# REVIEW OF INCONSISTENCIES BETWEEN SUDAS AND IOWA DOT SPECIFICATIONS

## Phase II: Implementation of Recommendations into SUDAS Specifications

**Final Report**
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## Background Summary:

In the 1990's, city, county, and utility agencies throughout central Iowa joined together to develop the Des Moines Metropolitan Standards and Specification Committee, with the goal of developing a unified set of design and construction standards that could be applied to work within these communities. The Urban Standard Specifications for Public Improvements were adopted in 1998. Soon thereafter, communities outside central Iowa began to realize the benefits and potential cost savings of utilizing the uniform specifications, and adopted them for their own use. The interest in the Urban Standard Specifications continued to grow. Eventually control and upkeep of the specifications was transferred to the Center for Transportation Research and Education at Iowa State University. CTRE developed the Statewide Urban Design and Specifications (SUDAS) program to expand the use of the specifications to a statewide basis. Under the SUDAS program, the original Des Moines Metropolitan Standards, have become the benchmark documents used in water main, sanitary sewer, storm sewer, and other urban items of work across the State of Iowa.

The DOT has expressed an interest in improving its Standard Specifications to include items of work typically associated with construction in urban areas. Rather than duplicating work already performed in the development of the SUDAS Specifications, the DOT desired to either reference or model new specifications after portions of the SUDAS specifications. Prior to the DOT utilizing the SUDAS Specifications, changes need to be made to eliminate conflicts with the DOT's specifications. At the same time, the revised specifications need to remain specific enough so there is no ambiguity in how items are constructed, what the material requirements are, and how the items will be measured and paid for.

To begin this process, a research project was initiated in 2004 to identify the inconsistencies between the two sets of specifications and standard drawings, with the aim of updating both the DOT and SUDAS specifications. This project (now referred to as Phase 1) compared the following areas:

- Definitions and abbreviations
- Bid items, measurement, and payment
- Construction methods and materials
- Standard drawings.

Both specifications were also examined to identify references to the contractual provisions portions of the documents (Division I of SUDAS and Division 11 of the DOT). The elimination of such references would make it possible to utilize the means and methods of one set of specifications with the general conditions of another. The specifications were also examined to determine areas of overlap and items of work covered by one and not the other.

Comparisons were made in 2005 and 2006, with a final report issued in May 2006. Since that time, both agencies have begun steps to implement the Phase 1 recommendations. SUDAS has rewritten and re-issued their Division 1, General Provisions and Covenants, incorporating the recommendations of the Phase 1 project. The Iowa DOT is currently in

the process of rewriting its entire specification manual and will be incorporating many of the revisions recommended in the Phase I report.

A second phase of this project was initiated in the fall of 2006 (now called Phase 2). This project proposed to implement the recommendations from Phase 1 for selected sections of the technical specifications and standard drawings, and incorporate them into the SUDAS specifications. Phase 2 focused on revising those areas identified by the Phase 1 committee as being the highest priority for the DOT's successful utilization of the SUDAS Specifications. These areas included: trench and backfill, trenchless construction, storm and sanitary sewers, water mains, manholes, intakes, sidewalks, recreation trails, and driveways.

The results of this project are contained within this report.

## Project Objectives:

The current version of the SUDAS Specifications will be revised to accommodate the DOT's utilization of SUDAS. The revisions to the SUDAS Specifications will be based upon the recommendations from Phase 1. In some instances, the recommendations will require reorganization of portions of the SUDAS Specifications.

Upon incorporation of the Phase 1 recommendations, each applicable Division of the SUDAS Specifications will be updated into the active-imperative style, utilizing the 3-part specification format currently utilized by SUDAS.

Review and update the following SUDAS Divisions updated as described.

1. **Division 3: Trench, Backfill, and Trenchless**
   Re-examine the bid items compared during Phase 1, including items for Class 20 Excavation, rock excavation, overexcavation and trench stabilization, and jacked pipe. Review pipe materials, allowed by the DOT, and consider for inclusion in the SUDAS Specifications. Revise all bid items into a three-part measurement, payment, and incidental format.

   Relocate excavation and backfill requirements, related to intakes and manholes, to Division 6 (Structures for Sanitary and Storm). Remove references to Class 20 excavation the SUDAS Specifications. Develop revisions based upon the recommendations from Phase 1 and incorporate them into the specifications to accommodate the DOT's utilization of Division 3 of SUDAS.

2. **Division 4: Sewers and Drains**
   Reexamine the bid items compared during Phase 1, including items for sanitary and storm sewer, testing, and other related items. Revise all bid items into a three-part measurement, payment, and incidental format. Incorporate recommended changes into the text.

   Remove the SUDAS specifications for pipe culverts and subdrains from the storm sewer section of SUDAS in order to eliminate conflicts with the DOT. Place the specifications for pipe culverts and subdrains in their own section of SUDAS Division 4. Pay particular attention to the different terminology used between the DOT and SUDAS Specifications (for example Class III pipe in SUDAS is 2000D pipe in the DOT Specifications). Develop and incorporate revisions into the specifications to accommodate the DOT's utilization of Division 4 of SUDAS.

3. **Division 5: Water Main and Appurtenances**
   Compare the specifications revised by SUDAS staff against the recommendations from the Phase 1 project to ensure all inconsistency issues have been addressed, and that the bid items are properly updated.

4. **Division 6: Structures for Sanitary and Storm**
   Reexamine the bid items compared in Phase 1, including items for manhole and intake structures, and other related items. Revise all bid items into a three-part measurement, payment, and incidental format.

   Manholes and intakes, although separated into different specification sections, are generally constructed in a similar manner. Therefore, combine the manhole, intake, and structural concrete specifications into one all-encompassing, more concise, section to eliminate conflicts with the DOT's structural concrete specifications section.

   Develop and incorporate revisions into the specifications, based upon the recommendations from Phase 1, to accommodate the DOT's utilization of Division 6 of SUDAS.

5. **Section 7030: Recreational Trails, Sidewalks, and Driveways**
   Reexamine the bid items compared during Phase 1, including items for sidewalks, paved driveways, recreational trails, and curb ramps, along with other related items. Revise all bid items into a three-part measurement, payment, and incidental format.

   Expand the driveway specifications to include granular surfacing.

   Develop revisions and incorporate into the specifications, based upon the recommendations of Phase 1, to accommodate the DOT's possible future utilization of Section 7030.

6. **Standard Drawings**
   Reexamine the comparisons between SUDAS figures and DOT Standard Road Plans, for those specification sections listed above.

