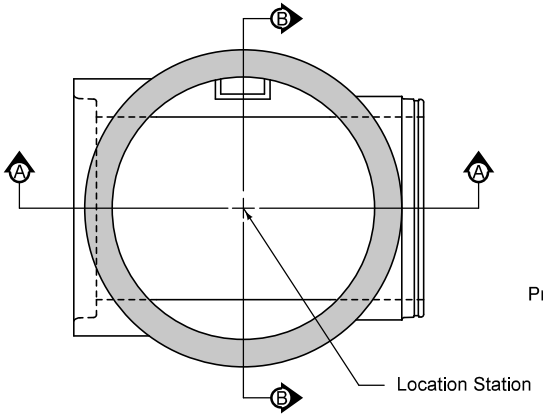
FIGURE 6010.405 SHEET 1 OF 2

SUDAS	IOWA DOT	REVISION 2 10-17-17
FIGURE 6010.405	STANDARD ROAD PLAN	SW-405
		SHEET 1 of 2

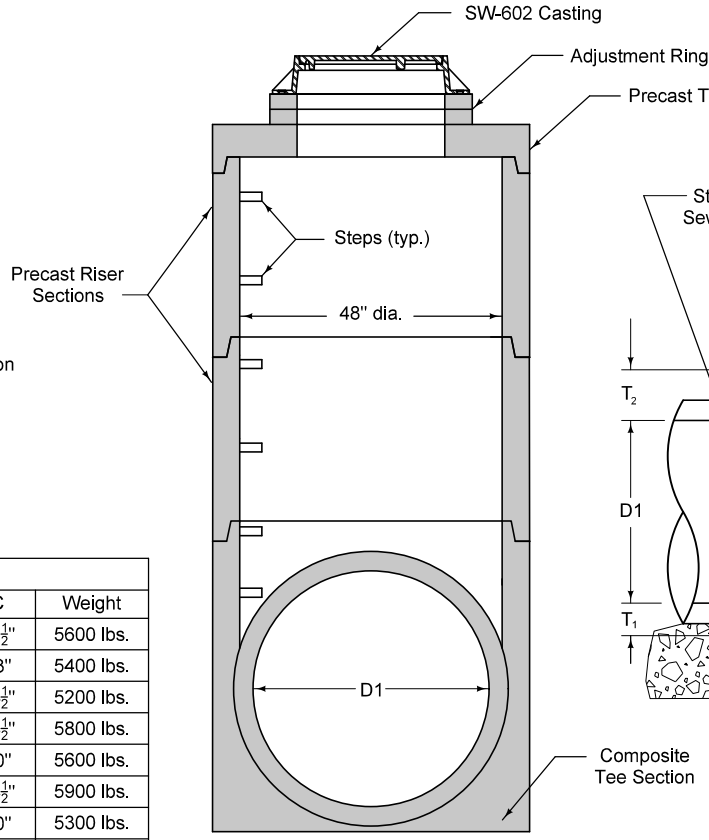
REVISIONS: Changed title from TEE-SECTION STORM SECTION MANHOLE to TEE-SECTION STORM SEWER MANHOLE.

Paul D. Wigant — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

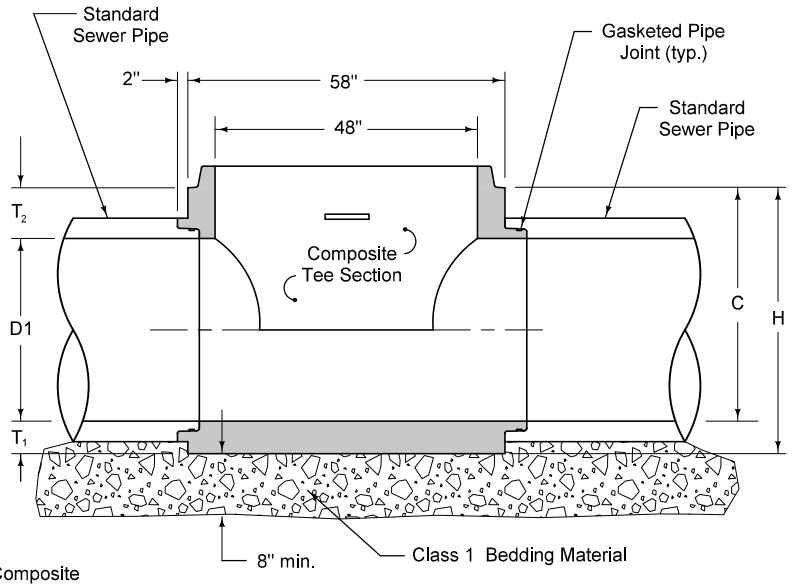
TEE-SECTION STORM SEWER MANHOLE



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

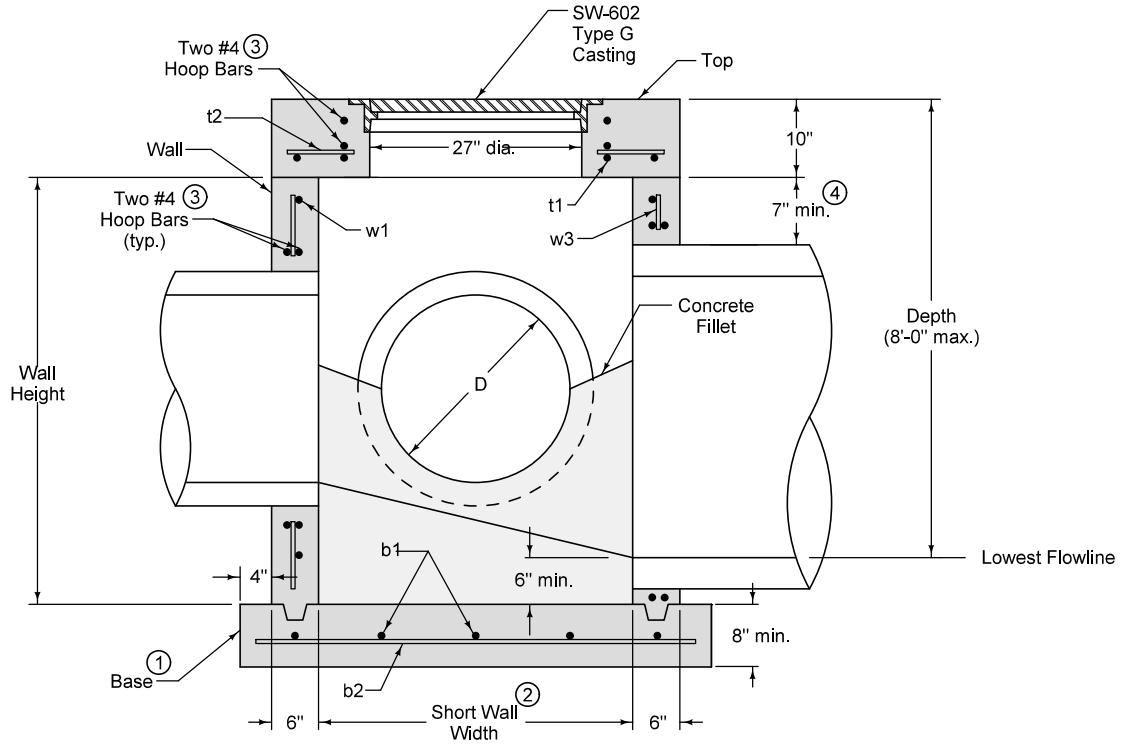
SUDAS | IOWADOT | REVISION 2 10-17-17

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

REVISIONS: Changed title from TEE-SECTION STORM SECTION MANHOLE to TEE-SECTION STORM SEWER MANHOLE.

Paul D. Wigant, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

TEE-SECTION 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 7 inch minimum wall height above all pipes.

FIGURE 6010.406 SHEET 1 OF 2

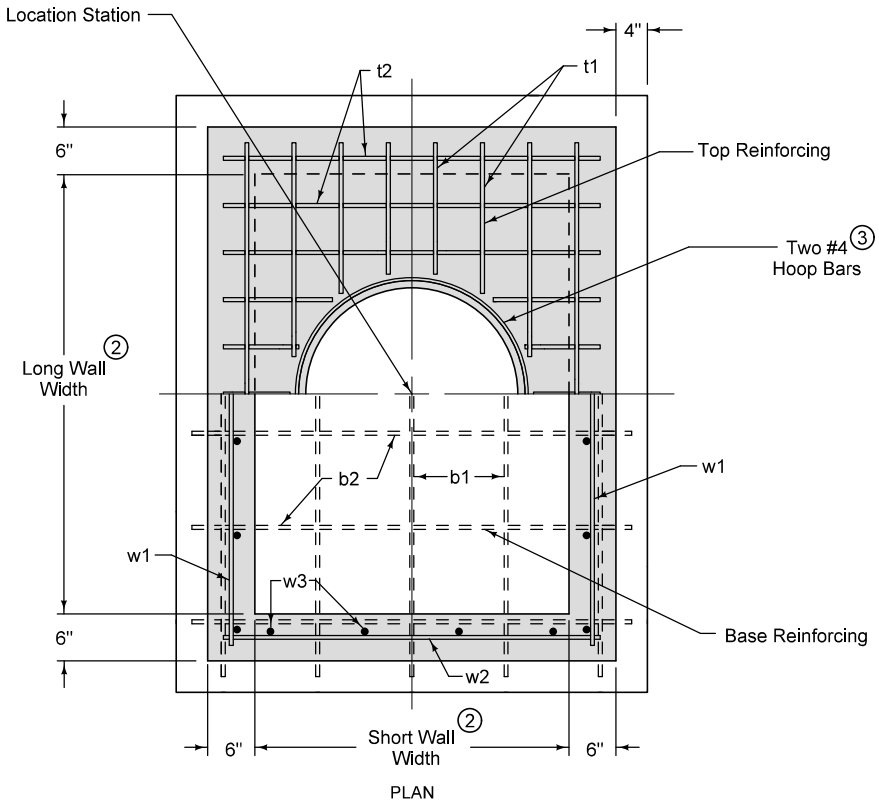
SUDAS | IOWA DOT | REVISION 1 04-17-18

FIGURE 6010.406 | STANDARD ROAD PLAN | SW-406 | SHEET 1 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

Paul D. Wigant, SUDAS DIRECTOR | Brian Smith, 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

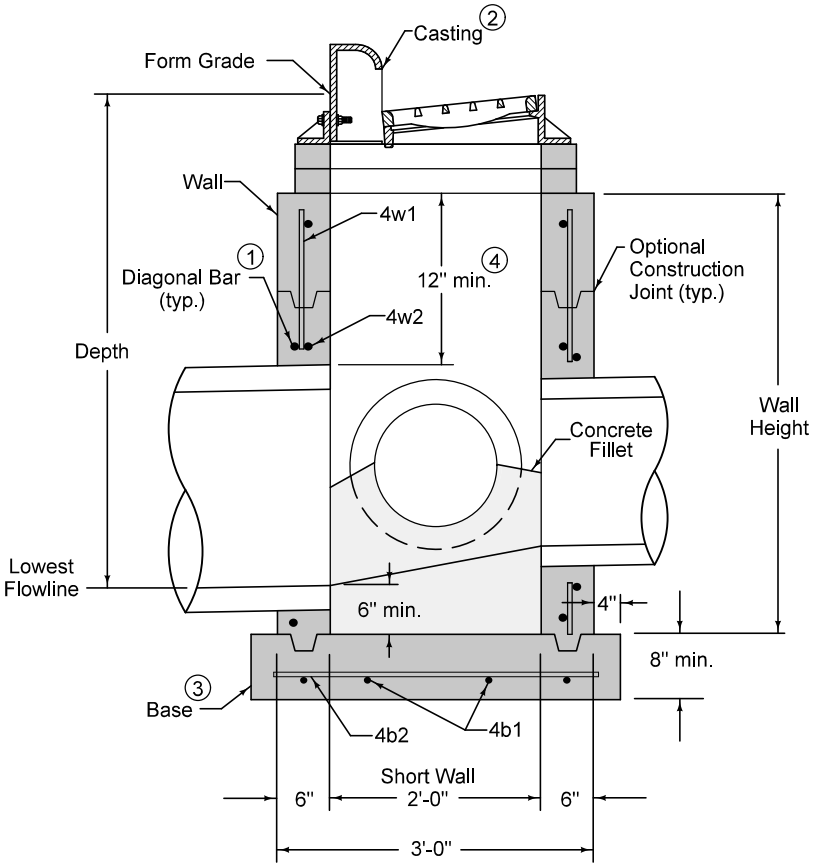
SUDAS | IOWADOT | REVISION 1 04-17-18

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

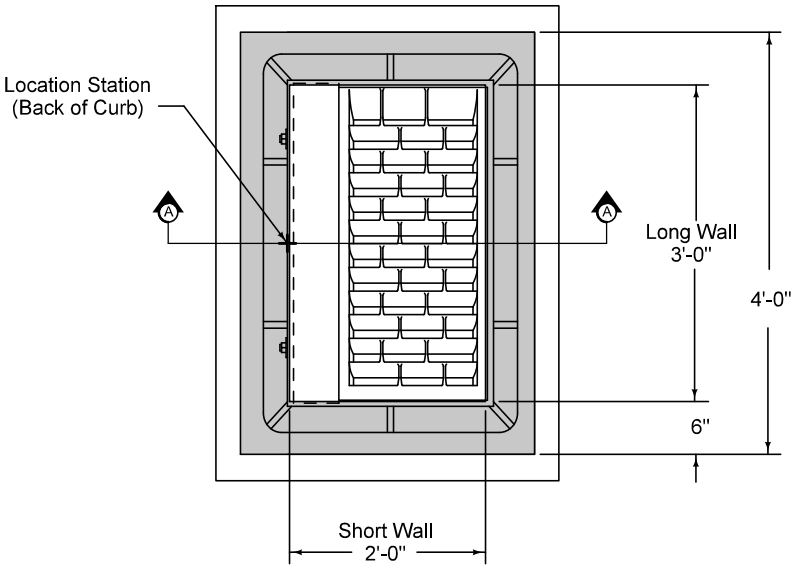
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

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

SHALLOW RECTANGULAR STORM SEWER MANHOLE



SECTION A-A



PLAN

Refer to SW-514 for boxout details.

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

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

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

SUDAS | IOWA DOT | REVISION 2 04-17-18

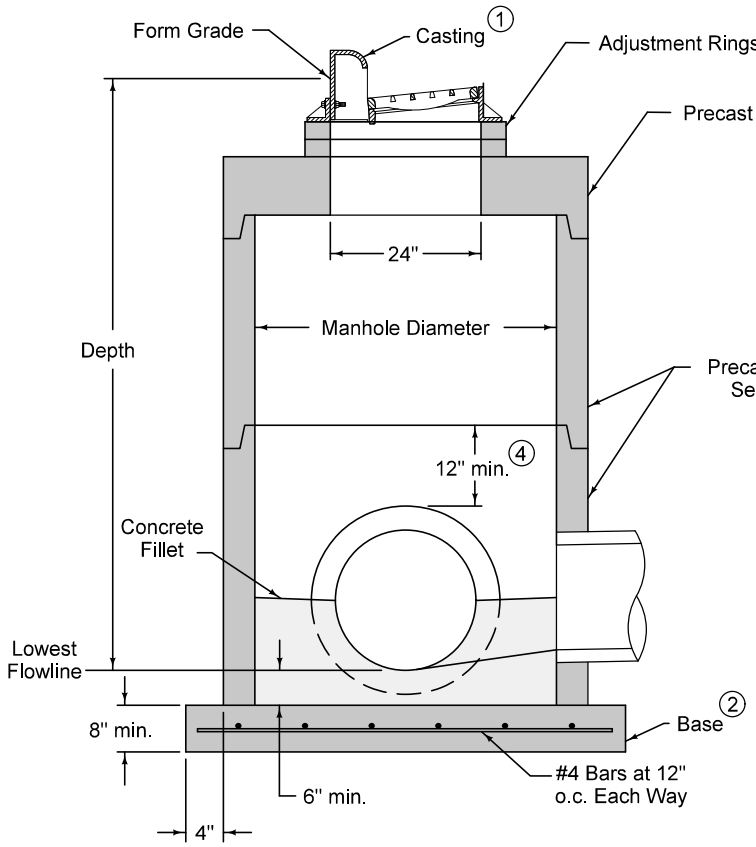
FIGURE 6010.501 | STANDARD ROAD PLAN | SW-501 | SHEET 1 of 1

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated DOT and SUDAS logo.

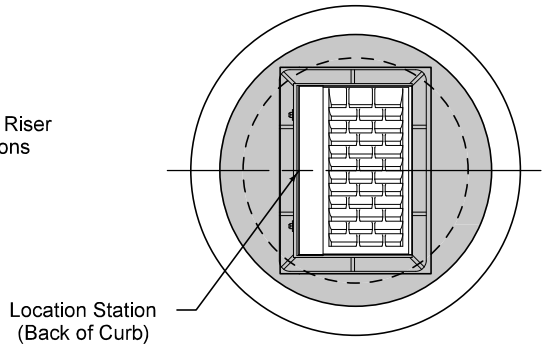
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

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

FIGURE 6010.502 SHEET 1 OF 1

SUDAS | IOWA DOT

REVISION 2 04-17-18

FIGURE 6010.502 | STANDARD ROAD PLAN | SW-502

SHEET 1 of 1

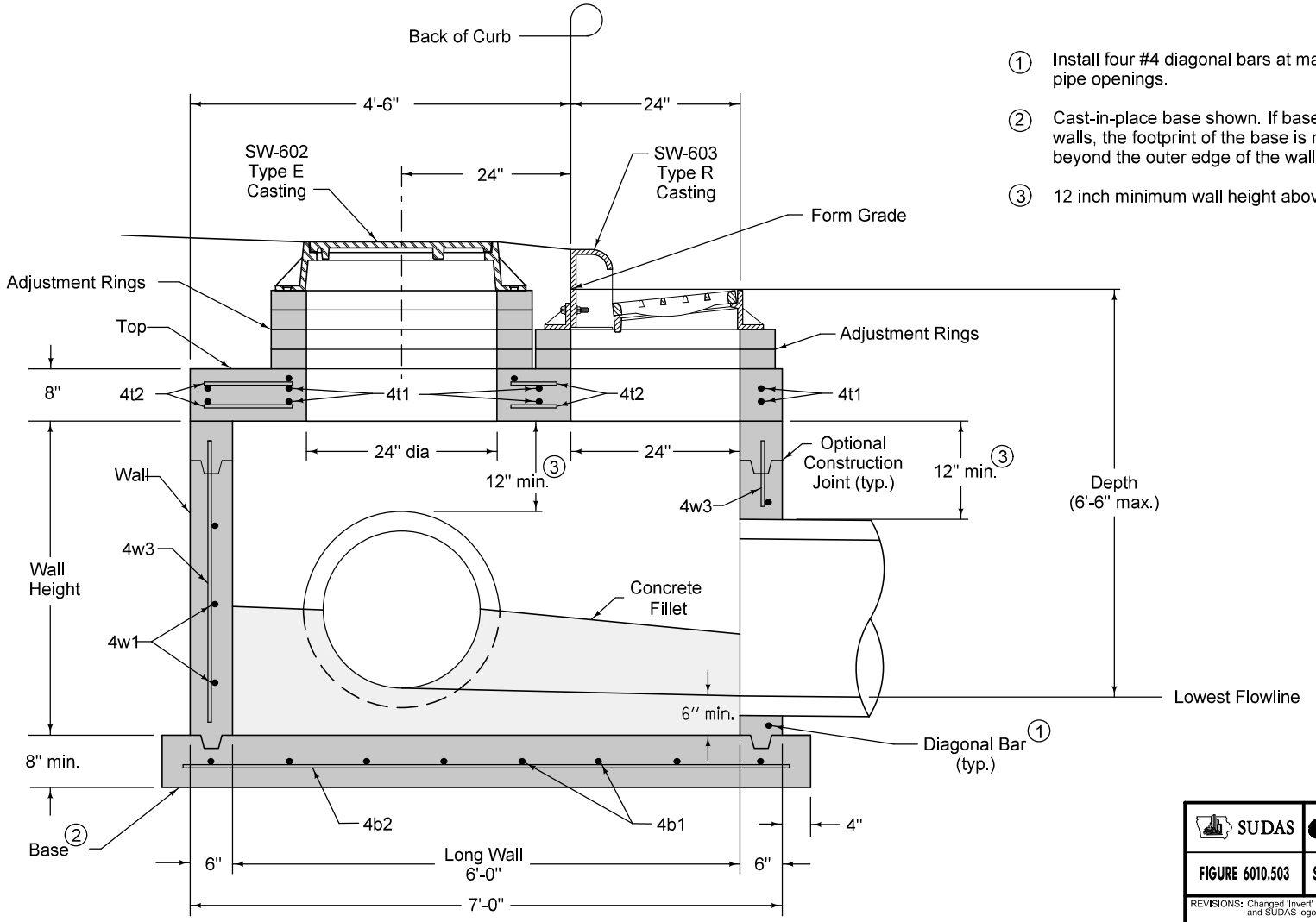
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated linework and Iowa DOT and SUDAS logo.