   Revise the SUDAS figures to a new format that more closely resembles the DOT Standard Road Plans. Eliminate conflicts identified during Phase 1 and update figures to accommodate the DOT's utilization of SUDAS figures.

## Review Process:

Each of the specification sections was revised in a similar manner. The process would begin with Snyder and Associates staff reviewing the existing specifications and the conflicts identified during the Phase I project. Snyder would then develop a plan for revising the specifications to eliminate these conflicts. For some of the specification sections, this required a complete restructuring and rewrite of the specifications.

Each of the revised specifications sections underwent a number of drafts before being presented to the committee for review. During the revision process, questions inevitably arose which required the consideration of the review committee. These questions were noted in the revised specifications for eventual discussion with and input from the review committee.

The final draft of the revised specifications sections was then presented to the committee for review and comment. The committee and Snyder staff reviewed each of the specifications section by section. Invaluable feedback was provided by the review committee. Through their input, additional changes were recommended and incorporated into the revised specification sections.

During the review period for a particular specification section, Snyder staff would begin the revisions to the SUDAS figures related to the specifications under review. New drafting standards were developed for SUDAS figures which are similar to the Iowa DOT's Standard Road Plans. During each figure's update, any errors were corrected and the language within the figure was revised to comply with the new specifications.

After completion of the specification review, the committee then had the opportunity to review and comment on the figures for that section.

The committee's recommended changes to the updated specifications and figures were incorporated and presented to them for final approval before moving on to the next specification section.

After receiving final approval from the review committee, the specifications and figures were presented to the SUDAS District Committees and Board of Directors for approval. The SUDAS committees typically provided additional comments that were incorporated into the final documents.

## Results:

This project produced new construction specifications that will be utilized by both the Iowa DOT and SUDAS. SUDAS will directly incorporate the final documents into the Urban Standard Specifications for Public Improvements. The Iowa DOT decided not to reference the SUDAS documents as originally planned, but will use the documents as a model for sections currently being developed for their new specifications book. This book is scheduled for release in 2009.

In addition to the specifications, new standard drawings were developed for each of the revised sections. Through discussions during the review meetings, the Iowa DOT and SUDAS have agreed to share many of these drawings. The Iowa DOT has agreed to develop a common title block that will be inserted into the drawing. The title block will contain SUDAS' logo and Figure number as well as the DOT's logo and Standard Road Plan number. Eventually, the responsibility for maintenance and upkeep of these drawings will be transferred to the Iowa DOT; however, SUDAS will retain jurisdiction over its original drawings.

After adoption by both agencies, both SUDAS and the Iowa DOT will have nearly identical construction specifications for urban construction items including trench and backfill, storm and sanitary sewer, water main, manholes, and intakes. This uniformity will ease frustration for both designers and contractors and provide for consistency between local and state projects.

## Project Summary:

The Phase 1 (TR-524) study identified inconsistencies between the Iowa DOT and SUDAS in Divisions 1, 2, 3, 4, 5, 6, 7, and 9 of the SUDAS specifications. With the work completed under the Phase 2 project and other related projects, a majority of the inconsistencies within the SUDAS manual have been addressed and eliminated through re-writes of the conflicting sections. The following table summarizes the status for the overall update of the SUDAS manual:

| *Division* | | *Status* | *Notes* |
|---|---|---|---|
| Division 1 | General Provisions | Update complete | Updates completed by SUDAS staff. |
| Division 2 | Earthwork | Update complete | Updates completed by SUDAS staff. |
| Division 3 | Trench & Trenchless | Update complete | Completed under TR-565 |
| Division 4 | Sewers & Drains | Update complete | Completed under TR-565 |
| Division 5 | Water mains | Update complete | Completed by SUDAS staff and under TR-565 |
| Division 6 | Structures for Sanitary & Storm | Update complete | Completed under TR-565 |
| Division 7 | Streets & Related Work | Partially complete | Section 7020 specs revised by SUDAS staff. Section 7030 completed under TR-565. Sections 7010, 7040, 7050, 7060, & 7070 remain. |
| Division 8 | Traffic Signals | In progress | Update in progress under TR-546 |
| Division 9 | Site Work | Partially complete | Sections 9010 and 9040 updated under TR-508. Sections 9020, 9030, 9050, 9060, 9070, and 9080 remain. |
| Division 10 | Utility Locations | No update proposed | This Division was not reviewed under Phase I |
| Division 11 | Demolition | No update proposed | This Division was not reviewed under Phase I |

As can be seen in the table, several sections reviewed under the Phase 1 project have not yet been revised and still contain inconsistencies with the Iowa DOT specifications manual.

Most of Division 7, Streets & Related Work, has not been addressed. This includes Section 7010, PCC Pavement; Section 7020, HMA Pavement; Section 7040, Pavement Repair and Rehabilitation; Section 7050, Asphalt Stabilization; Section 7060, Bituminous Seal Coat; and Section 7070, Emulsified Asphalt Slurry Seal. SUDAS staff is currently developing a plan to address the inconsistencies for concrete pavement within Section 7010. Separate research projects are proposed for the pavement maintenance practices in Sections 7050, 7060, and 7070. The only items in Division 7, identified in the Phase 1 project, that have not yet been assigned, are the figures in Sections 7010 and 7020, and the figures and specifications in Section 7040.

A majority of the specifications and figures in Division 9 also require updates to eliminate inconsistencies. This includes Section 9020, Sodding; Section 9030, Plant Material and Planting; Section 9050, Gabions and Rip Rap; Section 9060, Fencing; Section 9070, Retaining Walls; and Section 9080, Concrete Steps and Handrail.

## Recommendations

The Iowa DOT intends to publish a new specification manual in early 2009. Ideally, the remaining items identified during the Phase 1 project would be addressed before issuing this manual. In order to accomplish this, a third phase of this project may be proposed.

The third and final phase would address the remaining work that has not yet been completed or assigned to another project. The third phase would include the figures in Section 7010 and 7020, the specifications and figures in Section 7040, and all of the specifications and figures in Division 9 (with the exception of Sections 9010 and 9040).

In order to meet the Iowa DOT's schedule for review and publication, work on the remaining items needs to be completed by the fall of 2008. With the volume of work involved, the proposed Phase 3 project would need to begin in the spring or early summer of 2008 and move quickly to meet the completion deadline.

Completion of the work proposed under Phase 3 of this project and completion of other ongoing or proposed projects, will achieve the goal of eliminating significant conflicts between SUDAS and the Iowa DOT specifications. The result will be a pair of specifications that complement each other, do not conflict, and are easier for both designers and contractors to use. The benefit of these improvements is cost savings to the public through fewer change orders and less time spent comparing contract language.