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

CIRCULAR SINGLE GRATE INTAKE

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 2 04-17-18

FIGURE 6010.503 | STANDARD ROAD PLAN

SW-503

SHEET 1 of 2

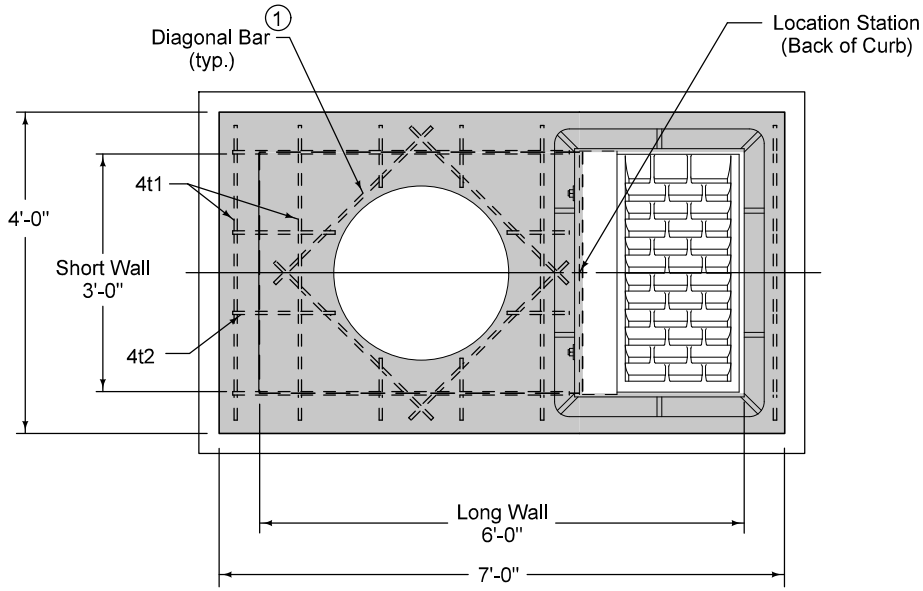
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated linework and Iowa DOT and SUDAS logo.

Paul D. Wigant, SUDAS DIRECTOR

Brian Smith, 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 2 04-17-18

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

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated linework and Iowa DOT and SUDAS logo.

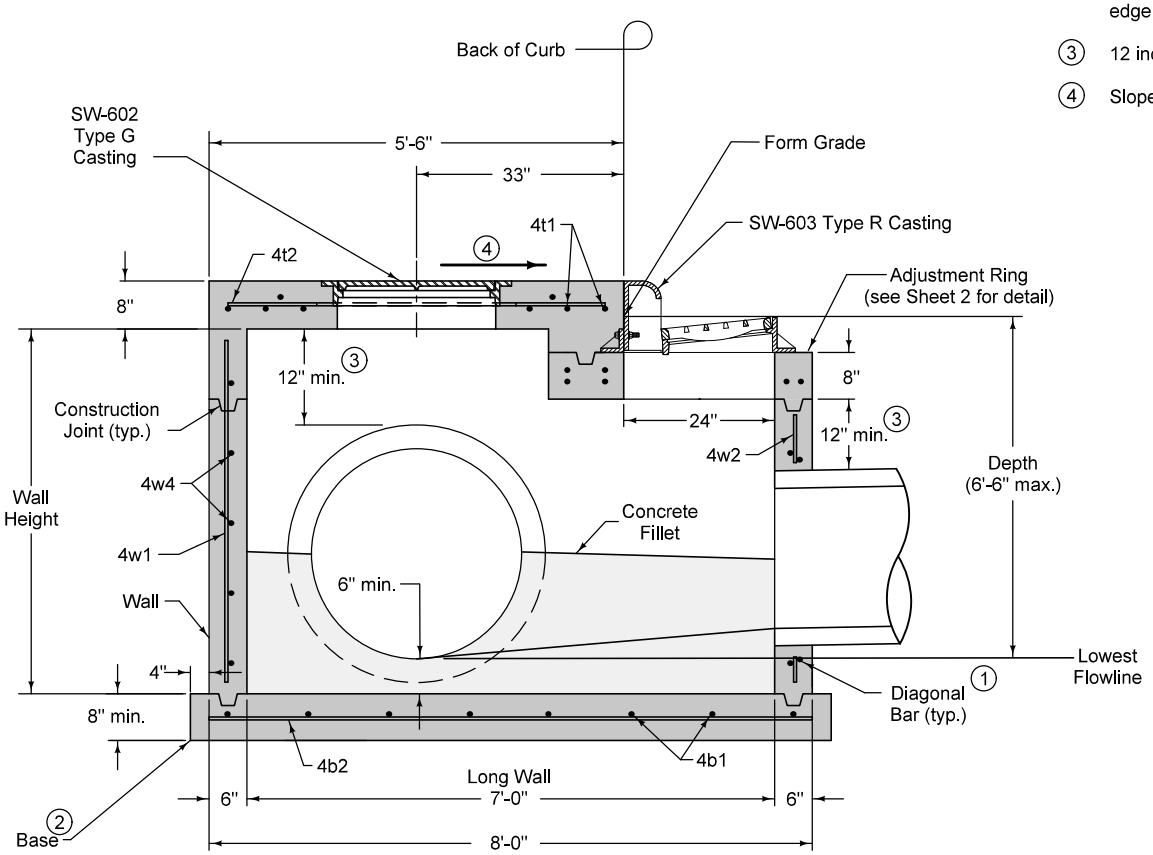
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

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

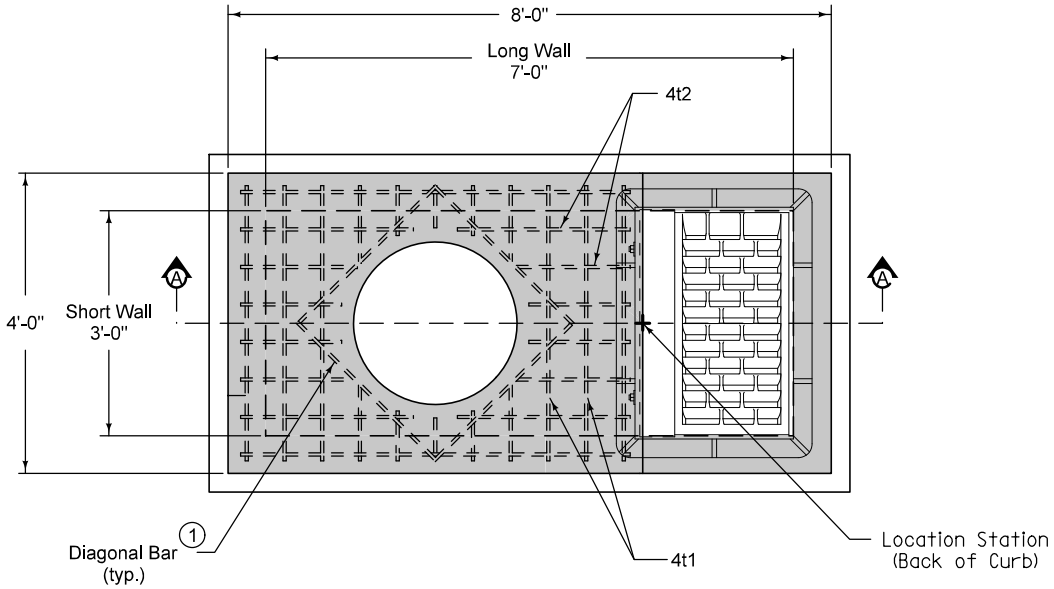
SUDAS	IOWA DOT	REVISION 3 04-17-18
FIGURE 6010.504	STANDARD ROAD PLAN	SW-504
		SHEET 1 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

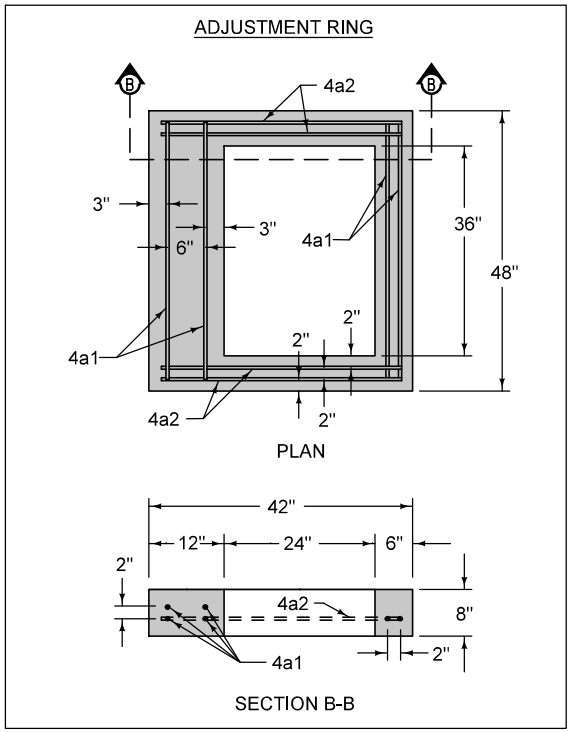
Paul D. Wigant, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

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"

FIGURE 6010.504 SHEET 2 OF 2

SUDAS | IOWADOT | REVISION 3 04-17-18

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

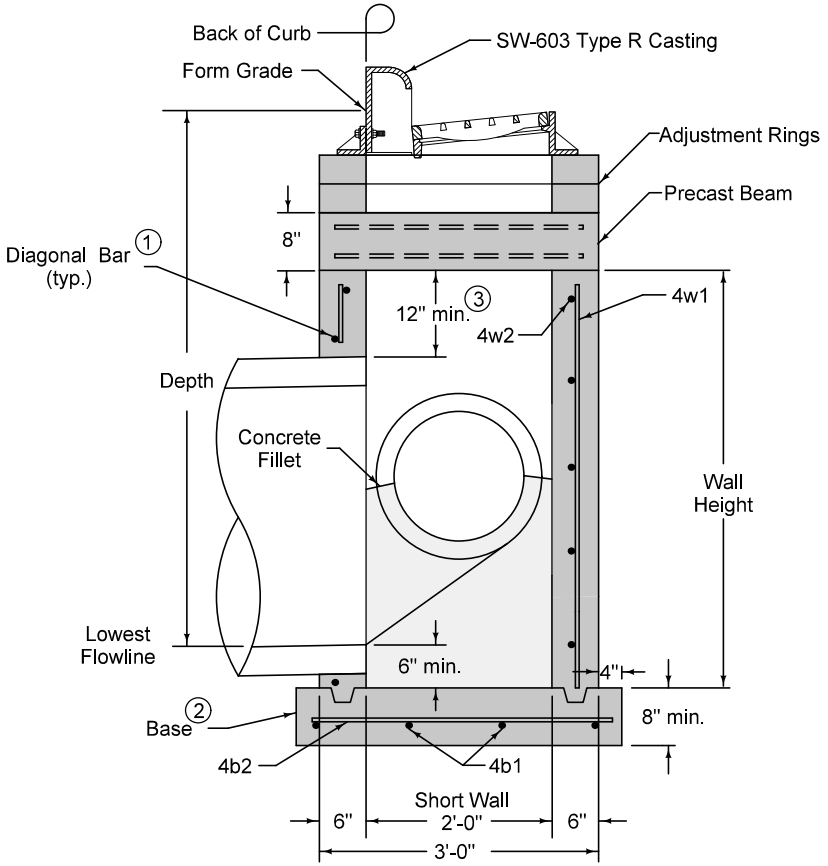
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

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

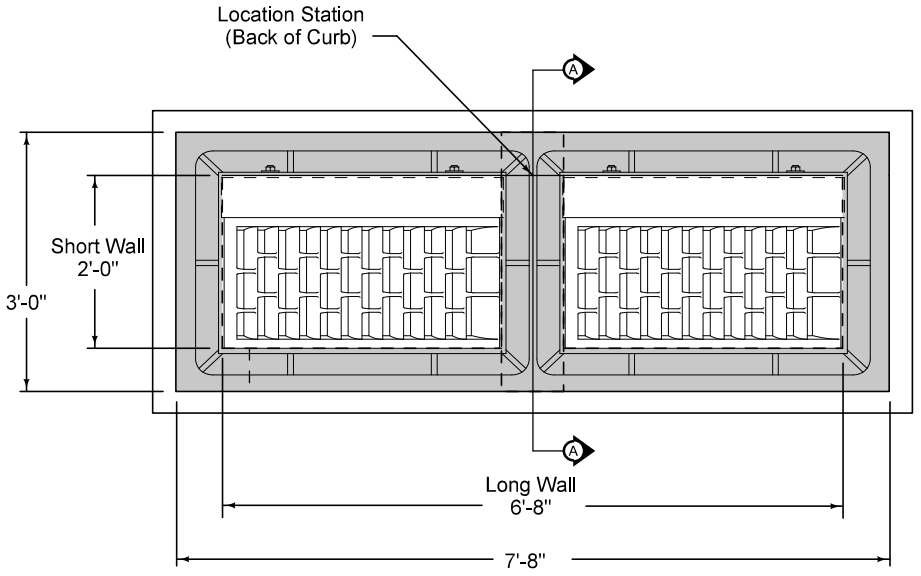
SINGLE GRATE INTAKE WITH FLUSH-TOP MANHOLE

Refer to SW-514 for boxout details.

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



SECTION A-A



PLAN

SUDAS	IOWA DOT	REVISION 2 04-17-18
FIGURE 6010.505	STANDARD ROAD PLAN	SW-505 SHEET 1 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete fillet'. Updated linework and Iowa DOT and SUDAS logo.

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

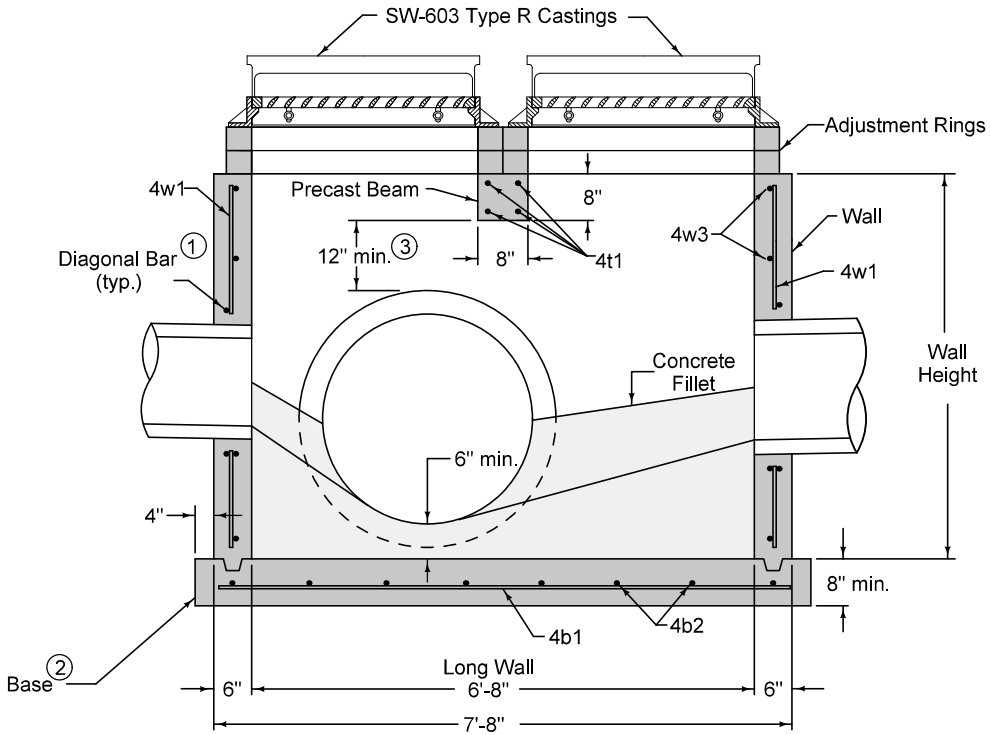
DOUBLE GRATE INTAKE

FIGURE 6010.505 SHEET 1 OF 2

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

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

③ 12 inch minimum wall height above all pipes.



TYPICAL SECTION

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

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

SUDAS | IOWA DOT | REVISION 2 | 04-17-18

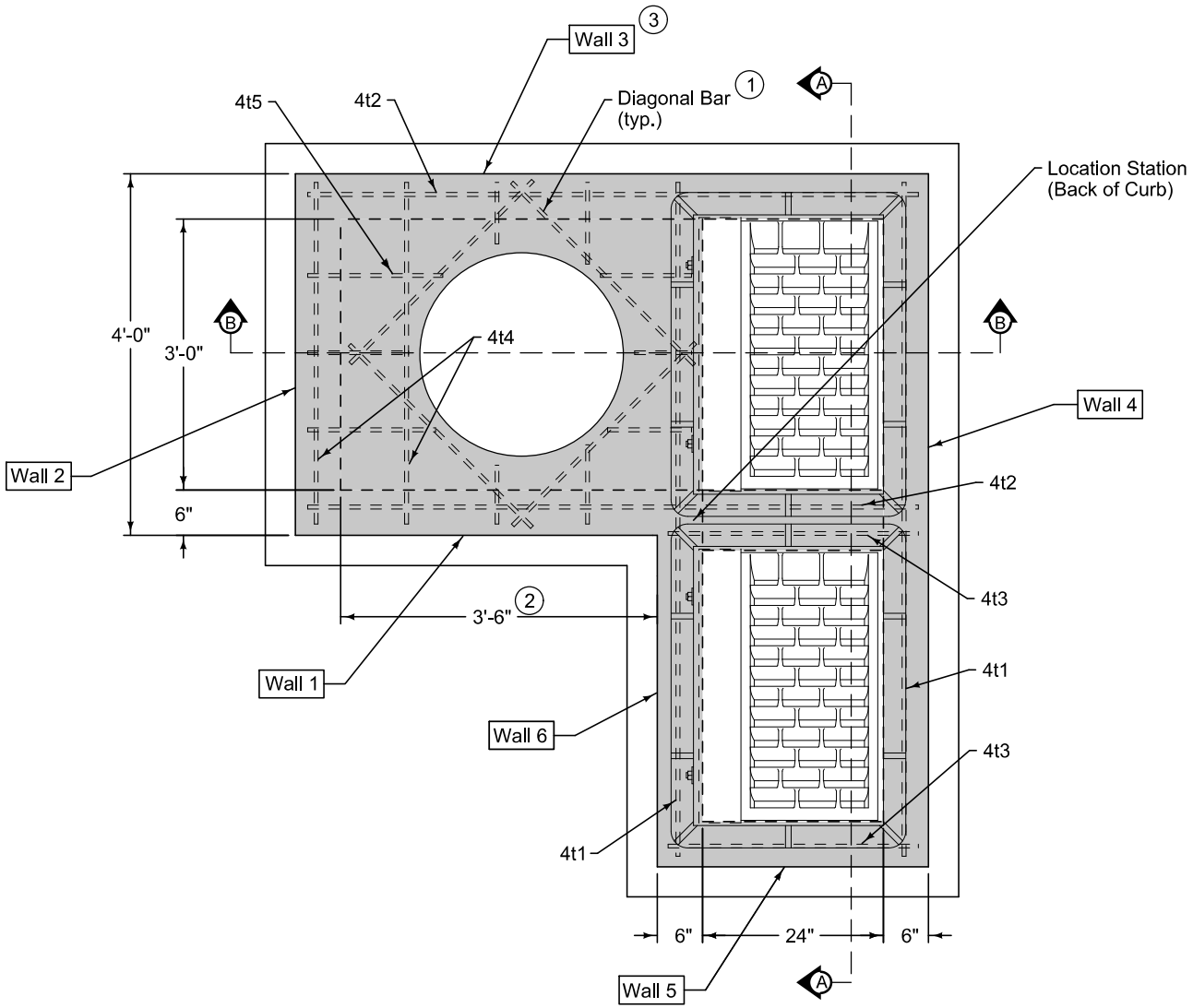
FIGURE 6010.505 | STANDARD ROAD PLAN | SW-505 | SHEET 2 of 2

REVISIONS: Changed 'Invert' callout to 'Concrete fillet'. Updated linework and Iowa DOT and SUDAS logo.

Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, 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 3 04-17-18

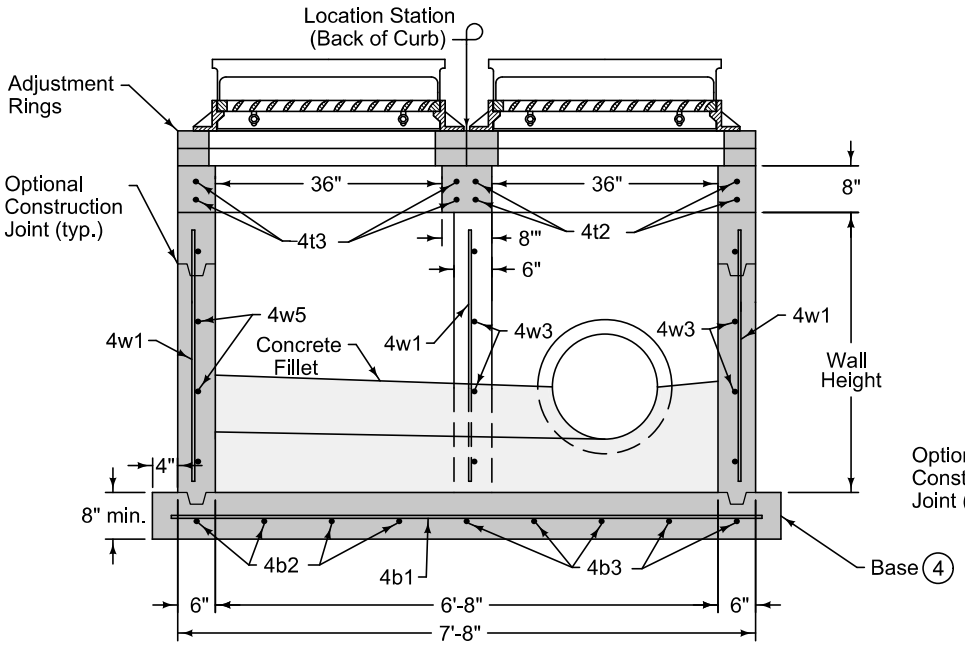
FIGURE 6010.506 | STANDARD ROAD PLAN | SW-506

SHEET 1 of 2

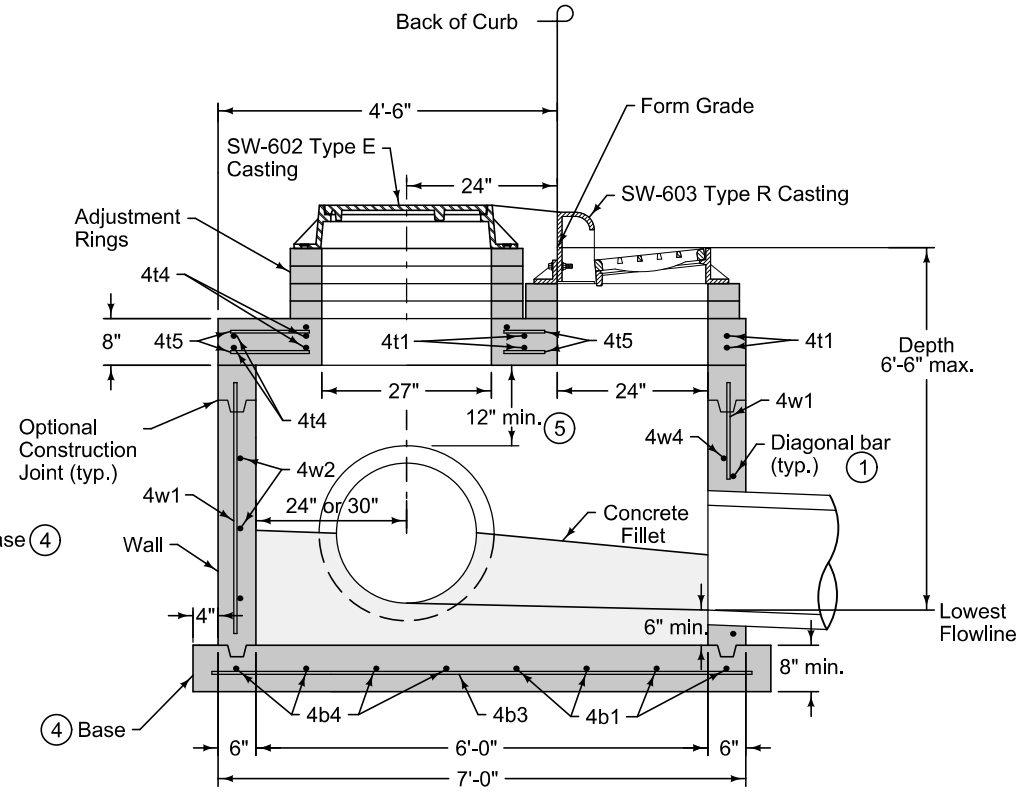
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

Paul D. Wigant, SUDAS DIRECTOR | Brian Smith, 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 | IOWADOT | REVISION 3 04-17-18

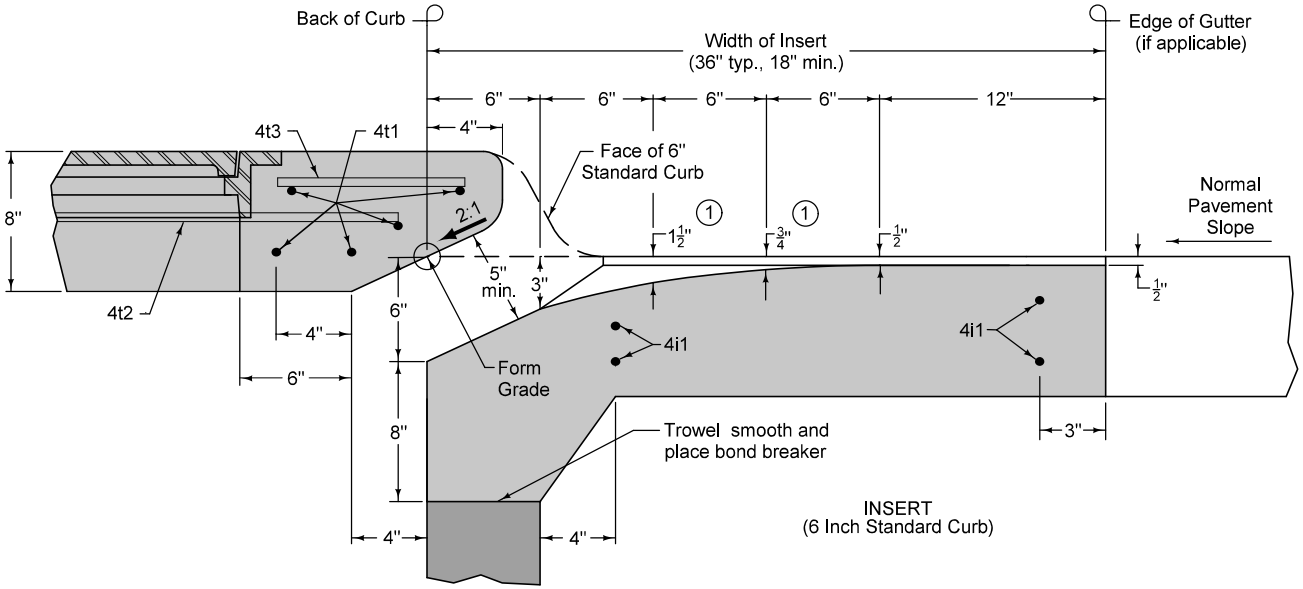
FIGURE 6010.506 | STANDARD ROAD PLAN | SW-506 | SHEET 2 of 2

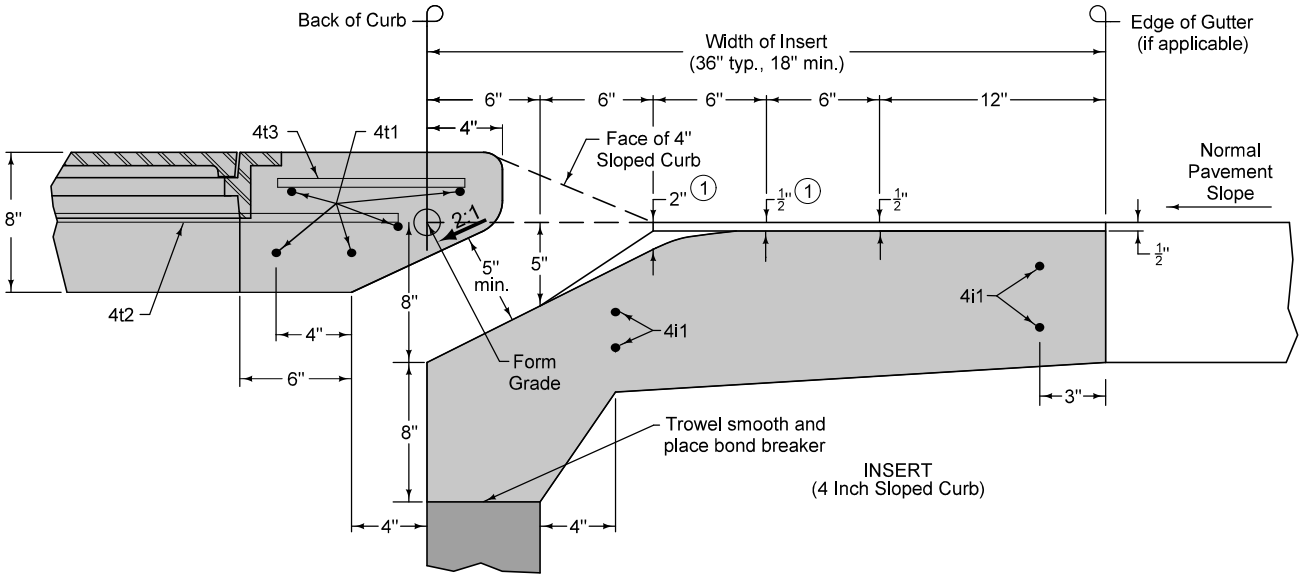
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, 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.

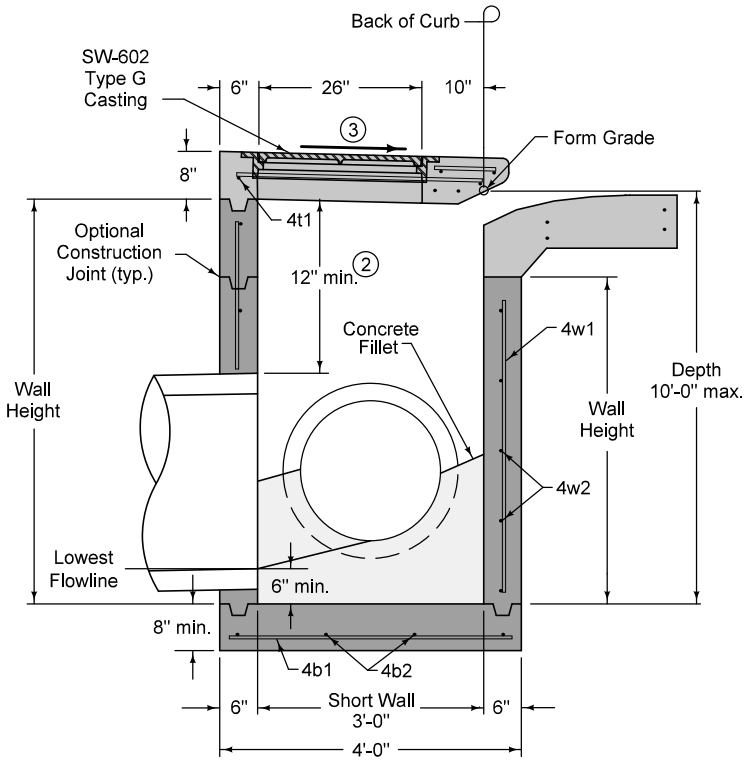
SUDAS	IOWA DOT	REVISION 3	04-17-18
FIGURE 6010.507	STANDARD ROAD PLAN	SW-507	SHEET 1 of 2

REVISIONS: Added second insert drawing to include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

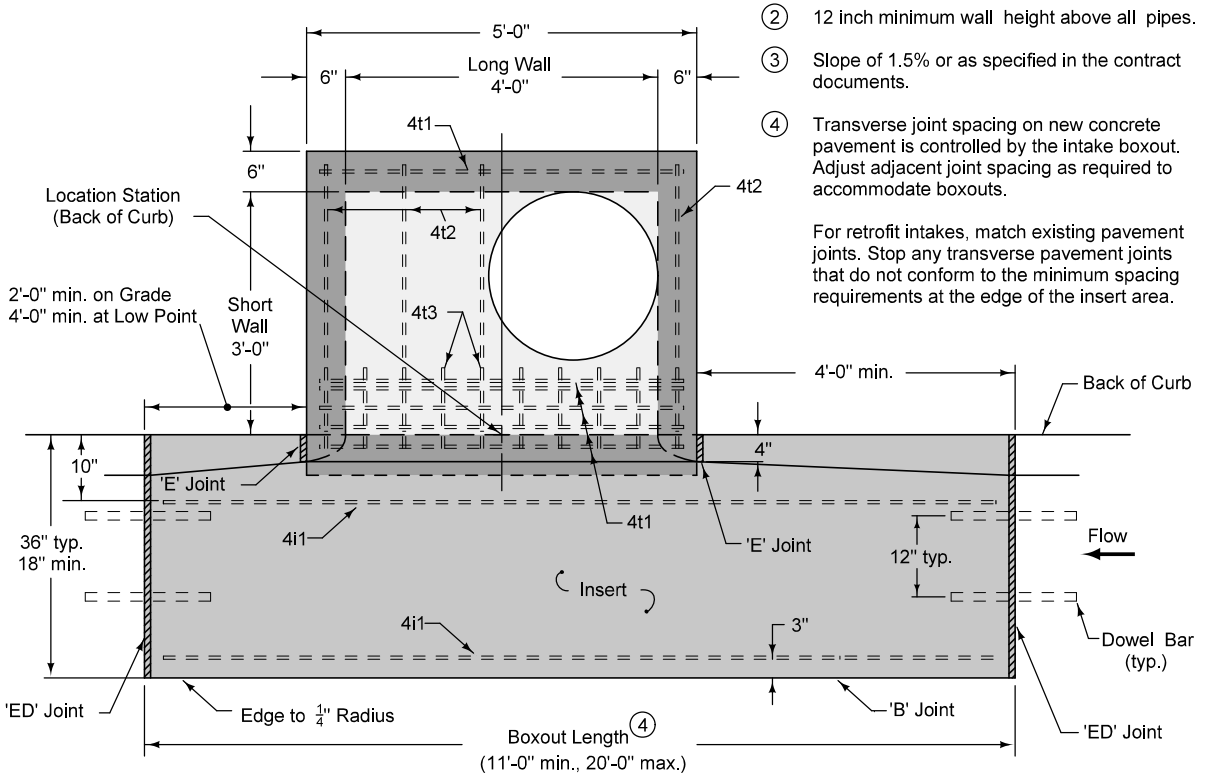
Paul D. Wigant — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.507 SHEET 1 OF 2



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"