# REVISED SPECIFICATIONS

# Division 3 Specifications
## Trench and Trenchless Construction

# Division 3
# Trench and Trenchless Construction

The title of this division was revised from “Trench Backfill and Trenchless” to “Trench and Trenchless Construction” to provide a better description of the division contents.

The original organization of Division 3 was retained. Section 3010 covers underground work in trenches and was renamed from “Trench and Backfill” to “Trench Excavation and Backfill.”

Section 3020, Trenchless Construction, covers underground work installed with trenchless construction methods.

Both sections were re-written to the imperative mood. Language redundant with Division 1 was removed. The bid items were converted to a 3-part format indicating the method of measurement, basis of payment, and incidental work for each item.

Section 3010 was re-organized. The soil properties table was split up and the properties for each soil type were shown under the section for each particular soil type (e.g. the material properties for Class III material were given under the section for Class III material).

The pipe bedding and backfill specification section was expanded to describe each backfill and bedding area and what types of materials and compaction requirements are required within that area.

All bid items were eliminated from Section 3020. New trenchless bid items were established within each of the applicable sections (storm sewer, sanitary sewer, and water main).

# Summary of Changes to Section 3010
# Trench Excavation and Backfill

| | Location | Comments |
|---|---|---|
| 1 | Section Title | Changed Title from "Trench and Backfill" to "Trench Excavation and Backfill" |
| 2 | Part 1 | Updated to eliminate redundancy with Division 1 |
| 3 | 1.08, A | *General*: Provided a more detailed list of what items are incidental to the utility line being installed. Clarified that adjustment of the moisture content of excavated material was incidental. |
| 4 | 1.08, C | *Trench Foundation:* replaced previous bid item "Over-Excavation and Trench Bottom Stabilization." Clarified that overexcavation of unstable materials was incidental to the trench foundation material. |
| 5 | 1.08, D | *Replacement of Unsuitable Backfill Material:* Replaced previous bid item "Unsuitable Backfill." Clarified that the item was for replacement of unsuitable material. |
| 6 | 1.08, E | *Special Pipe Embedment or Encasement:* Created a new bid item for concrete cradles and arches and encasement with concrete, flowable mortar, or CLSM. |
| 7 | 1.08, F | *Trench Compaction Testing:* Made compaction testing a bid item to conform with the recently rewritten earthwork section (2010). Embankment compaction testing is a bid item when it is the contractor's responsibility. Normally the Jurisdictions responsibility unless otherwise stated. Bid item is lump sum. |
| 8 | Old 1.08, B | *Open cut Casing Pipe Installation:* Item was deleted. The sanitary, storm, and water main sections not have separate bid items for installation of those utilities in a casing pipe. |
| 9 | Old 1.08, D | *Culvert Excavation:* Item was deleted. Previous item was for payment of excavation related to the installation of a culvert (Class 20). In urban areas, culverts are installed in the same manner as storm sewers and the related excavation should be incidental as well. |
| 10 | Old 1.08, F | *Structure Removal:* Item was deleted. Section 2010 currently contains a bid item for structure removal. This bid item was redundant. |
| 11 | Old 1.08, G | *Surfacing Removal and Replacement:* Item was deleted. This "bid item" made removal and replacement of pavement (street, driveways, and sidewalks) incidental to the utility being installed. This is inappropriate for most projects. |
| 12 | Old 1.08, H | *Abandoned Utilities:* This item was deleted. The previous bid item made removal of abandoned utilities in the work zone incidental. New bid items were added to the Storm, Sanitary, and Water Main sections to pay for the removal of such items. |
| 13 | Part 2 | Entire section was re-organized for clarity |
| 14 | 2.01, A | *Standard Trench Excavation:* Section re-written to better define what materials constitute Suitable, Unsuitable, and Topsoil. |
| 15 | 2.02-2.04 | *Bedding and Backfill Materials:* Section was re-organized. Material requirements were not changed. |
| 16 | 2.05 | *Special Pipe Embedment and Encasement Material:* The flowable mortar specification was revised to follow the Iowa DOT specifications. |
| 17 | Old 2.11, A | *Concrete Supports*: Deleted reference and figures dealing with special concrete supports over utilities. These are special situations that should be addressed on a project by project basis. |

# Summary of Changes to Section 3010
# Trench Excavation and Backfill

| | | |
|---|---|---|
| 18 | Old 3.02 J | *Structure Excavation:* Moved information regarding structure excavation to Division 6. |
| 19 | 3.01 | *Trench Excavation:* Statement was added requiring contractor to have trench excavations greater than 20 feet deep designed by a professional Engineer. |
| 20 | 3.03 | *Trench Protection:* This section was previous titled Sheeting, Shoring and Bracing and contained significantly more information (much of it on sheeting). Since the OSHA regulations cover trench safety, much of this section was eliminated to avoid any conflicts. |
| 21 | 3.04 | *Dewatering:* Required the contractor to install sediment control for water discharged directly from a trench. |
| 22 | 3.05 | *Pipe bedding and backfill:* Section was expanded to include some of the requirements previously indicated only on the figures |
| 23 | 3.05, A | *General:* Contractor is required to dry or moisten excavate material to achieve the required moisture content for backfill. |
| 24 | 3.05, B | *Pipe Bedding:* Required that Class I bedding material be "moderately consolidated" by slicing.<br>Provided direction for bedding of water main and force main pipes in natural soils. |
| 25 | 3.05, C | *Haunch Support:* Required that Class I bedding material be "moderately consolidated" by slicing. Suitable backfill materials must be compacted to 90% of Standard Proctor density. |
| 26 | 3.05, D | *Primary and Secondary Backfill:* Required that granular material be compacted to minimum 65% relative density. Suitable materials must be compacted to 95% standard Proctor. |
| 27 | 3.05, E | *Final Trench Backfill:* Required 65% relative density for granular, and 95% Proctor for other suitable. |
| 28 | 3.06 | *Testing:* summarized the requirements for testing when testing is the contractor's responsibility. Frequency and location is the same as previous specification. |
| | | |

# TRENCH EXCAVATION AND BACKFILL

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Trench Excavation for Pipe Systems

B. Trench Foundation Stabilization

C. Pipe Bedding and Backfill

### 1.02 DESCRIPTION OF WORK

A. Excavate trench for pipe installation.

B. Stabilize trench and install pipe bedding materials.

C. Place backfill material in trench.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants, as well as the following:

A. Gradation reports for bedding materials.

B. Results of required testing.

C. Dewatering plan.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

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

1. Standard trench excavation.

2. Removal and disposal of unsuitable backfill material encountered during standard trench excavation.

3. Removal of abandoned private utilities encountered during trench excavation.

4. Furnishing and placing granular bedding material.

5. Placing and compacting backfill material.

6. Dewatering.

7. Sheeting, shoring, and bracing.

8. Adjusting the moisture content of excavated backfill material to the range specified for placement and compaction.

**B. Rock Excavation:**

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

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

**C. Trench Foundation:**

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

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

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

**1.08 MEASUREMENT AND PAYMENT (Continued)**

**D. Replacement of Unsuitable Backfill Material:**

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

2. Payment: Payment will be at the unit price for the quantity of backfill material furnished.

3. Includes: Unit price includes, but is not limited to, furnishing, hauling, and placing backfill material.

**E. Special Pipe Embedment or Encasement:**

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

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

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

**F. Trench Compaction Testing:**

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

2. If the contract documents specify that the Contractor is responsible for trench compaction testing performed by an independent testing laboratory hired by the Contractor, measurement and payment will be as follows:
   a. Measurement: Measurement will be a lump sum.
   b. Payment: Payment will be at the unit price for the lump sum.

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

## PART 2 - PRODUCTS

### 2.01 MATERIALS EXCAVATED FROM A TRENCH

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

1. Suitable Backfill Material: Class II, Class III, Class IVA, or Class IVB as defined in Section 3010, 2.02.

2. Unsuitable Backfill Material: Includes, but is not limited to, the following materials:
   a. Soils not classified as suitable backfill material, as defined in Section 3010, 2.02.
   b. Individual stones or concrete chunks larger than 6 inches, and averaging more than one per each cubic foot of soil.
   c. Frozen materials.
   d. Stumps, logs, branches, and brush.
   e. Trash, metal, or construction waste.
   f. Soil in clumps or clods larger than 6 inches, and without sufficient fine materials to fill voids during placement.
   g. Environmentally contaminated soils.
   h. Materials removed as rock excavation or over-excavation.

3. Topsoil: Class V material. Comply with Section 3010, 2.03.

**B. Rock Excavation:** Boulders or sedimentary deposits that cannot be removed from the trench without continuous use of pneumatic tools or blasting.

**C. Over-excavation:** Excavation of unsuitable or unstable material from the trench below the pipe zone, comply with Figure 3010.1.

### 2.02 BEDDING AND BACKFILL MATERIAL

**A. Class I Material:**

1. Crushed stone complying with the following gradation:

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

## 2.02 BEDDING AND BACKFILL MATERIAL (Continued)

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

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

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

**B. Class II Material:** Class II material includes manufactured and non-manufactured open-graded (clean) or dense-graded (clean) processed aggregate, clean sand, or coarse-grained natural soils (clean) with little or no fines. Comply with Table 3010.01.

**Table 3010.01: Class II Material**

| | | | | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class | Type | Soil Group Symbol D 2487 | Description | 1 1/2 in. (40 mm) | No. 4 (4.75 mm) | No. 200 (0.075 mm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| II | Coarse-Grained Soils, clean | GW | Well-graded gravels and gravel-sand mixtures; little or no fines. | 100% | <50% of "Coarse Fraction" | < 5% | Non Plastic | | >4 | 1 to 3 |
| | | GP | Poorly-graded gravels and gravel-sand mixtures; little or no fines. | | | | | | <4 | <1 or >3 |
| | | SW | Well-graded sands and gravelly sands; little or no fines. | | >50% of "Coarse Fraction" | | | | >6 | 1 to 3 |
| | | SP | Poorly-graded sands and gravelly sands; little or no fines. | | | | | | <6 | <1 or >3 |
| | Coarse-Grained Soils, borderline clean to with fines | e.g. GW-GC, SP-SM | Sands and gravels which are borderline between clean and with fines. | 100% | Varies | 5% to 12% | Non Plastic | | Same as for GW, GP, SW, and SP | |

**C. Class III Material:**

1. Class III material is natural coarse-grained soils with fines. Comply with Table 3010.02.

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

## 2.02 BEDDING AND BACKFILL MATERIAL (Continued)

**Table 3010.02: Class III Material**

| | | | | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class | Type | Soil Group Symbol D 2487 | Description | 1 $^1/_2$ in. (40 mm) | No. 4 (4.75 mm) | No. 200 (0.075 mm) | LL | PI | Uni-formity $C_u$ | Curva-ture $C_c$ |
| III | Coarse-Grained Soils, with fines | GM | Silty gravels, gravel-sand-silt mixtures. | 100% | <50% of "Coarse Fraction" | 12% to 50% | N/A | <4 or <"A" Line | N/A | N/A |
| | | GC | Clayey gravels, gravel-sand-clay mixtures. | | | | | <7 and >"A" Line | | |
| | | SM | Silty sands, sand-silt mixtures. | | >50% of "Coarse Fraction" | | | >4 or <"A" Line | | |
| | | SC | Clayey sands, sand-clay mixtures. | | | | | >7 and >"A" Line | | |

### D. Class IVA Material:

1. Class IVA material is natural fine grained inorganic soils. Comply with Table 3010.03.

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

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

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

**Table 3010.03: Class IVA Material**

| | | | | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class | Type | Soil Group Symbol D 2487 | Description | 1 $^1/_2$ in. (40 mm) | No. 4 (4.75 mm) | No. 200 (0.075 mm) | LL | PI | Uni-formity $C_u$ | Curva-ture $C_c$ |
| IVA | Fine-Grained Soils (inorganic) | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity. | 100% | 100% | >50% | <50 | <4 or <"A" Line | N/A | N/A |
| | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clay, lean clay. | | | | | >7 and >"A" Line | | |

## 2.02 BEDDING AND BACKFILL MATERIAL (Continued)

### E. Class IVB Material:

1. Class IVB material is natural fine-grained inorganic (high elastic silts and plastic clays - fat clay) with a liquid limit greater than 50%. Comply with Table 3010.04.

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

3. Do not use in the pipe embedment zone.

**Table 3010.04: Class IVB Material**

| | | | | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class | Type | Soil Group Symbol D 2487 | Description | 1 $^1/_2$ in. (40 mm) | No. 4 (4.75 mm) | No. 200 (0.075 mm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| IVB | Fine-Grained Soils (inorganic) | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. | 100% | 100% | >50% | >50 | <"A" Line | N/A | N/A |
| | | CH | Inorganic clays of high plasticity, fat clays. | | | | | >"A" Line | | |

## 2.03 CLASS V MATERIAL (TOPSOIL)

A. Class V material consists of organic soils. Comply with Table 3010.05.

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

C. Do not use in the pipe embedment zone.

**Table 3010.05: Class V Material**

| | | | | Percentage Passing Sieve Sizes | | | Atterberg Limits | | Coefficients | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class | Type | Soil Group Symbol D 2487 | Description | 1 $^1/_2$ in. (40 mm) | No. 4 (4.75 mm) | No. 200 (0.075 mm) | LL | PI | Uniformity $C_u$ | Curvature $C_c$ |
| V | Organic Soils (Unsuitable for backfill) | OL | Organic silts and organic silty clays of low plasticity. | 100% | 100% | >50% | <50 | <4 or <"A" Line | N/A | N/A |
| | | OH | Organic clays of medium to high plasticity, organic silts. | | | | >50 | <"A" Line | | |
| | Highly Organic (Unsuitable for backfill) | PT | Peat and other high organic soils. | | | | | | | |

## 2.04 STABILIZATION (FOUNDATION) MATERIALS

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

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

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

C. Subject to the Engineer’s approval, crushed concrete may be used if it is within ± 5% of the gradation for each size of material.

## 2.05 SPECIAL PIPE EMBEDMENT AND ENCASEMENT MATERIAL

**A. Concrete Cradle, Arch, or Encasement:** Minimum 3,000 psi compressive strength.

**B. Flowable Mortar:** Comply with Iowa DOT Article 2506.02.

**C. Controlled Low Strength Material (CLSM):**

1. Approximate material proportions per cubic yard:
   a. Cement: 50 pounds
   b. Fly ash: 250 pounds
   c. Fine aggregate: 2910 pounds
   d. Water: 60 gallons

2. Minimum 50 psi compressive strength at 28 days.

3. Comply with material requirements of Iowa DOT Article 2506.02.

## PART 3 - EXECUTION

### 3.01 TRENCH EXCAVATION

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

B. Remove topsoil to a minimum depth of 12 inches and stockpile.

C. Excavate trench to required elevations and dimensions. Comply with Figure 3010.1.

1. Protect existing facilities, trees, and shrubs during trench excavation.

2. Place excavated material away from trench.

3. Grade spoil piles to drain. Do not allow spoil piles to obstruct drainage.

D. Unsuitable Backfill Material:

1. If unsuitable backfill material is encountered, notify the Engineer.

2. Remove rock, rubbish, boulders, debris, and other unsuitable backfill materials at least 6 inches below and on each side of the pipe.

3. Keep unsuitable backfill material separated from suitable backfill material and topsoil.

4. Restore trench to design dimensions using bedding or stabilization material.

### 3.02 ROCK OR UNSTABLE SOILS IN TRENCH BOTTOM

A. Notify the Engineer prior to over-excavation.

B. The Engineer will determine the need for over-excavation and trench foundation stabilization prior to installation of pipes and structures.

C. Comply with Figure 3010.1 for over-excavation of rock and wet or soft foundations.

### 3.03 TRENCH PROTECTION

A. Install adequate trench protection (sheeting, shoring, and bracing) to prevent ground movement or damage to adjacent structures, pipelines, and utilities.

B. Move trench boxes carefully to avoid disturbing pipe, bedding, or trench wall.

## 3.04 DEWATERING

A. Maintain water levels below the bottom of trench excavation.

B. Perform the dewatering operation according to the dewatering plan approved by the Engineer. Dewatering plan may be modified to meet actual field conditions, with approval of the Engineer.

C. Ensure that operation of dewatering system does not damage adjoining structures and facilities. Cease dewatering operations and notify the Engineer if damage is observed.

D. Discharged Water:

1. Do not discharge water into sanitary sewers.

2. Discharge of water into storm sewers requires Engineer's approval.

3. Obtain permission of adjacent property owner prior to discharging water onto their property.

4. Maintain and control water discharge as necessary to prevent a safety hazard for vehicular and pedestrian traffic.

5. Direct water discharge away from electrical facilities or equipment.

6. Use dewatering equipment that will minimize disturbance from noise and fumes.

7. Protect discharge points from erosion. Provide sediment control for sediment contaminated water discharged directly from trench.

## 3.05 PIPE BEDDING AND BACKFILL

**A. General:** Comply with Figures 3010.1 through 3010.9, as appropriate.

1. Bedding and backfill used for pipe installation will depend on:
   a. Type of installation (water main, sanitary sewer gravity main, sanitary sewer force main, or storm sewer).
   b. Pipe material.
   c. Depth of bury.
   d. Pipe diameter.

2. After pipe installation, place remaining bedding material and immediately place backfill in trench.

**3.05 PIPE BEDDING AND BACKFILL (Continued)**

3. Adjust the moisture content of excessively wet, but otherwise suitable, backfill material by spreading, turning, aerating, and otherwise working material as necessary to achieve required moisture range.

4. Adjust the moisture content of excessively dry, but otherwise suitable, backfill material by adding water, then turning, mixing, and otherwise blending the water uniformly throughout the material until the required moisture range is achieved.

5. Hydraulic compaction (flooding with water) is not allowed unless authorized by the Engineer.

**B. Pipe Bedding:**

1. Granular Material:
   a. Class I granular bedding material is required for all gravity mains. Use when specified for pressure pipes.
   b. Comply with Figures 3010.1 through 3010.5.
   c. Place bedding material in the bottom of the trench in lifts no greater than 6 inches thick. Consolidate and moderately compact bedding material.
   d. Shape bedding material to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.
   e. Install pipe and system components.
   f. Place, consolidate, and moderately compact additional bedding material adjacent to the pipe to a depth equal to 1/6 the outside diameter of the pipe.

2. Suitable Backfill Material:
   a. Only use with pressure pipe. Comply with Figure 3010.4.
   b. Use suitable backfill material to shape trench bottom to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.

3. Special Pipe Embedment and Encasement Materials:
   a. If required in the contract documents, use concrete, flowable mortar, or CLSM in lieu of other bedding materials.
   b. Secure pipe against displacement or flotation prior to placing concrete, flowable mortar, or CLSM.

**3.05 PIPE BEDDING AND BACKFILL (Continued)**

**C. Haunch Support:** Place from the top of the pipe bedding to the springline of the pipe.

1. Granular Material:
   a. Place Class I material in lifts no greater than 6 inches thick.
   b. Consolidate and moderately compact by slicing with a shovel or using other approved techniques.
2. Suitable Backfill Material:
   a. Place in lifts no greater than 6 inches thick.
   b. For Class II backfill material, consolidate and moderately compact by slicing with a shovel or using other approved techniques.
   c. For Class III and Class IVA backfill materials, compact to at least 90% of Standard Proctor Density. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.