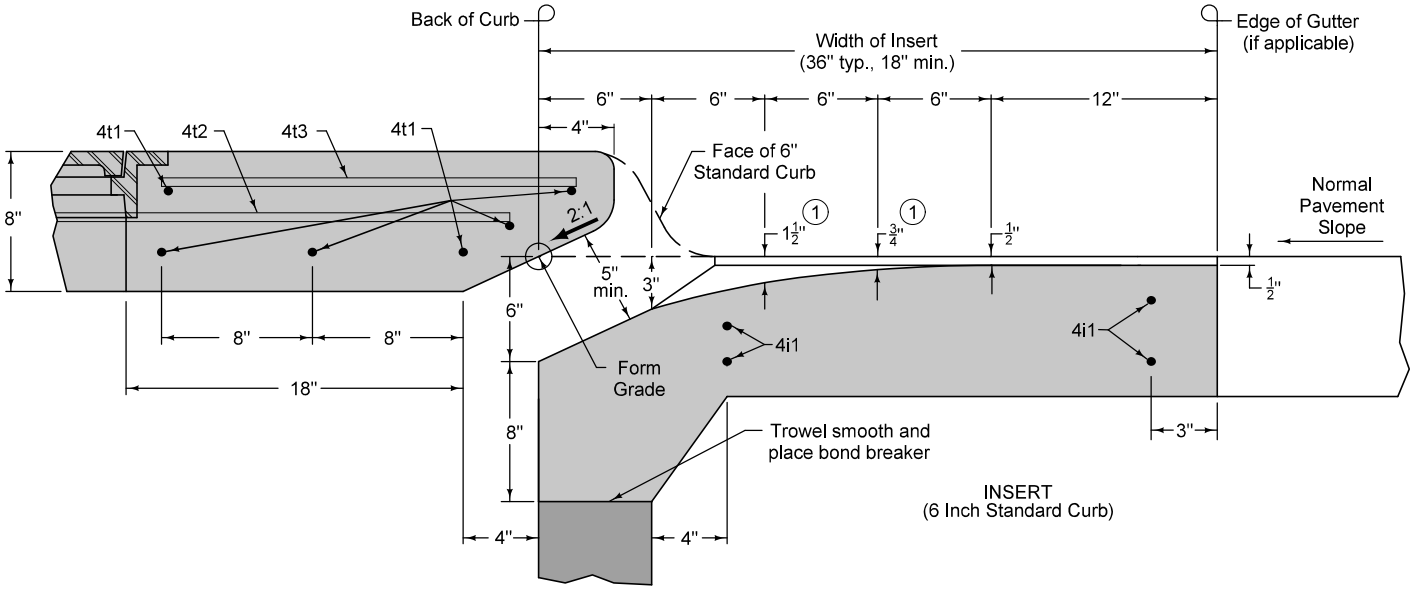
SUDAS | IOWADOT | REVISION 3 04-17-18

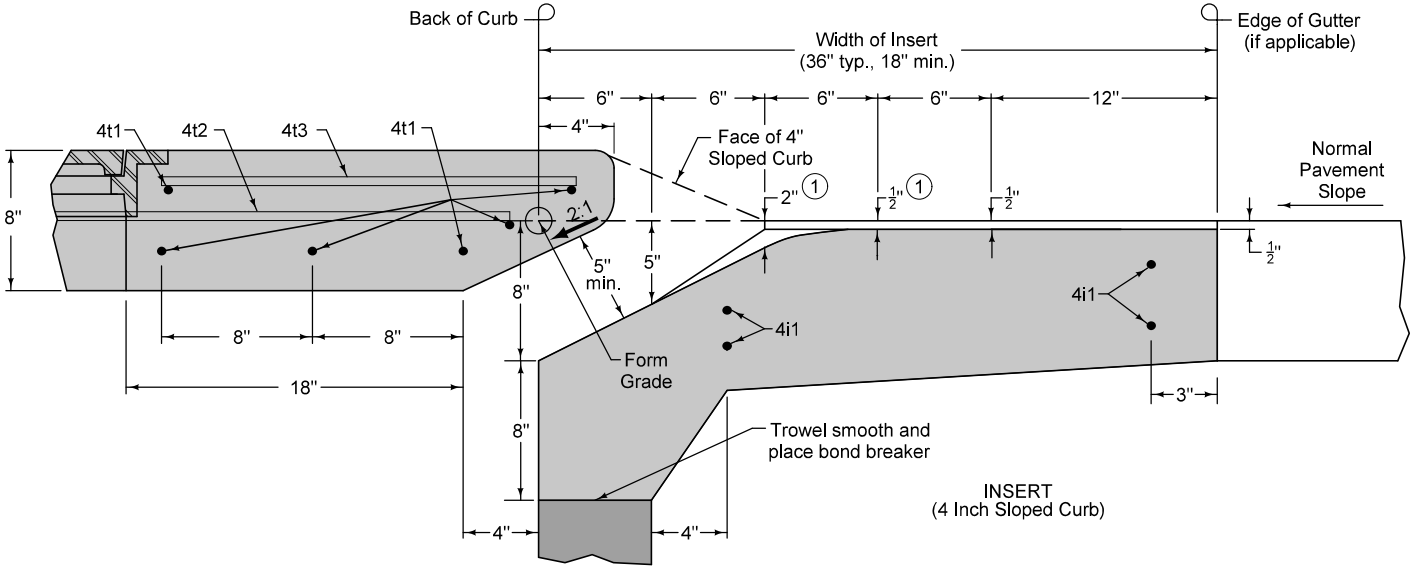
FIGURE 6010.507 | STANDARD ROAD PLAN | SW-507 | SHEET 2 of 2

REVISIONS: Added second Insert drawing to Include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, 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.

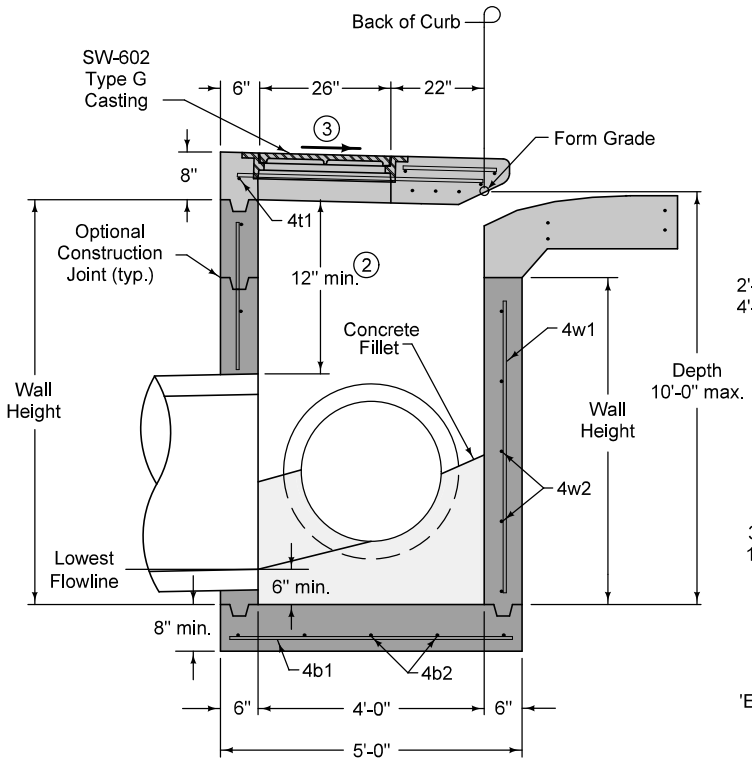
SUDAS	IOWA DOT	REVISION 3	04-17-18
FIGURE 6010.508	STANDARD ROAD PLAN	SW-508	
		SHEET 1 of 2	

REVISIONS: Added second insert drawing to include 4" curb, changed 'Invert' callout to 'Concrete Fillet', and modified circle notes.

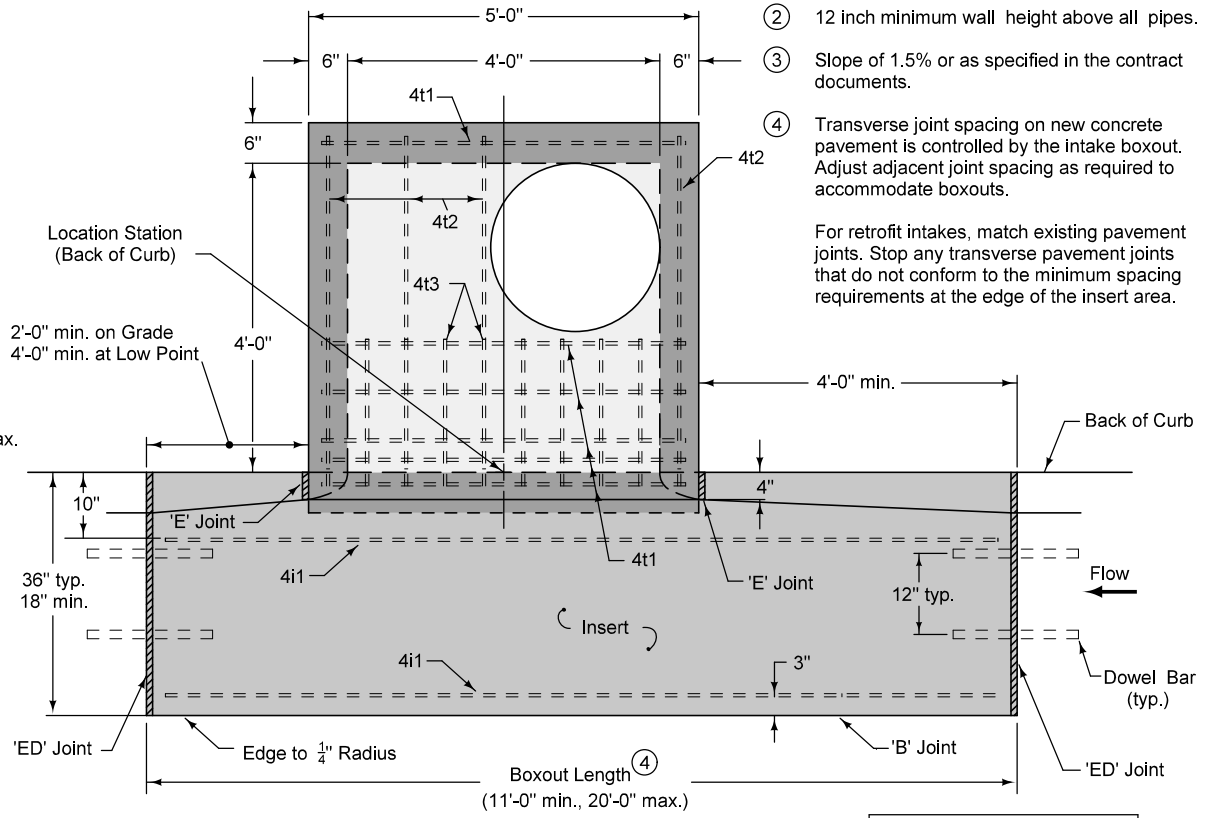
Paul D. Wigant — SUDAS DIRECTOR
Brian Smith — DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE, LARGE BOX

FIGURE 6010.508 SHEET 1 OF 2



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"

FIGURE 6010.508 SHEET 2 OF 2

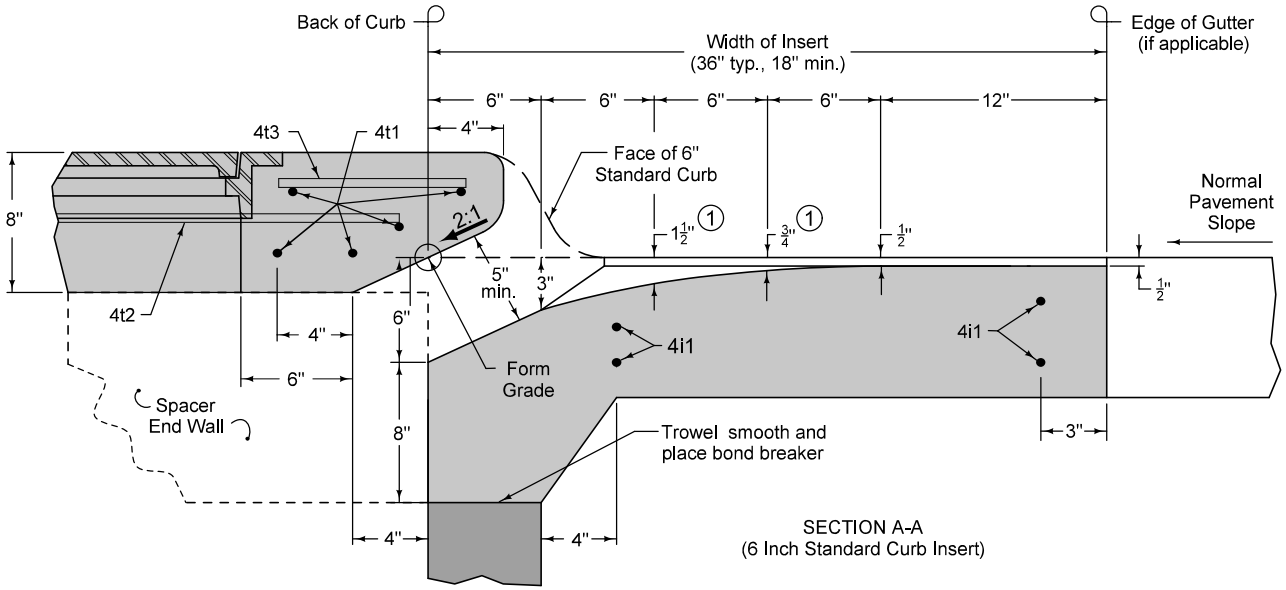
SUDAS | IOWADOT | REVISION 3 04-17-18

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

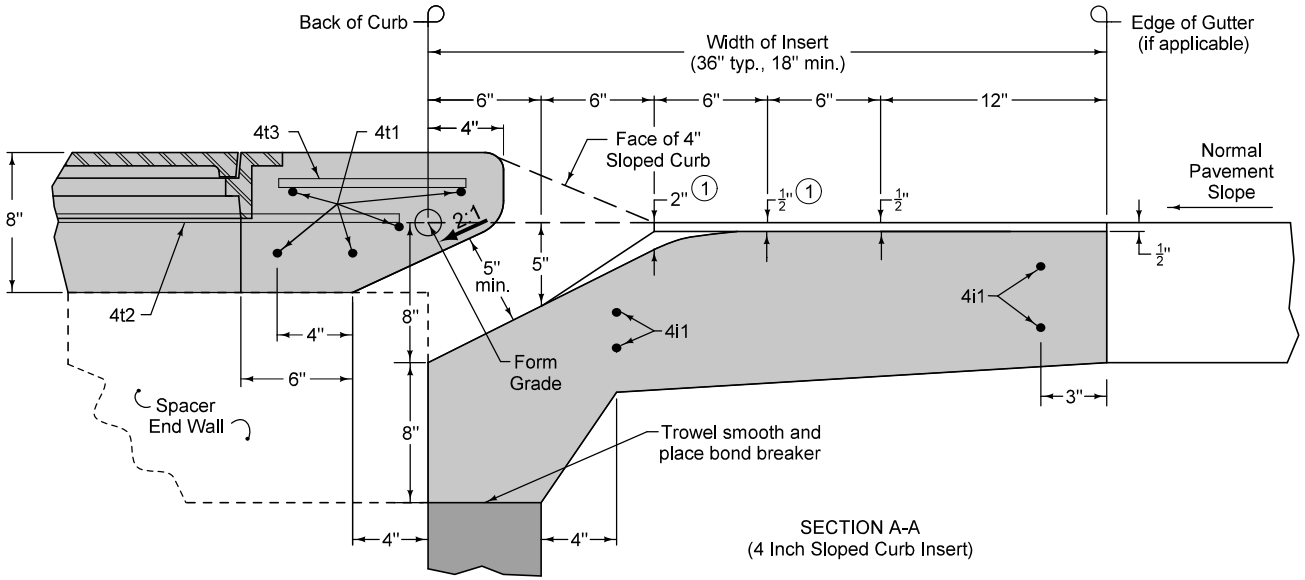
REVISIONS: Added second Insert drawing to Include 4" curb, changed 'Invert' callout to 'Concrete Fillet', and modified circle notes.

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

SINGLE OPEN-THROAT CURB INTAKE, LARGE BOX



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.

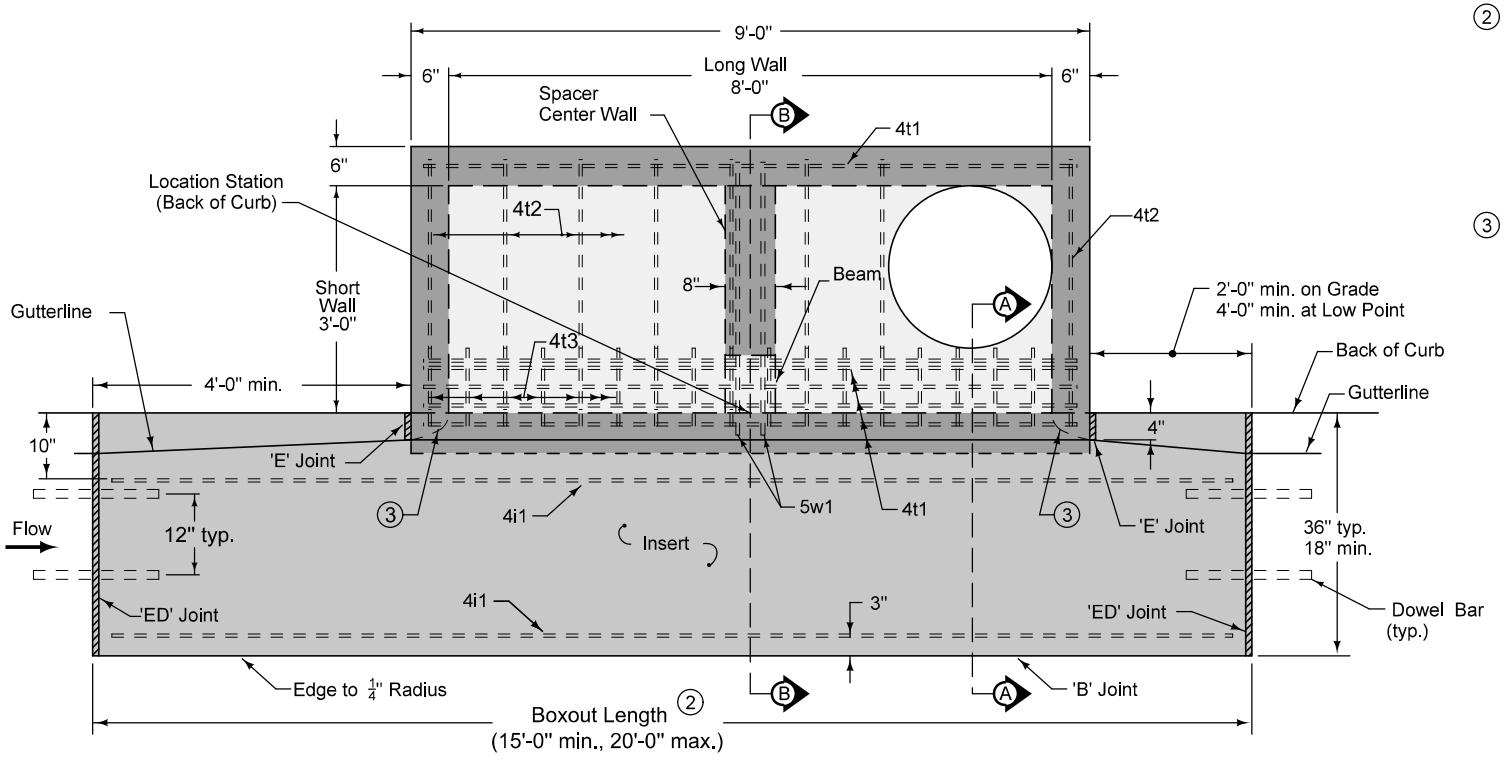
SUDAS	IOWADOT	REVISION 5	04-17-18
FIGURE 6010.509	STANDARD ROAD PLAN	SW-509	SHEET 1 of 3

REVISIONS: Added second Insert drawing to Include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

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

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.509 | SHEET 1 OF 3



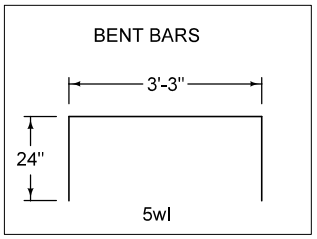
PLAN

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 5 04-17-18

FIGURE 6010.509 | STANDARD ROAD PLAN | SW-509

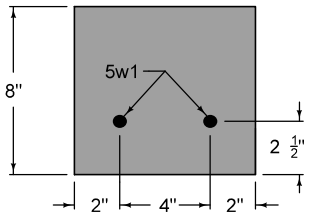
SHEET 2 of 3

REVISIONS: Added second insert drawing to include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

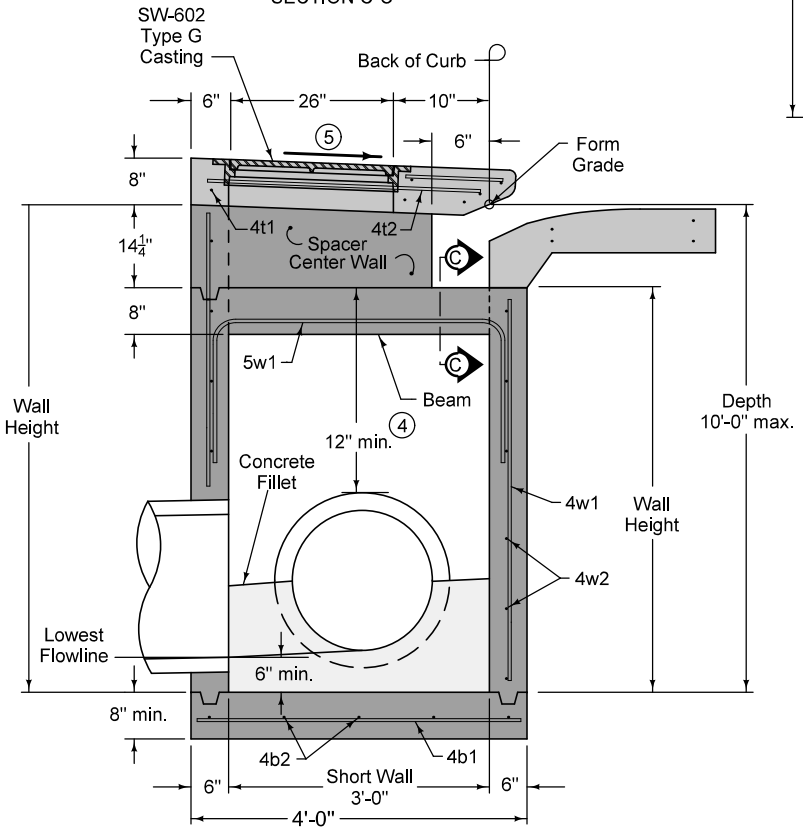
Paul D. Wigant, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

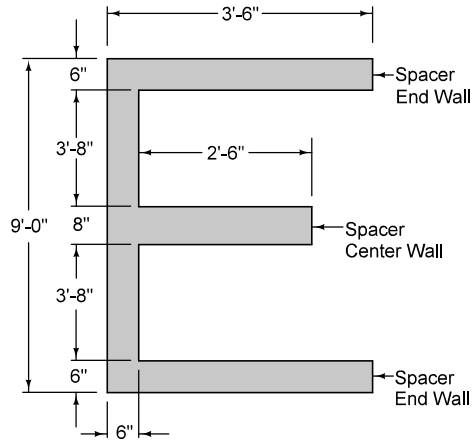
FIGURE 6010.509 SHEET 2 OF 3



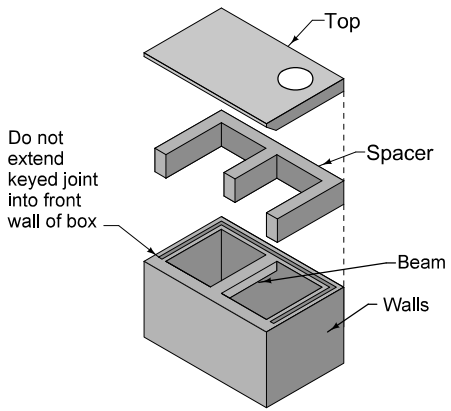
SECTION C-C



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 5 | 04-17-18

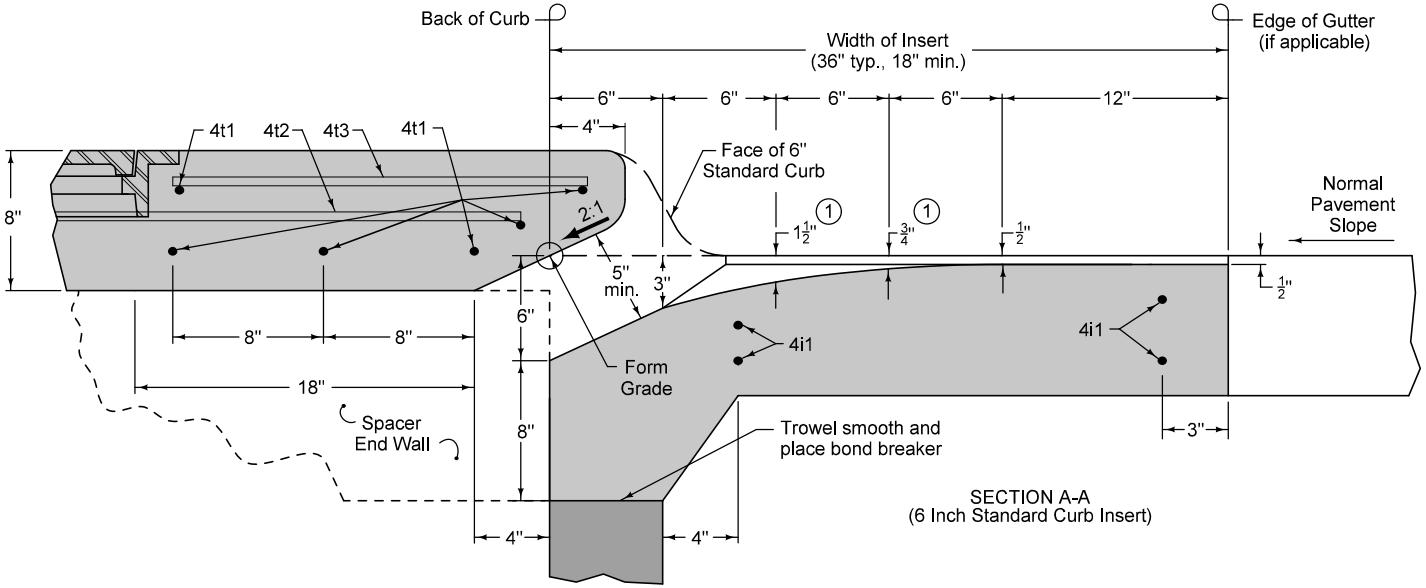
FIGURE 6010.509 | STANDARD ROAD PLAN | SW-509 | SHEET 3 of 3

REVISIONS: Added second Insert drawing to Include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

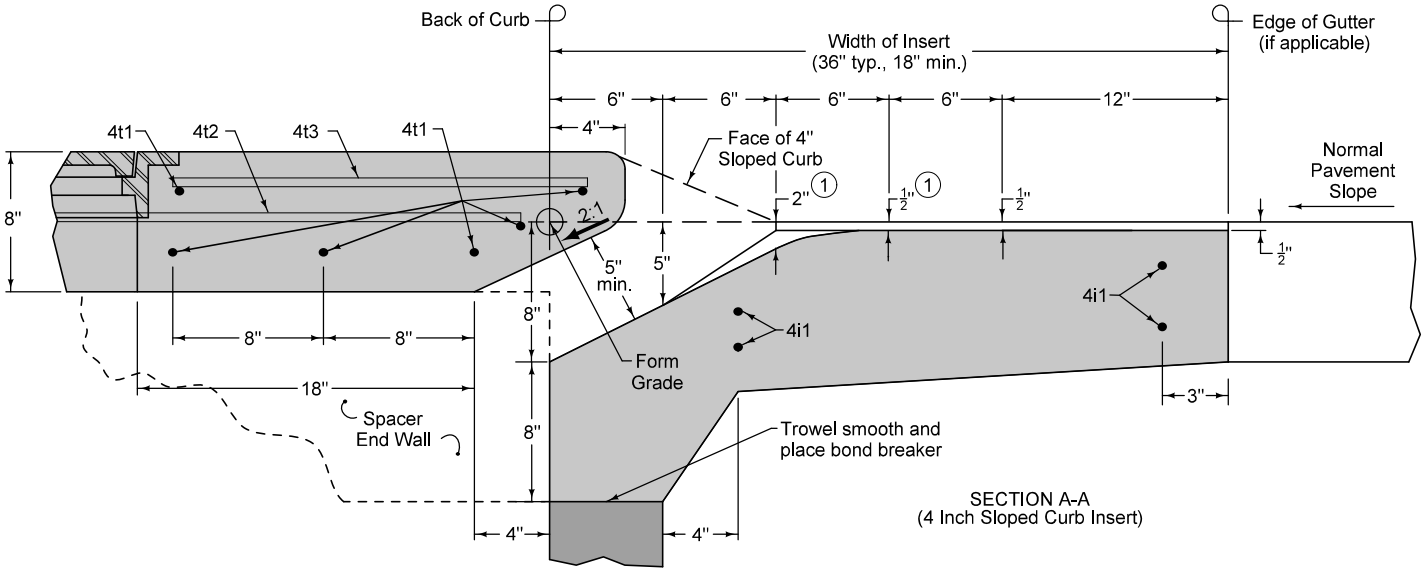
Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, SMALL BOX

FIGURE 6010.509 | SHEET 3 OF 3



SECTION A-A
(6 Inch Standard Curb Insert)



SECTION A-A
(4 Inch Sloped Curb Insert)

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

FIGURE 6010.510 | SHEET 1 OF 3

SUDAS | IOWADOT

REVISION
5 | 04-17-18

FIGURE 6010.510 | STANDARD ROAD PLAN

SW-510

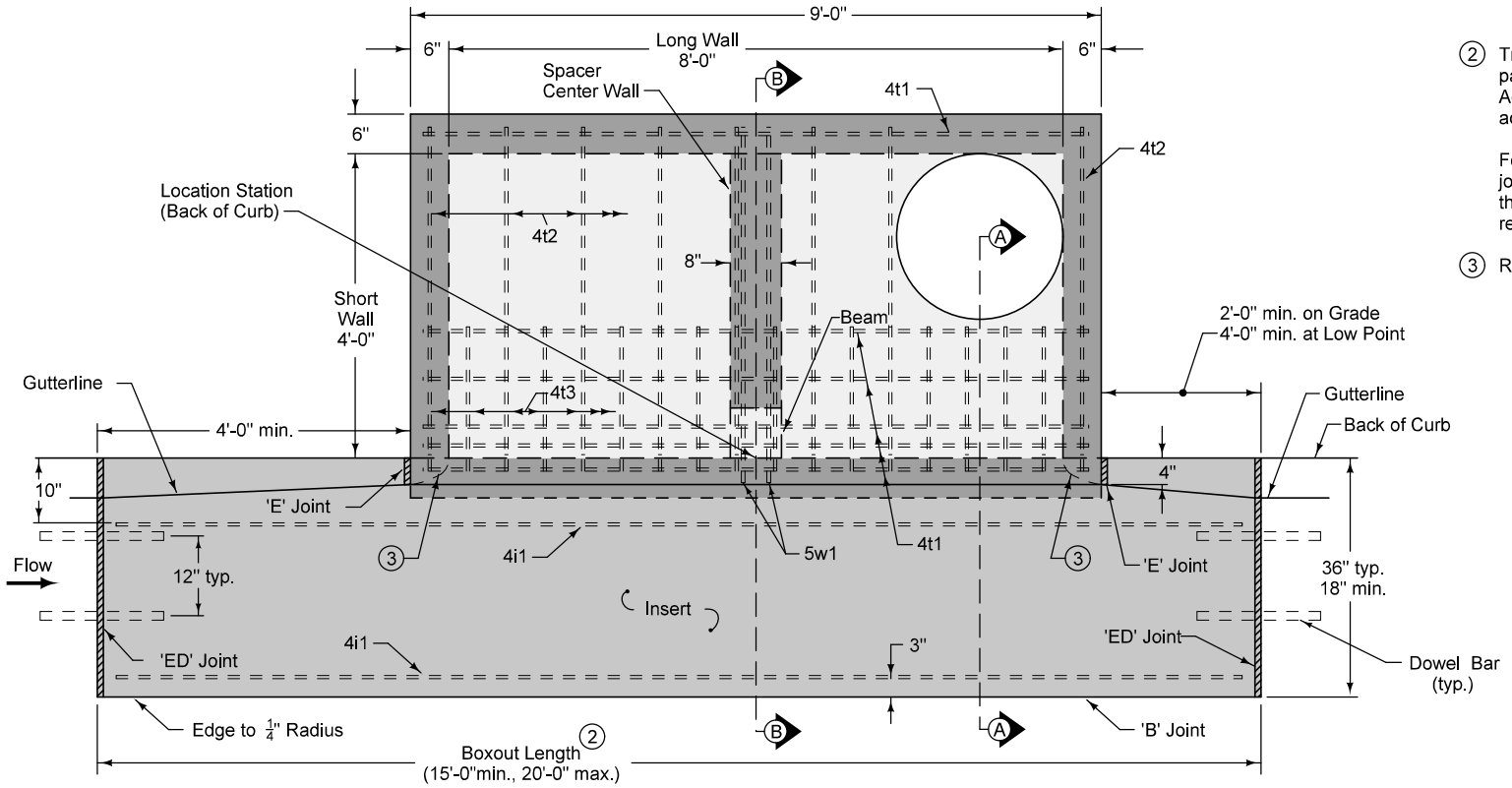
SHEET 1 of 3

REVISIONS: Added second Insert drawing to Include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

Paul D. Wigand
SUDAS DIRECTOR

Brian Smith
DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX



PLAN

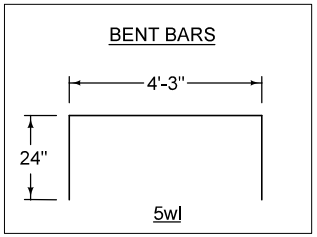
(2) Transverse joint spacing on new concrete pavement is controlled by the intake boxout. Adjust adjacent joint spacing as required to accommodate boxouts.

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

(3) Rounded shaping at inlet.

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

BENT BARS



5wl

SUDAS | IOWA DOT

REVISION 5 04-17-18

FIGURE 6010.510 | STANDARD ROAD PLAN | SW-510

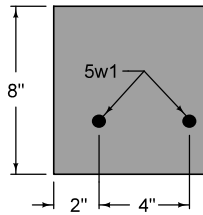
SHEET 2 of 3

REVISIONS: Added second insert drawing to include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

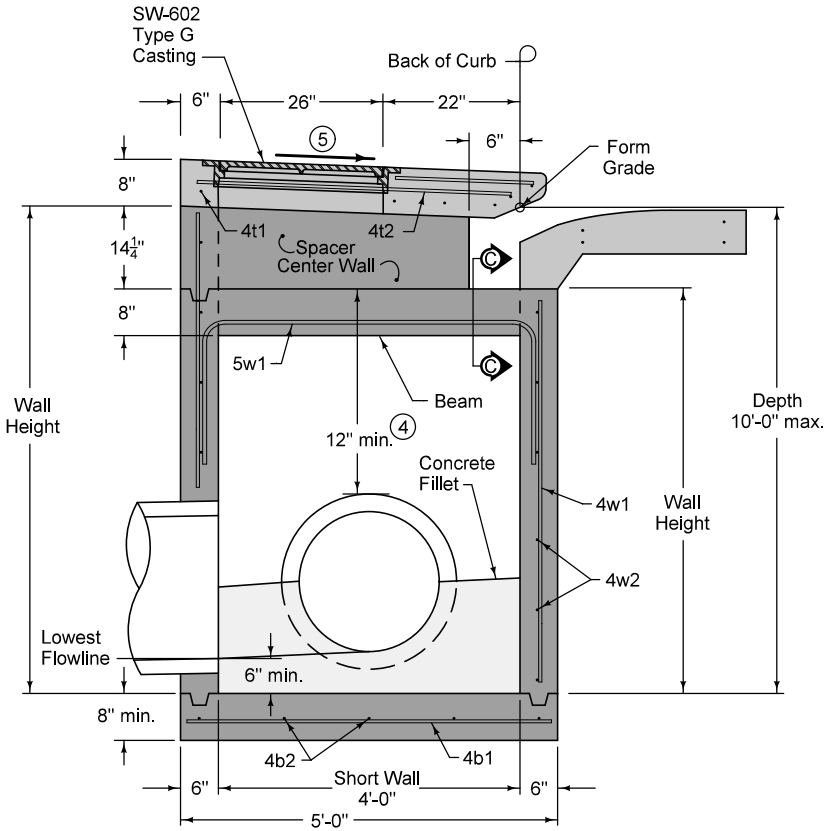
Paul D. Wigant, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX

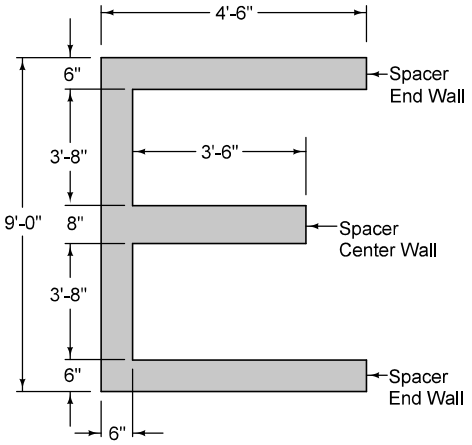
FIGURE 6010.510 | SHEET 2 OF 3



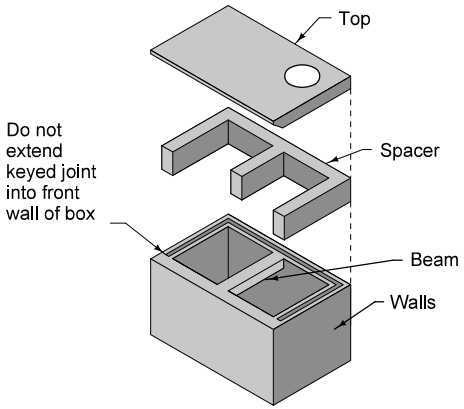
SECTION C-C



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	30"	36"
Long Wall	60"	66"

SUDAS | IOWADOT | REVISION 5 04-17-18

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

REVISIONS: Added second Insert drawing to Include 4" curb. Changed 'Invert' callout to 'Concrete Fillet'. Modified circle notes.