3. Special Pipe Embedment and Encasement Materials:
   a. If required in the contract documents, use concrete, flowable mortar, or CLSM in lieu of other haunch materials.
   b. Secure pipe against displacement or flotation prior to placing flowable mortar, CLSM, or concrete.

**D. Primary and Secondary Backfill:**

1. General:
   a. For primary backfill, place from the springline of the pipe to the top of the pipe.
   b. For secondary backfill, place from the top of the pipe to 1 foot above the top of the pipe.

2. Granular Material:
   a. Place in lifts no greater than 6 inches thick.
   b. Compact to at least 65% relative density.

3. Suitable Backfill Material:
   a. Place in lifts no greater than 6 inches thick.
   b. For Class II backfill material, compact to at least 65% relative density.
   c. For Class III and Class IVA backfill materials, compact to at least 95% of Standard Proctor Density. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.

4. Special Pipe Embedment and Encasement Materials:
   a. If required in the contract documents, use concrete, flowable mortar, or CLSM in lieu of other primary and secondary backfill materials.
   b. Secure pipe against displacement or flotation prior to placing concrete, flowable mortar, or CLSM.

## 3.05 PIPE BEDDING AND BACKFILL (Continued)

### E. Final Trench Backfill:

1. Place suitable backfill material from 1 foot above the top of the pipe to the top of the trench.
   a. Use no more than 8 inch thick lifts for backfill areas more than 3 feet below the bottom of pavement.
   b. Use no more than 6 inch thick lifts for backfill areas less than or equal to 3 feet below the bottom of pavement.

2. Place backfill material after recording locations of connections and appurtenances or at the Engineer's direction.

3. Class I and Class II Backfill Material:
   a. Compact to at least 65% of relative density within right-of-way.
   b. Compact to at least 50% of relative density outside right-of-way.

4. Class III and Class IVA Backfill Material:
   a. Compact to at least 95% of Standard Proctor Density within right-of-way.
   b. Compact to at least 90% of Standard Proctor Density outside right-of-way.
   c. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.

5. In areas to remain unpaved, terminate backfill material 8 inches below finish grade. Use topsoil for the final 8 inches above trench backfill material.

6. Terminate backfill material at subgrade elevation in areas to be paved.

## 3.06 TRENCH COMPACTION TESTING

**A. General:** When trench compaction testing is specified in the contract documents as the Contractor's responsibility, provide testing of trench backfill material using the services of an independent testing laboratory approved by the Engineer.

### B. Soil Testing:

1. Cohesive Soils:
   a. Determine moisture-density relationships by ASTM D 698 (Standard Proctor). Perform at least one test for each type of cohesive soil used.
   b. Determine in-place density and moisture content. Use ASTM D 1556 (sand-cone method) and ASTM D 2216 (laboratory moisture content), or use ASTM D 2922 and ASTM D 3017 (nuclear methods for density and moisture content).

**3.06 TRENCH COMPACTION TESTING (Continued)**

2. Cohesionless Soils:
   a. Determine maximum and minimum index density and calculate relative density using ASTM D 4253 and ASTM D 4254.
   b. For Class I granular bedding material, determine gradation according to ASTM C 136.

**C. Field Testing:**

1. Testing Frequency and Locations: Perform testing of the final trench backfill, beginning at a depth of 2 feet above the top of the pipe, as follows:
   a. Coordinate the timing of testing with the Engineer.
   b. The Engineer will determine the location of testing.
   c. For each 2 vertical feet of consolidated fill, provide tests at a maximum horizontal spacing of 200 feet and at all street crossings.
   d. Additional testing may be required by the Engineer in the event of non-compliance or if conditions change.
   e. If necessary, excavate to the depth and size as required by the Engineer to allow compaction tests. Place backfill material and recompact.

2. Test Failure and Retesting: Rework, recompact, and retest as necessary until specified compaction and moisture content is achieved in all areas of the trench. In the event of failed tests, the Engineer may require retesting as deemed necessary.

END OF SECTION

# Summary of Changes to Section 3020
# Trenchless Construction

| | Location | Comments |
|---|---|---|
| 1 | Part 1 | Updated to eliminate redundancy with Division 1 |
| 2 | 1.08 | *Measurement and Payment:* Eliminated all bid items from this section. They are covered under the related utilities being installed (sanitary, storm, water). |
| 3 | 2.01 | *Carrier Pipe:* added references to the appropriate sections (storm, sanitary, or water) for carrier pipe installed by trenchless methods. |
| 4 | 2.02 | *Casing Pipe:* Eliminated the wall thickness table in the current spec. This table is being moved to the design manual. The contract documents should indicate what the minimum casing pipe wall thickness is.<br><br>Updated the reference to the AWS Code of Arc and Gas Welding in Building Construction. The referenced publication was last printed in 1946. The current standard is the "Structural Welding Code." |
| 5 | 3.04, A | *General:* Clarified that it is the contractors duty to select a trenchless installation method that will meet the specification requirements. Listed the allowable installation methods and provided a brief description of each. Removed references to trenchless methods that are not allowed. |
| 6 | 3.05 | *Pit Restoration:* Added a new section regarding clean-up and pit restoration. |
| | | |

# TRENCHLESS CONSTRUCTION (BORING, JACKING, AND TUNNELING)

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Trenchless Installation of Carrier Pipe with Casing Pipe

B. Trenchless Installation of Carrier Pipe without Casing Pipe

### 1.02 DESCRIPTION OF WORK

A. Excavate launching and receiving pits.

B. Install casing or carrier pipe by trenchless methods.

C. Install carrier pipe inside casing pipe (if required).

D. Place backfill material in excavations.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants, as well as the following:

A. Proposed installation methods and equipment.

B. Gradation reports for bedding materials if required.

C. Shop drawings of casing spacers and proposed spacing.

D. Dewatering plan (if required).

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

All items of work contained in this section are incidental to the underground utility pipe being installed and will not be paid for separately.

## PART 2 - PRODUCTS

### 2.01 CARRIER PIPE

A. Carrier Pipe Installed within Casing Pipe:

1. Sanitary Sewer Gravity Main: Comply with Section 4010, 2.01.

2. Sanitary Sewer Force Main:
   a. Restrained Joint Ductile Iron Pipe: Comply with Section 4010, 2.02.
   b. Restrained Joint PVC Pipe: Comply with Section 4010, 2.02.