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

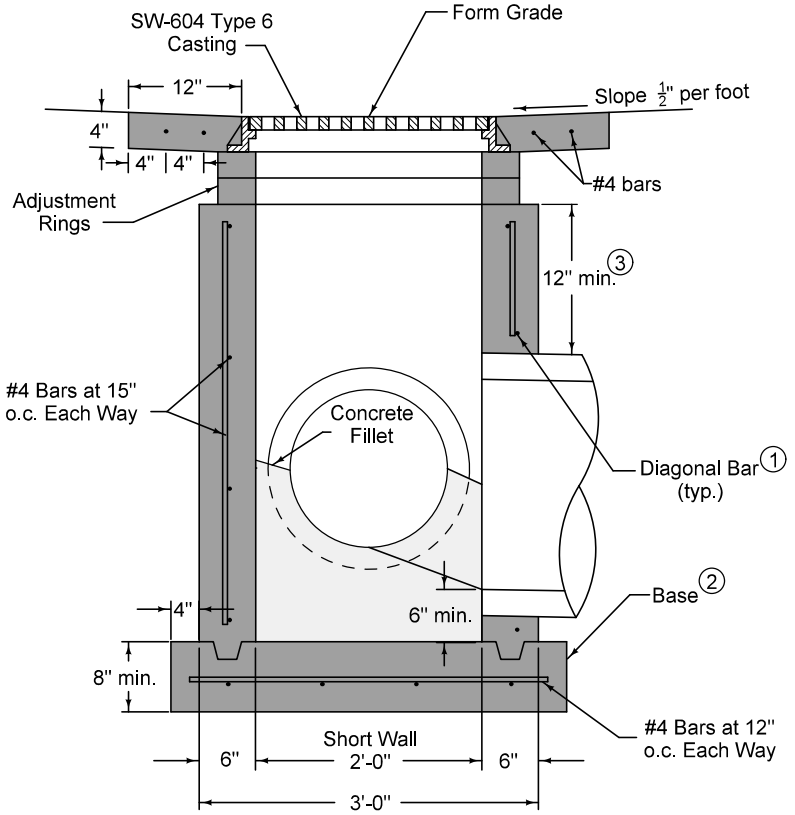
DOUBLE OPEN-THROAT CURB INTAKE, LARGE BOX

FIGURE 6010.510 | SHEET 3 OF 3

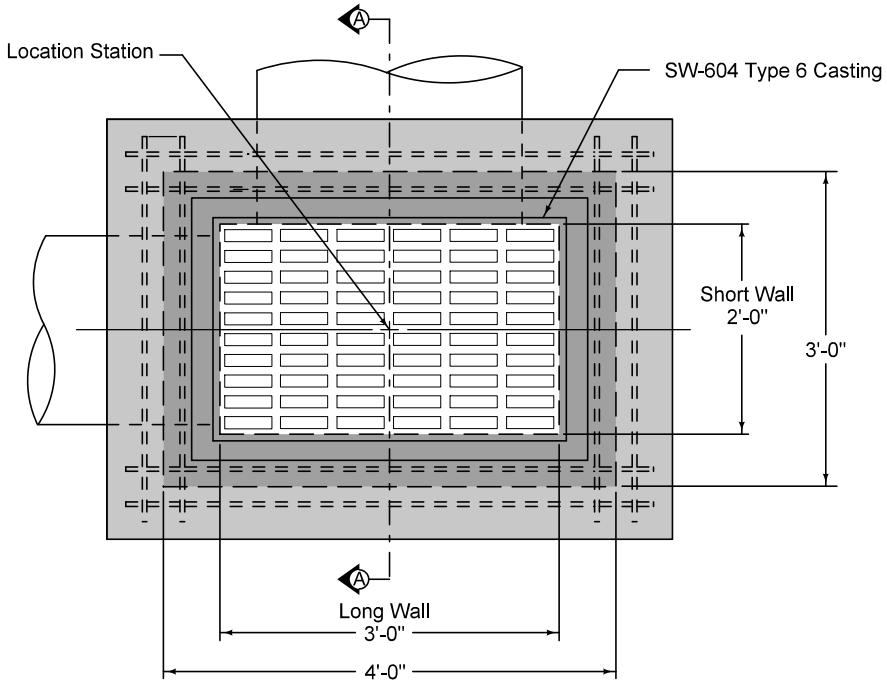
① Install four #4 diagonal bars at all pipe openings.

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

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

FIGURE 6010.511 | SHEET 1 OF 1

SUDAS | IOWA DOT

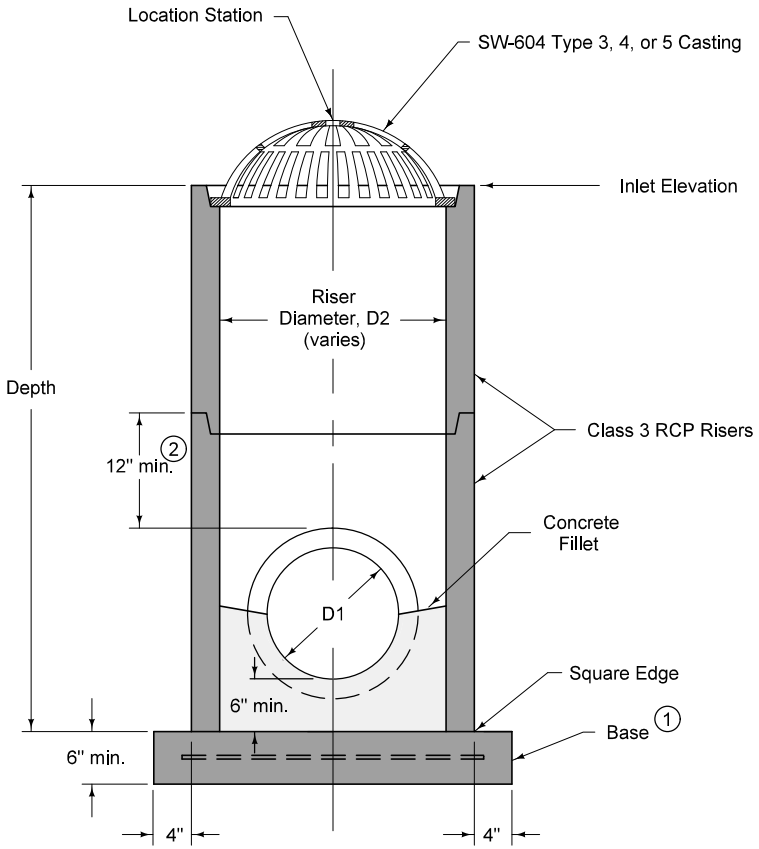
REVISION 1 04-17-18

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

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and Iowa DOT and SUDAS logo.

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

RECTANGULAR AREA INTAKE



TYPICAL SECTION

CASE 1

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

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

SUDAS | IOWA DOT

REVISION 3 04-17-18

FIGURE 6010.512 | STANDARD ROAD PLAN | SW-512

SHEET 1 of 2

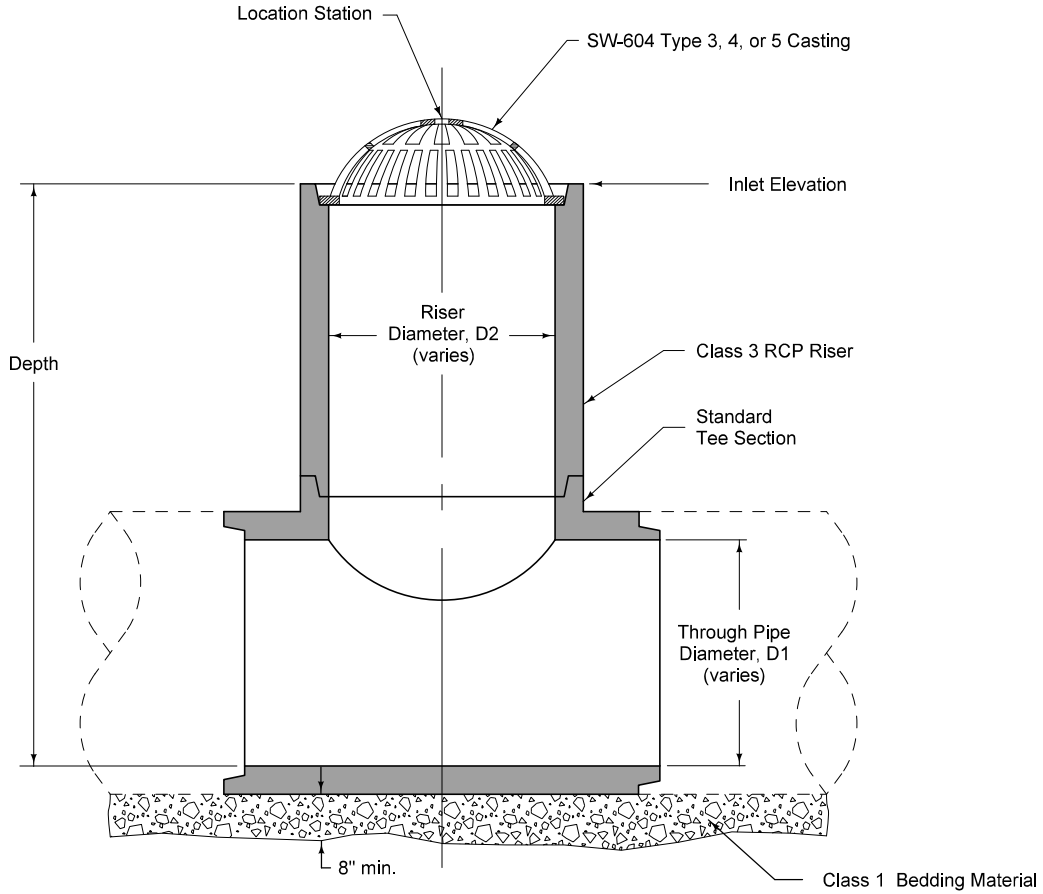
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

Paul D. Wigant, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

CIRCULAR AREA INTAKE

FIGURE 6010.512 SHEET 1 OF 2

③ Minimum riser diameter is 18 inches.



TYPICAL SECTION

CASE 2

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

FIGURE 6010.512 SHEET 2 OF 2

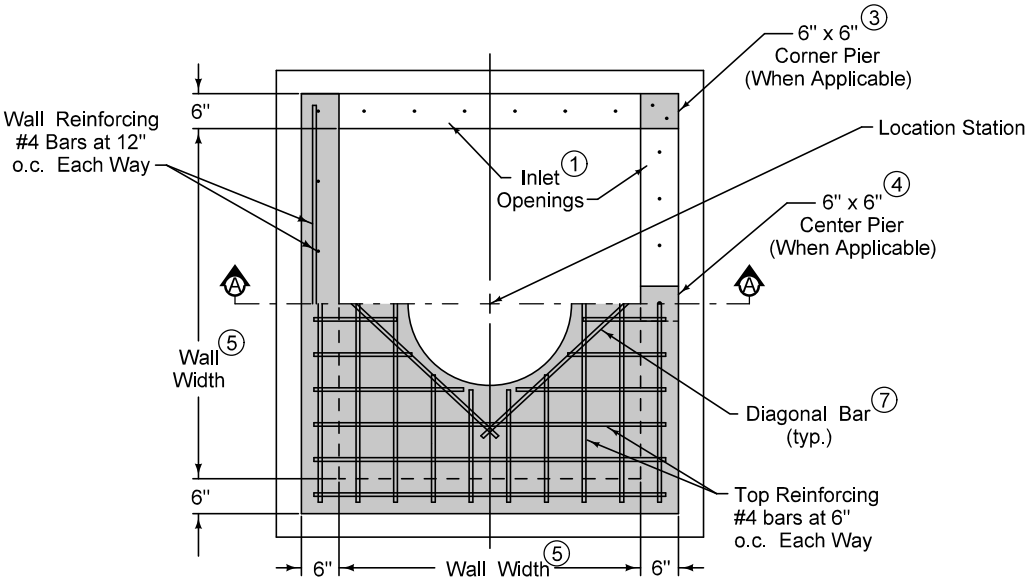
SUDAS | IOWA DOT | REVISION 3 04-17-18

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

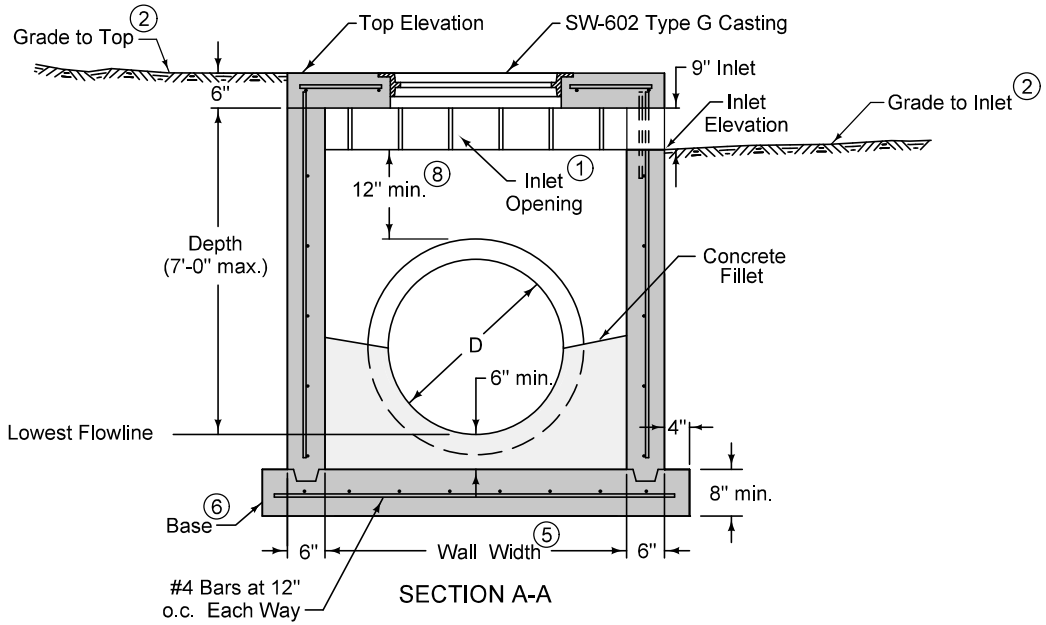
REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'.

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

CIRCULAR AREA INTAKE



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.

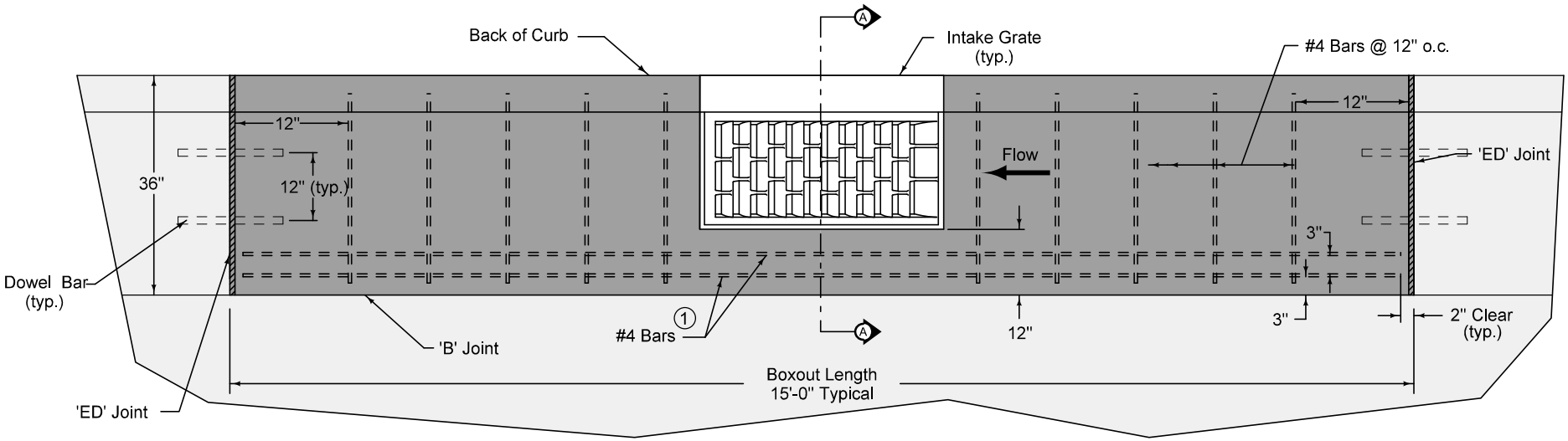
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.513	STANDARD ROAD PLAN	SW-513
		SHEET 1 of 1

REVISIONS: Changed 'Invert' callout to 'Concrete Fillet'. Updated line work and Iowa DOT and SUDAS logo.

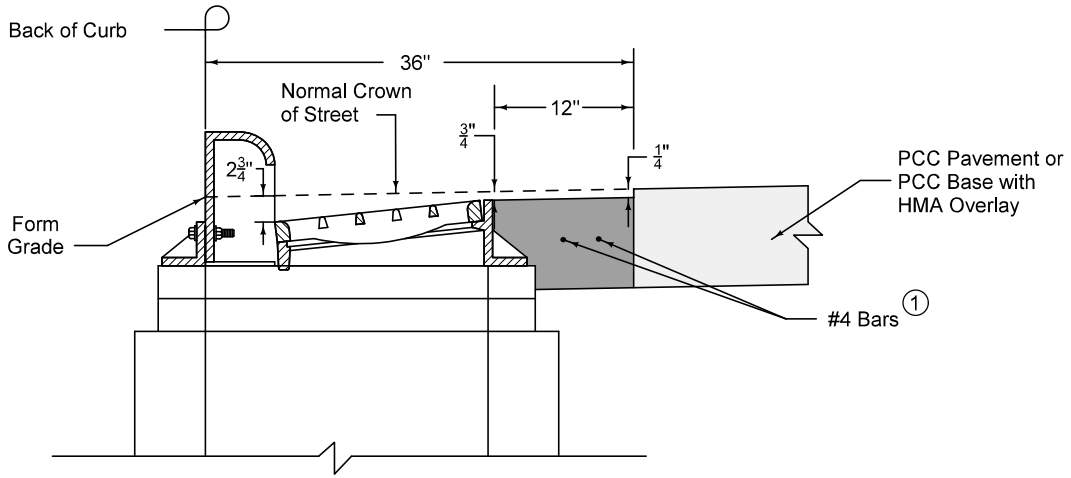
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

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.

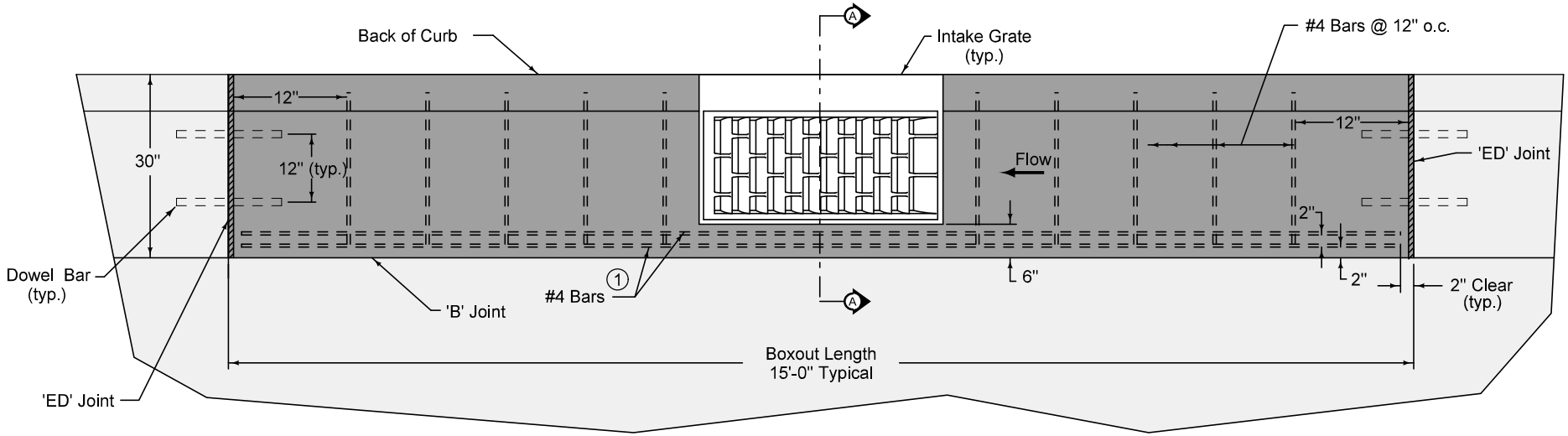
SUDAS	IOWA DOT	REVISION 1 04-17-18
FIGURE 6010.514	STANDARD ROAD PLAN	SW-514
		SHEET 1 of 3

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

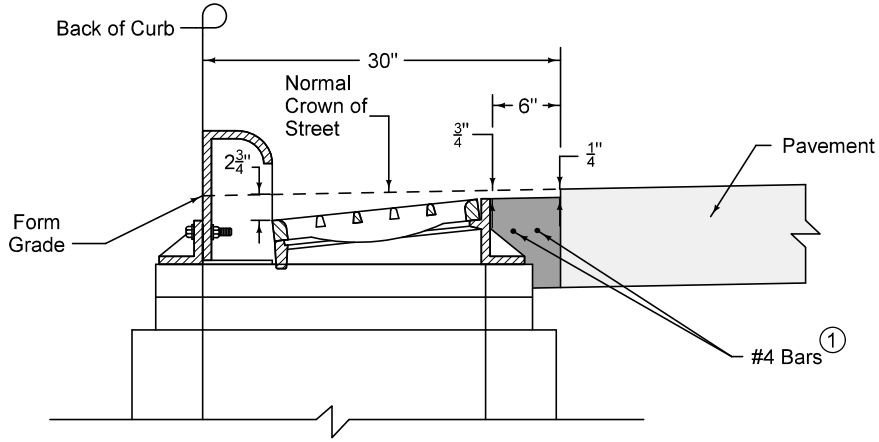
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

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.

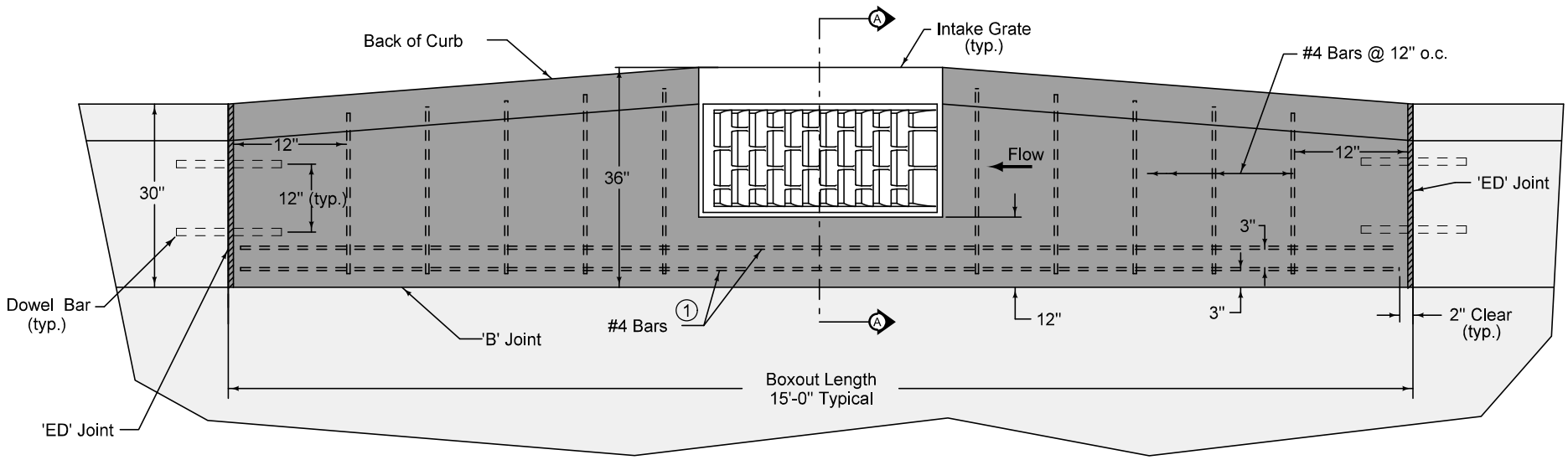
FIGURE 6010.514 SHEET 2 OF 3

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

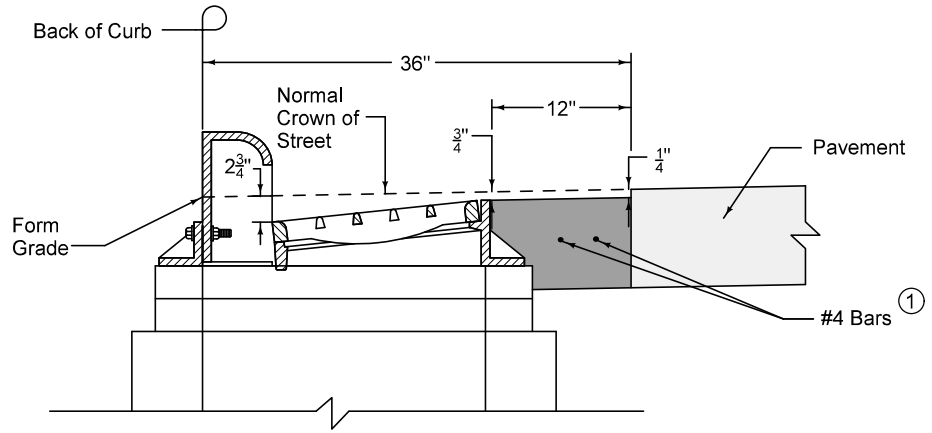
REVISIONS: Added dimension to back of grate. Updated line work and Iowa DOT and SUDAS logo.

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

BOXOUT FOR GRATE INTAKES



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

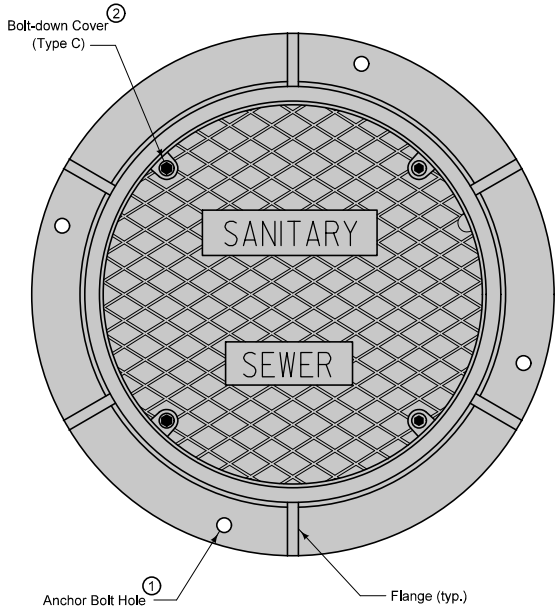
FIGURE 6010.514 SHEET 3 OF 3

TYPE A

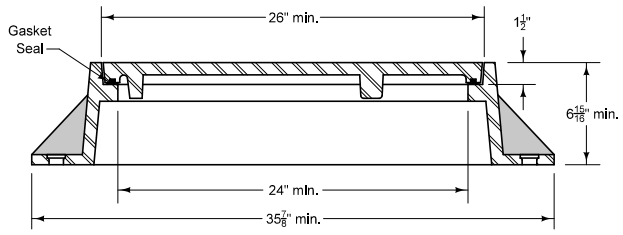
Two-piece fixed casting

TYPE C

Two-piece fixed casting with bolt-down cover ②



PLAN



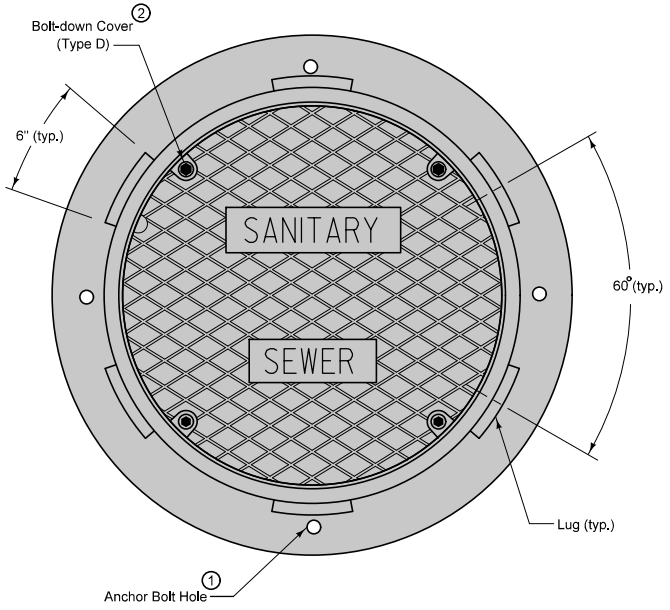
TYPICAL SECTION

TYPE B

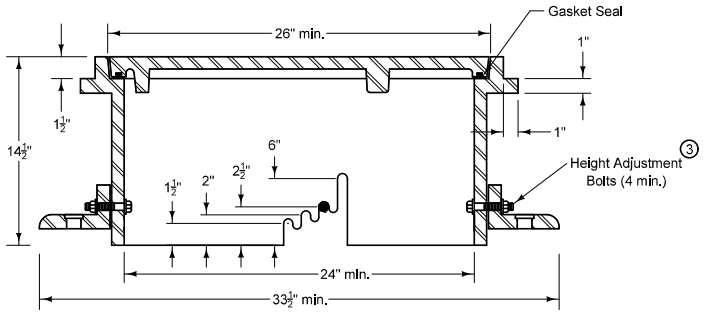
Three-piece floating casting

TYPE D

Three-piece floating casting with bolt-down cover ②



PLAN



TYPICAL SECTION

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

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

① When the contract documents require the frame to be attached to the structure, drill four $\frac{7}{8}$" diameter holes or slots, equally spaced around frame.

② If specified, furnish bolt down frame and cover with four $\frac{1}{2}$" x $2\frac{1}{2}$" stainless steel, hex head, recessed cap screws. Secure cover with screws, washers, and rubber gasket seals.

③ Set casting at proper grade using one of the adjustment slots. Remove bolts upon completion of paving.

SUDAS	IOWA DOT	REVISION	
		3	04-21-15
FIGURE 6010.601	STANDARD ROAD PLAN	SW-601	
		SHEET 1 of 1	

REVISIONS: Minor revision to depict adjustability of TYPE B and TYPE D casting. Modified circle note 3.

Paul D. Wigand
SUDAS DIRECTOR

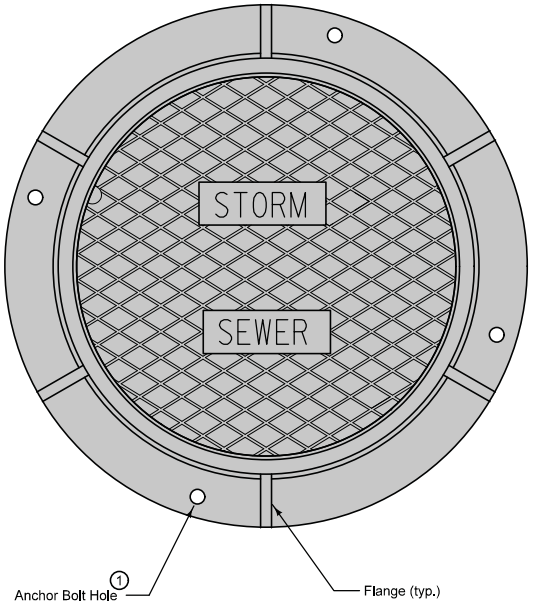
Brian Smith
DESIGN METHODS ENGINEER

CASTINGS FOR SANITARY SEWER MANHOLES

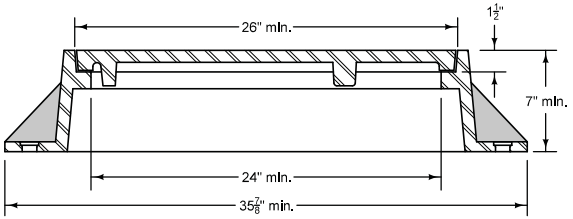
FIGURE 6010.601 | SHEET 1 OF 1

TYPE E

Two-piece fixed casting



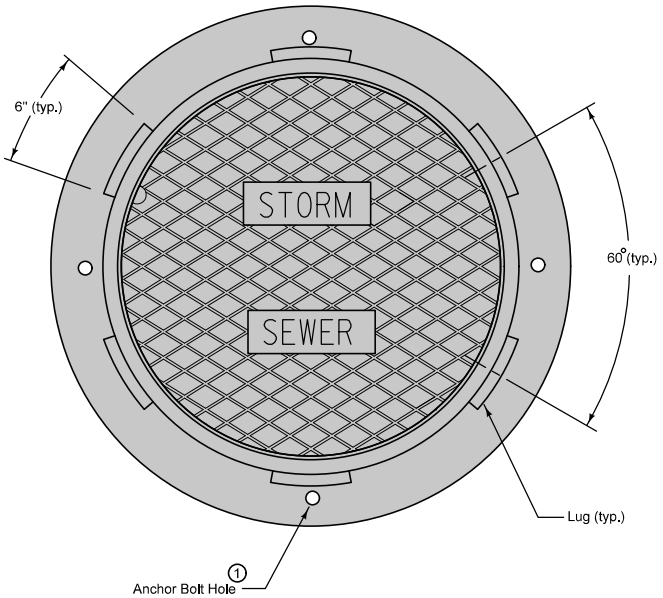
PLAN



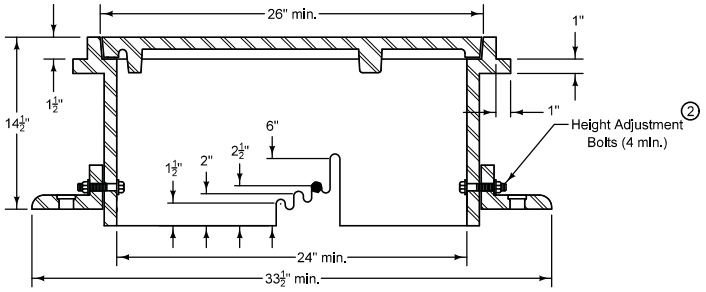
TYPICAL SECTION

TYPE F

Three-piece floating casting



PLAN



TYPICAL SECTION

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

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

1. When the contract documents require the frame to be attached to the structure, drill four $\frac{7}{8}$" diameter holes or slots, equally spaced around frame.
2. Set casting at proper grade using one of the adjustment slots. Remove bolts upon completion of paving.

SUDAS | IOWADOT

REVISION 3 04-21-15

FIGURE 6010.602 | STANDARD ROAD PLAN

SW-602

SHEET 1 of 2

REVISIONS: Revised three-piece casting configuration. Modified circle note 2.

Paul D. Wigant
SUDAS DIRECTOR

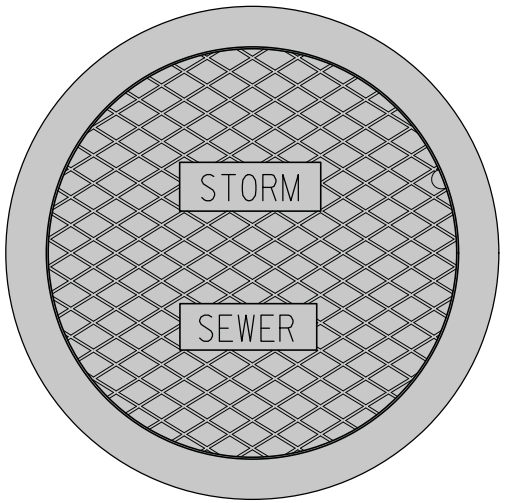
Brian L Smith
DESIGN METHODS ENGINEER

CASTINGS FOR STORM SEWER MANHOLES

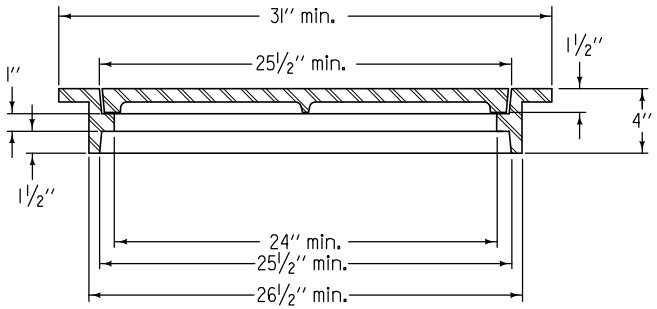
FIGURE 6010.602 | SHEET 1 OF 2

TYPE G

Two-piece fixed casting



PLAN



TYPICAL SECTION

FIGURE 6010.602 SHEET 2 OF 2

SUDAS | IOWA DOT | REVISION 3 04-21-15

FIGURE 6010.602 | STANDARD ROAD PLAN | SW-602 | SHEET 2 of 2

REVISIONS: Revised three-piece casting configuration. Modified circle note 2.

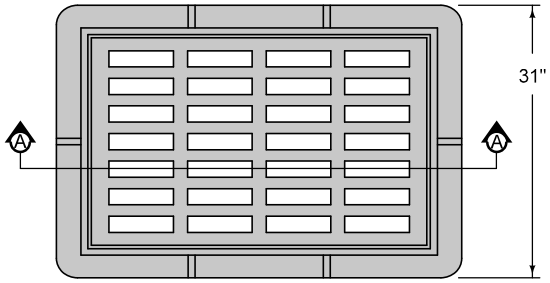
Paul D. Wigand, SUDAS DIRECTOR | Brian Smith, DESIGN METHODS ENGINEER

CASTINGS FOR STORM SEWER MANHOLES

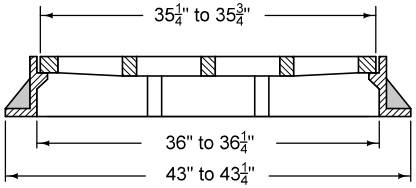
TYPE Q (1)

Driveway Grate

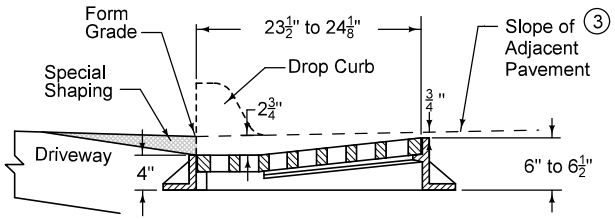
(Minimum open area 370 in^2)



PLAN



SECTION A-A

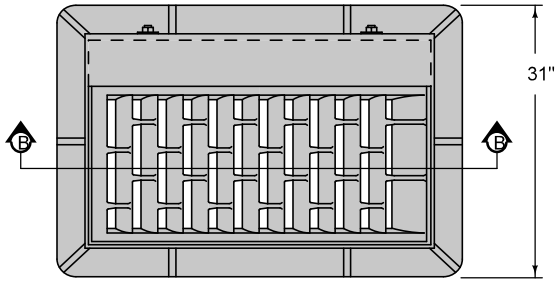


TYPICAL SECTION

TYPE R (2)

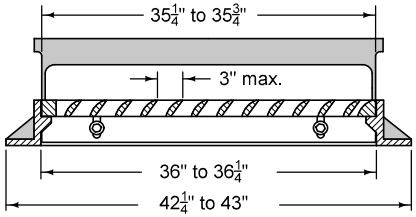
Curb Inlet Grade

(Minimum open area 180 in^2)

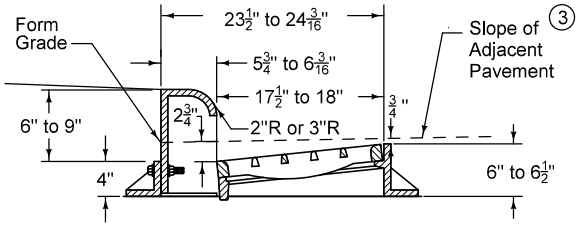


PLAN

Flow



SECTION B-B



TYPICAL SECTION

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

SUDAS	IOWA DOT	REVISION 5 04-17-18
FIGURE 6010.603	STANDARD ROAD PLAN	SW-603
		SHEET 1 of 2

REVISIONS: Added dimension on back of grate on page 1. Replace Iowa DOT and SUDAS logos.