3. Storm Sewer: Comply with Section 4020, 2.01.

4. Culverts: Comply with Section 4030, 2.01.

5. Water Main:
   a. Restrained Joint Ductile Iron Pipe: Comply with Section 5010, 2.01.
   b. Restrained Joint PVC Pipe: Comply with Section 5010, 2.01.

B. Carrier Pipe Installed without a Casing Pipe:

1. Sanitary Sewer Gravity Main:
   a. Reinforced Concrete Pipe: Comply with Section 4010, 2.01.
   b. Vitrified Clay Pipe: Comply with Section 4010, 2.01
   c. Restrained Joint Ductile Iron Pipe: Comply with Section 4010, 2.02
   d. Restrained Joint PVC Pipe: Comply with Section 4010, 2.02

2. Sanitary Sewer Force Main:
   a. Restrained Joint Ductile Iron Pipe: Comply with Section 4010, 2.02
   b. Restrained Joint PVC Pipe: Comply with Section 4010, 2.02

3. Storm Sewer and Culverts:
   a. Reinforced Concrete Pipe: Comply with Section 4020, 2.01.
   b. Reinforced Concrete Arch Pipe: Comply with Section 4020, 2.01.
   c. Reinforced Concrete Elliptical Pipe: Comply with Section 4020, 2.01.
   d. Reinforced Concrete Low Head Pressure Pipe: Comply with Section 4020, 2.01.

4. Water Main:
   a. Restrained Joint Ductile Iron Pipe: Comply with Section 5010, 2.01.
   b. Restrained Joint PVC Pipe: Comply with Section 5010, 2.01.

## 2.02 CASING PIPE

**A. Pipe:** Use only new, steel pipe meeting the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; or ASTM A 53, Grade B. Pipe may be welded or seamless. Wall thickness will be as specified in the contract documents.

**B. Joints:**

1. Comply with AWS D1.1 (Structural Welding Code). Weld all joints with full penetrating weld.

2. Upon approval of the Engineer, an interlocking casing pipe connection system may be used in lieu of field welding the sections of casing pipe.

**C. Pipe Diameter:** Minimum inside diameter as specified in the contract documents. If diameter is not specified, use a minimum inside casing diameter of at least 4 inches greater than the largest outside diameter of the carrier pipe, including pipe bells.

## 2.03 CASING SPACERS

A. Use manufactured casing spacers to position carrier pipe in casing. Do not use wood skids.

B. Use casing spacers meeting the following material requirements:

1. HDPE Band/Panel and Riser: ASTM D 638.

2. Stainless Steel or Carbon Steel Band/Panel and Riser: Type 304 stainless steel according to ASTM A 240 or carbon steel according to ASTM A 36.
   a. Liner: Elastomeric PVC per ASTM D 149.
   b. Spacer Skid/Runner: Abrasion resistant polymer with a low coefficient of friction.
   c. Fasteners: Type 304 (18-8) stainless steel per ASTM A 193.

## 2.04 BACKFILL FOR ABANDONED TUNNELS

**A. Option 1:** PCC, 3,000 psi minimum, approximately 4-inch slump.

**B. Option 2:** Flowable mortar or controlled low strength material (CLSM) per Section 3010, 2.11.

## 2.05 BACKFILL MATERIAL

A. Excavated Materials: Comply with Section 3010 for classification of excavated materials. Use only suitable material for backfill material.

B. Special Fill Materials: For use where specified in the contract documents.

1. PCC: 3,000 psi minimum with approximately 4 inch slump.

2. Flowable Mortar: Comply with Iowa DOT Article 2506.02.

3. Controlled Low Strength Material (CLSM): Comply with Section 3010, 2.04.

## 2.06 CASING END SEAL

**A. Manufactured:** Minimum 1/8 inch thick manufactured synthetic rubber casing end seal with stainless steel bands and fasteners.

**B. PCC:** Comply with Section 6010. Do not use PCC casing end seals with flexible carrier pipes.

## PART 3 - EXECUTION

### 3.01 EXCAVATION

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

B. Remove topsoil to a minimum depth of 12 inches and stockpile.

C. Excavate the minimum size pits necessary to safely and properly perform the work.

1. Protect existing facilities, trees, and shrubs during excavation.

2. Place excavated material away from trench.

3. Grade and shape spoil piles to drain and protect adjacent areas from runoff. Do not allow spoil piles to obstruct drainage. Stabilize stockpiles with seeding and provide sediment control around stockpiles.

D. Remove rock, rubbish, debris, and other materials not suitable for use as backfill.

### 3.02 SHEETING, SHORING, AND BRACING

Comply with Section 3010, 3.03.

### 3.03 DEWATERING

Comply with Section 3010, 3.04.

### 3.04 TRENCHLESS INSTALLATION

**A. General:** Select a method of installation that is appropriate for the soil conditions anticipated, will allow the pipe to be installed to the desired line and grade within the specified tolerances, will prevent heaving or settlement of the ground surface or damage to nearby facilities, and will prevent damage to the carrier pipe and any lining materials within the carrier pipe.

1. Installation Methods:
   a. Auger Boring: A method that utilizes a rotating cutting head to form the bore hole and a series of rotating augers inside a casing pipe to remove the spoil.
   b. Directional Drilling: A method for installing pipe from a surface-launched drilling rig. A pilot bore is formed and then enlarged by back reaming and removing the spoil material. The pipe is then pulled in place.
   c. Open-ended Pipe Ramming: A method that involves driving a steel casing pipe with a percussive hammer. The front end of the casing pipe is open-ended. Spoils are removed from the pipe.

**3.04 TRENCHLESS INSTALLATION (Continued)**

d. Pipe Jacking: A method in which pipe is pushed into the ground with hydraulic jacks while soil is simultaneously excavated. Excavation is normally completed with a tunnel boring machine. This method requires personnel to enter the tunnel during the excavation process.
e. Microtunneling: A method of pipe jacking utilizing a remote controlled tunnel boring machine.
f. Utility Tunneling: A method of forming large diameter tunnels. As excavation takes place at the front of the tunnel, a liner is constructed to temporarily support the tunnel. Upon completion of the tunnel, the pipe is pushed in place.
g. Other: Other methods may be allowed with the Engineer's approval.