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

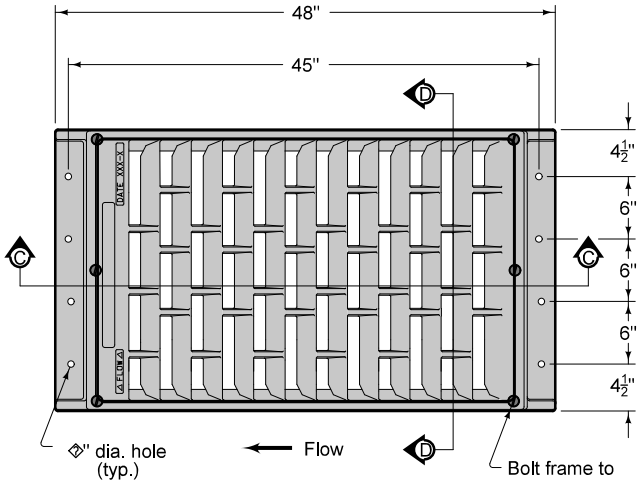
CASTINGS FOR GRATE INTAKES

FIGURE 6010.603 SHEET 1 OF 2

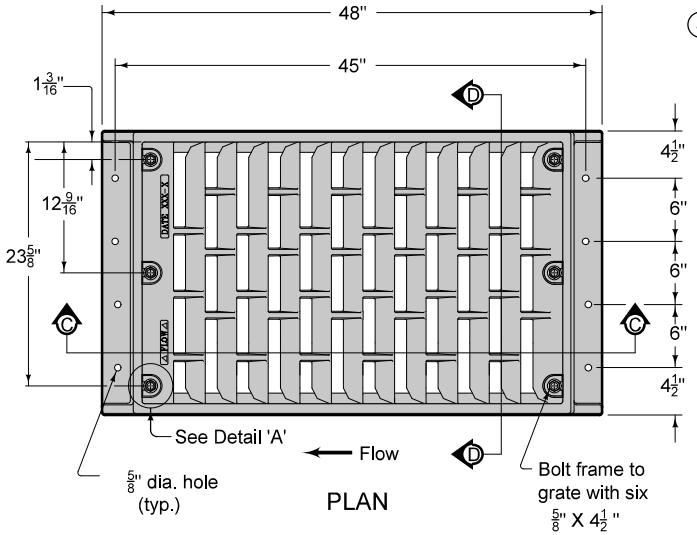
TYPE S ②④

Barrier Intake Grate

(Minimum open area 300 in^2)



PLAN

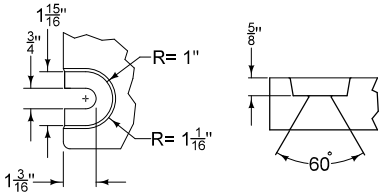


PLAN

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

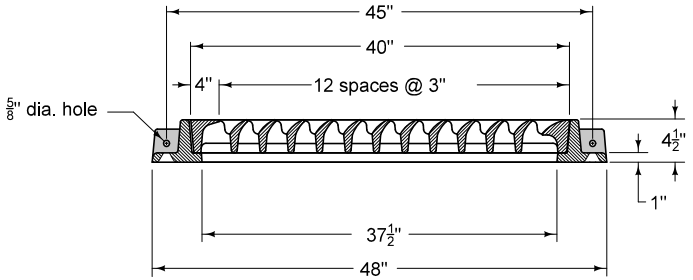
④ Use ductile iron frame castings meeting the requirements of ASTM A 536.

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

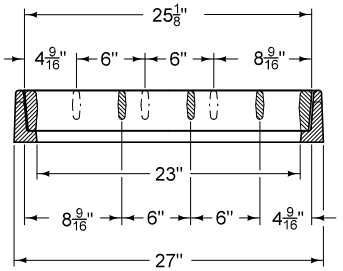


DETAIL'A'

Bolt Slot Detail



SECTION C-C



SECTION D-D

SUDAS	IOWA DOT	REVISION 5 04-17-18
FIGURE 6010.603	STANDARD ROAD PLAN	SW-603 SHEET 2 of 2

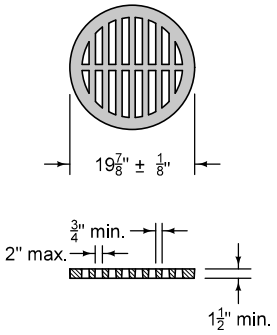
REVISIONS: Added dimension on back of grate on page 1. Replace Iowa DOT and SUDAS logos.

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

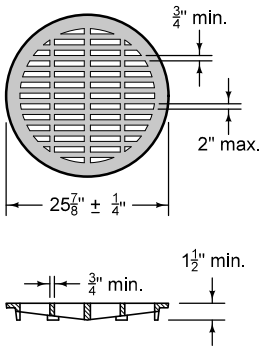
CASTINGS FOR GRATE INTAKES

FIGURE 6010.603 SHEET 2 OF 2

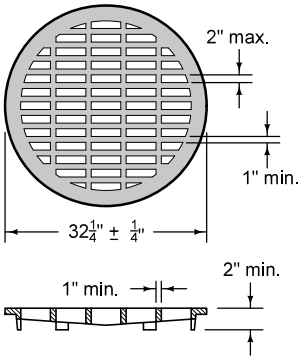
TYPE 4



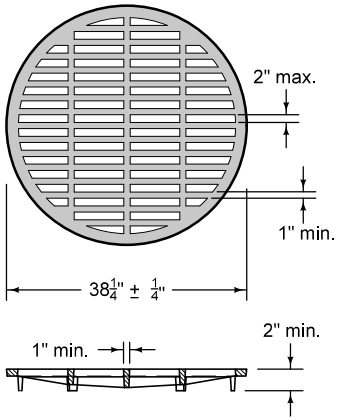
TYPE 4A
For Placement on 18" RCP



TYPE 4B
For Placement on 24" RCP

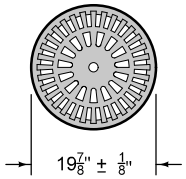


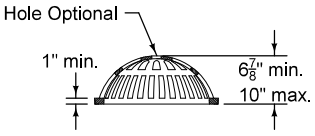
TYPE 4C
For Placement on 30" RCP



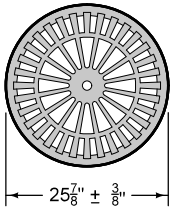
TYPE 4D
For Placement on 36" RCP

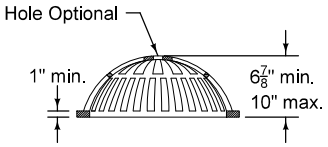
TYPE 3
(Light Duty)





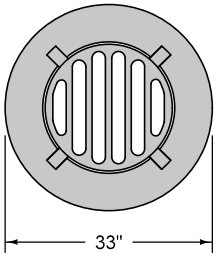
TYPE 3A
For Placement on 18" RCP





TYPE 3B
For Placement on 24" RCP

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



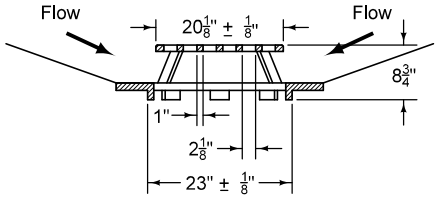


FIGURE 6010.604 SHEET 1 OF 2

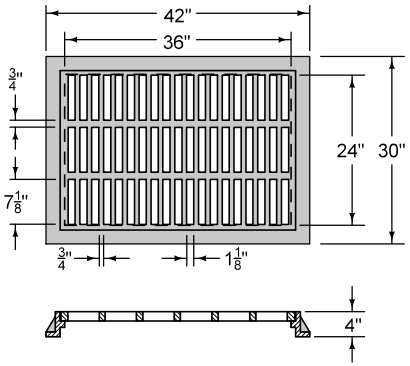
SUDAS	IOWA DOT	REVISION 2 04-17-18
FIGURE 6010.604	STANDARD ROAD PLAN	SW-604
		SHEET 1 of 2

REVISIONS: Replaced Iowa DOT and SUDAS logos.

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

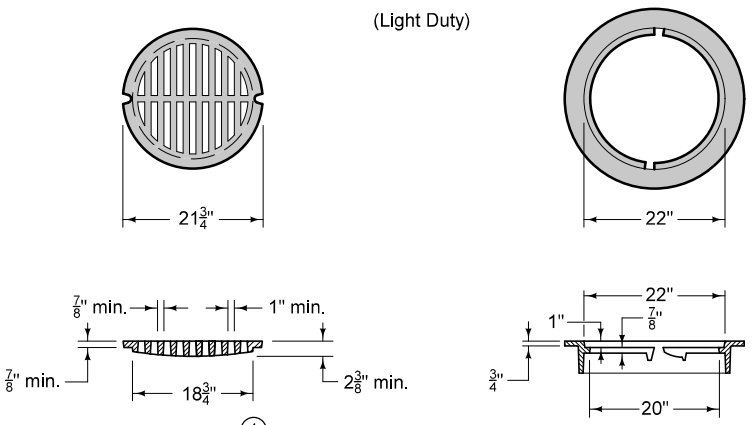
CASTINGS FOR AREA INTAKES

TYPE 6



TYPE 9

(Light Duty)



GRATE (1)

Minimum Weight = 85 lbs.

FRAME

Minimum Weight = 75 lbs.

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

FIGURE 6010.604 SHEET 2 OF 2

SUDAS	IOWA DOT	REVISION 2 04-17-18
FIGURE 6010.604	STANDARD ROAD PLAN	SW-604 SHEET 2 of 2

REVISIONS: Replaced Iowa DOT and SUDAS logos.

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

CASTINGS FOR AREA INTAKES

REHABILITATION OF EXISTING MANHOLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

Rehabilitation of existing manholes.

1.02 DESCRIPTION OF WORK

Rehabilitate existing manholes to waterproof and to prevent inflow and infiltration, to prevent corrosion, or to reestablish the structural integrity of the manhole. Includes construction of structural liners, protective liners, and infiltration barriers.

1.03 SUBMITTALS

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

A. Concrete mix design, if required by the Engineer.

B. Catalog cuts of all mortar mixes, sealants, and liners.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Infiltration Barriers:

1. **Rubber Chimney Seal:**
   - **a. Measurement:** Each rubber chimney seal installed on an existing manhole will be counted.
   - **b. Payment:** Payment will be made at the unit price for each chimney seal.
   - **c. Includes:** Unit price includes, but is not limited to, all necessary compression or expansion bands and extension sleeves as necessary to complete chimney seal.

2. **Molded Shield:**
   - **a. Measurement:** Each molded shield installed on an existing manhole will be counted.
   - **b. Payment:** Payment will be made at the unit price for each molded shield.
   - **c. Includes:** Unit price includes, but is not limited to, sealant.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. **Urethane Chimney Seal:**
   a. **Measurement:** Each urethane chimney seal installed on an existing manhole will be counted.
   b. **Payment:** Payment will be at the unit price for each urethane chimney seal.

B. In-Situ Manhole Replacement, Cast-in-place Concrete:

1. **Measurement:** The vertical dimension of in-situ manhole replacement will be measured in feet from the lowest flowline to the top of the rim.

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

3. **Includes:** Unit price includes, but is not limited to, handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, and testing the manhole upon completion.

C. In-Situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner:

1. **Measurement:** The vertical dimension of in-situ manhole replacement with plastic liner will be measured in feet from the lowest flowline to the top of the rim.

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

3. **Includes:** Unit price includes, but is not limited to, handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, sealing at the frame and cover, sealing pipe penetrations as recommended by the manufacturer, and testing the manhole upon completion.

D. Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal

1. **Measurement:** The vertical dimension of manhole lining will be measured for depth in feet from the bottom of the lining to the top of the lining for each liner thickness specified.

2. **Payment:** Payment will be at the unit price per vertical foot for each liner thickness.

3. **Includes:** Unit price includes, but is not limited to, the handling of sewer flows during lining operations as required to properly complete the installation, and replacement of the existing casting with a new casting.

PART 2 - PRODUCTS

2.01 INFILTRATION BARRIER

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

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

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

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

Table 6020.01: Physical Properties

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

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

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

B. Concrete: 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	125 pcf
Set Time at 70° F ASTM C 403 Initial Set / Final Set	240 minutes / 440 minutes
Modulus of Elasticity ASTM C 469 24 hours / 28 days	180,000 psi / 1,150,000 psi
Flexural Strength ASTM C 293 24 hours / 28 days	650 psi / 800 psi
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
Compressive Strength ASTM D 695	16,800 psi
Flexural Strength ASTM D 790	13,900 psi
Tensile Strength ASTM D 638	12,400 psi
Hardness ASTM D 2240	68-72 Shore D
Heat Distortion ASTM D 648	220°F
Ultimate Elongation ASTM D 638	4.5 %
Adhesive Shear ASTM C 882	1,000 psi

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

PART 3 - EXECUTION

3.01 INFILTRATION BARRIER

A. Rubber Chimney Seal: Comply with Section 6010, 3.01.

B. Molded Shield: Comply with Section 6010, 3.01.

C. Urethane Chimney Seal: Use only when specified in the contract documents.

1. Prepare the surface according to the manufacturer's recommendations, including sandblasting, pressure washing, sealing leaks or gaps, and drying the surface.

2. Apply primer, prepare product, and brush-apply the seal to a minimum thickness of 175 mils, covering 2 inches above the bottom of the frame and the entire adjustment ring area to 3 inches below the bottom adjustment ring.

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

A. Preparation: Prepare according to the forming system manufacturer's recommendations, including the following:

1. Clean the existing surface to remove loose material and debris.

2. Remove existing steps that might interfere with the erection of the forms.

3. Control infiltration that may affect placement of concrete.

B. Installation: Install and test according to the forming system manufacturer's recommendations, including the following:

1. Place pipe extensions through the structure to maintain flow during installation.

2. Erect forms inside the manhole. Secure the assembled internal forms to prevent shifting and to provide sufficient stiffness and strength to prevent collapse.

3. Install a plastic liner when specified.

4. Seal the forms at the bottom of the manhole to ensure the concrete does not enter the sewer.

5. Carefully place concrete between the forms and the existing manhole walls. Place concrete from the bottom up to prevent segregation of concrete.

6. Consolidate concrete as required to fill all pockets, seams, and cracks within the existing manhole wall.

7. Remove the forms when the concrete has cured sufficiently.

8. Weld and test joints if a plastic liner is installed.

9. Apply a sealing strip around the circumference of the invert top where it meets the vertical wall and around all pipe penetrations to form a waterstop.

10. Overlay the invert top with concrete or high-strength mortar. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

3.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE (Continued)

11. Apply an epoxy lining to the invert top. Apply clean sand to the epoxy to create a non-slip surface.

12. Seal the plastic liner to the manhole casting and existing pipe stubs as recommended by the manufacturer.

13. Install new casting.

3.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL

A. Surface Preparation: Prepare according to the manufacturer's recommendations, including the following:

1. Wash the interior with a high-pressure washer.

2. Plug active leaks with the appropriate sealing material.

B. Mortar Application: Apply according to the manufacturer's recommendations, including the following:

1. Apply with a rotating centrifugal casting applicator, beginning at the bottom of the manhole.

2. Retrieve the applicator head at the manufacturer's recommended speed to achieve the desired thickness.

3. Apply to the full required thickness utilizing multiple passes as necessary. Minimize the time between passes so subsequent passes are cast against fresh mortar.

4. Verify thickness with a wet gauge at several locations to ensure proper depth.

5. Hand-apply high-strength mortar to the invert surface. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

C. Epoxy Seal Application: Seal according to the manufacturer's recommendations, including the following:

1. Apply with a rotating centrifugal casting applicator or airless sprayer onto the fresh mortar liner.

2. If the epoxy seal is applied more than 24 hours after application of the mortar liner, or if the mortar liner is contaminated, clean the liner and then apply the epoxy.

D. Finishing: Install a new casting.

3.04 CLEANING, INSPECTION, AND TESTING

Comply with Section 6030 for in-situ manhole replacement and centrifugally cast mortar lined rehabilitation.

END OF SECTION

CLEANING, INSPECTION, AND TESTING OF STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cleaning, inspecting, and testing sanitary sewer manholes.

B. Cleaning and inspecting storm sewer manholes, intakes, and other utility structures.

1.02 DESCRIPTION OF WORK

A. Clean, inspect, and test sanitary sewer manholes.

B. Clean and inspect storm sewer manholes, intakes, and other utility structures.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

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

A. Notify the Engineer at least 24 hours prior to performing testing.

B. The Engineer must be present to review testing procedures and record results.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

Cleaning, inspection, and testing of structures are incidental to construction of structures and will not be paid for separately.

PART 2 - PRODUCTS

None.

PART 3 - EXECUTION

3.01 CLEANING

A. Clean all manholes, intakes, and structures by removing sheeting, bracing, shoring, forms, soil sediment, concrete waste, and other debris.

B. Do not discharge soil sediment or debris to drainage channels or existing storm sewer or sanitary sewer system.

3.02 VISUAL INSPECTION

A. Examine structure for:

1. Damage.
2. Slipped forms.
3. Indication of displacement of reinforcement.
4. Porous areas or voids.
5. Proper placement of seals, gaskets, and embedments.

B. Verify that the structure is set to true line, grade, and plumb.

C. Verify structure dimensions and thicknesses.

3.03 REPAIR

Comply with Section 6010 for repairs.

3.04 SANITARY SEWER MANHOLE TESTING

A. General:

1. Use vacuum testing for sanitary sewer manholes, unless exfiltration testing is specified in the contract documents.
2. Conduct the final test after manhole construction is complete, all repairs and connections have been made, and the invert has been installed.

B. Vacuum Test:

1. Applicable only for new manholes isolated from connecting sewer lines.
2. Use manufactured vacuum test equipment meeting the Engineer's approval. Follow the equipment manufacturer's recommended procedures throughout, unless directed otherwise by the Engineer or these specifications.
3. Use extreme care and follow safety precautions during testing operations. Keep personnel clear of manholes during testing.
4. Seal all openings except manhole top access using pneumatic plugs rated for test pressures. Install plugs according to the test equipment manufacturer's recommendations.
5. Brace pipe inverts if backfill material has not been placed around connecting pipes.

3.04 SANITARY SEWER MANHOLE TESTING (Continued)

6. Install the vacuum tester head assembly on the manhole top access, and inflate the seal.

7. Evacuate the manhole to 5 psi or 10 inches mercury (Hg). Close the isolation valve and start the test. Record the starting time.

8. Maintain a vacuum in the manhole for the time indicated in the following table for the diameter and depth of manhole being tested.

9. Test failure is indicated by vacuum loss greater than 0.5 psi or 1 inch mercury (Hg) within the minimum test time indicated in the table below for the depth and diameter of the manhole being tested.

Table 6030.01: Minimum Vacuum Test Times for Various Manhole Diameters

Depth (feet)	Diameter (inches)				
	48	54	60	66	72
	Time (seconds)				
8	20	23	26	29	33
10	25	29	33	36	41
12	30	35	39	43	49
14	35	41	46	51	57
16	40	46	52	58	67
18	45	52	59	65	73
20	50	53	65	72	81
22	55	64	72	79	89
24	59	64	78	87	97
26	64	75	85	94	105
28	69	81	91	101	113
30	74	87	98	108	121

C. Exfiltration Test:

1. Testing may be performed in conjunction with sanitary sewer line testing. Comply with Section 4060.

2. Do not test by this method if water may potentially freeze during the test.

3. Plug the manhole inlet and outlet.

4. Fill the manhole with water to 2 feet above the outside top of the connecting pipe. If ground water is present, fill the manhole to no less than 2 feet nor more than 5 feet above the ground water level. Do not fill above the top of the standard barrel sections.

5. Mark the water level.

6. Allow water to stand in the manhole for 1 hour, then refill to the original water level and begin the test.

7. Determine the allowable drop in water level by using the equation given in Section 4060, 3.04. After 1 hour, measure the drop in water level.

8. Test failure is indicated by water loss greater than the maximum allowable calculated exfiltration.

3.05 TEST FAILURE

If testing fails, reseal the openings, repair the manhole, and retest. An alternate test method complying with these specifications may be used for a retest if desired.

END OF SECTION