2. Line and Grade:
   a. Install pipe at line and grade that will allow the carrier pipe to be installed at its true starting elevation and grade within a maximum alignment deviation of the pipe centerline as specified in the contract documents.
   b. When no deviation tolerances are specified in the contract documents, apply the following maximum deviations to the carrier pipe.
      1) Gravity Pipe:
         Horizontally: $\pm$ 1.0 foot per 100 feet;
         Vertically: $\pm$ 0.2 feet up to 100 feet; an additional $\pm$ 0.1 foot per 100 feet thereafter. Backfill in pipe is not allowed.
      2) Pressurized Pipe:
         Horizontally: $\pm$ 2.0 feet
         Vertically: $\pm$ 1.0 foot. Maintain the minimum depth specified in the contract documents.
   c. Greater deviation or interference with other identified facilities may be cause for rejection.

3. Deviation from Line and Grade:
   a. Provided adequate clearance remains for proper installation of the carrier pipe, the Contractor will be allowed to correct deviations in grade of a casing pipe in order to achieve design grade of the carrier pipe by:
      - Pouring an invert in the casing pipe, or
      - Shimming the carrier pipe with casing spacers to a uniform grade.
   b. Installations deviating from the specified tolerances that cannot be adjusted to conform to the specified tolerances may be rejected by the Engineer. If non-conforming installation is not rejected, provide all additional fittings, manholes, or appurtenances needed to accommodate horizontal or vertical misalignment, at no additional cost to the Jurisdiction.
   c. Abandon rejected installation and place special fill materials, at no additional cost to the Jurisdiction. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required to replace rejected installations.

**3.04 TRENCHLESS INSTALLATION (Continued)**

**B. Casing Pipe or Un-cased Carrier Pipe Installation:**

1. Install pipe by approved methods.

2. Use a jacking collar, timbers, and other means as necessary to protect the driven end of the pipe from damage.

3. Do not exceed the compressive or tensile capacity of the pipe during pushing or pulling operations.

4. Fully support bore hole at all times to prevent collapse. Insert pipe as soil is removed, or support bore with drilling fluid.

5. Fully weld all casing pipe joints or use an interlocking connection system when approved by the Engineer.

6. Fill space between the inside of the bore hole and the outside of the pipe with special fill material if the space is greater than 1 inch.

**C. Carrier Pipe Installation through Casing:**

1. Clean dirt and debris from the interior of the casing pipe after installation.

2. Install casing spacers on carrier pipe sections as necessary to support the pipe barrel according to the pipe manufacturer's recommendations subject to the following minimum requirements:
   a. Install a spacer within 1 foot of each side of the carrier pipe joint and at a maximum spacing of 6 feet.
   b. Do not allow the pipe to be supported by joint bells.
   c. Lubricate casing spacers with drilling mud or flax soap. Do not use petroleum-based lubricants or oils.

3. Ensure that thrust loads will not damage carrier pipe joints. Provide thrust collars between joint shoulders of concrete pipe.

4. Provide timbers for sufficient cushioning between the end of the pipe pushed and the jacking equipment to prevent damage to the pipe. Do not allow the steel jack face to thrust against the unprotected pipe end.

5. Position jacks so the resulting force is applied evenly to the entire end of the pipe.

6. Assemble pipe joints in the jacking pit before pushing the carrier pipe into the casing.

7. Close the end of the casing pipe around the carrier pipe with a casing end seal.

**3.04 TRENCHLESS INSTALLATION (Continued)**

8. When specified in the contract documents, fill the annular space between the carrier and casing pipe, with flowable mortar or CLSM.

**3.05 PIT RESTORATION**

A. Remove installation equipment and unused materials from the launching and receiving pits.

B. When the carrier pipe extends beyond the limits of trenchless installation and into the bore pit, place bedding and backfill material according to Section 3010.

C. Place suitable backfill material in the pit. Apply the testing requirements of Section 3010.

D. Restore the site to original condition or better.

END OF SECTION

# Division 4 Specifications
## Sewers and Drains

# Division 4
# Sewers and Drains

Division 4 was reorganized. Originally, Division 4 was organized as follows:

- Section 4010: Sanitary Sewers
- Section 4020: Storm Sewers
- Section 4030: Pipe Rehabilitation
- Section 4040: Testing

Section 4020, Storm Sewers, contained specifications for storm sewer, subdrains, and culverts. The Iowa DOT has its own specifications for subdrain and culvert construction, which are used regularly, and does not intend to follow the SUDAS specifications for these items. Because of this, the specifications for culverts and subdrains were separated from the storm sewer specifications and moved to their own sections. Division 4 was reorganized as follows:

- Section 4010: Sanitary Sewers
- Section 4020: Storm Sewers
- Section 4030: Pipe Culverts
- Section 4040: Subdrains and Footing Drain Collectors
- Section 4050: Pipe Rehabilitation
- Section 4060: Cleaning, Inspection, and Testing

All sections were re-written to the imperative mood. Language redundant with Division 1 was removed. The bid items were converted to a 3-part format indicating the method of measurement, basis of payment, and incidental work for each item.

# Summary of Changes to Section 4010
# Sanitary Sewers

| | Location | Comments |
|---|---|---|
| 1 | 1.08, A & B | *Sanitary Sewer:* Added bid items for trenchless (with and without a casing pipe) and a bid item for open cut sanitary with a casing pipe |
| 2 | 1.08, G | *Sewage Air Release Valve & Pit:* Added an item for "connection to an existing manhole." Previously, this had been in Division 6. |
| 3 | 1.08, H | *Removal of Sanitary Sewer:* Followed Iowa DOT method of payment. No payment for removal of pipe (regardless of size). Filling pipe smaller than 36" with flowable mortar is incidental. Filling pipe larger than 36" is a pay item. |
| 4 | 2.01, C | *Sanitary Sewer:* Removed note requiring "double wide gasket, indexed into two valleys" This is a proprietary feature (A-2000), and is not required to meet the ASTM specification. |
| 5 | 2.02 | *Force Mains:* Added specifications for tracer wire and tracer wire station for force mains. |
| 6 | Old 3.02 | *Line and Grade:* Removed section on "line and grade (laser and batter boards)." Line and grade information is provided in the pipe installation section, and the required alignment tolerances are provided. This section is not needed. |
| 7 | 3.05 | *Force Main Installation:* Added a reference to the water main section for installation of force mains. Previously, no guidance was provided. |
| 8 | 3.09 | *Connection to Existing Manhole:* Added information regarding connection of sanitary sewer to existing manhole. |
| | | |

# SANITARY SEWERS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Sanitary Sewer Gravity Mains

B. Sanitary Sewer Force Mains

C. Sanitary Sewer Services

### 1.02 DESCRIPTION OF WORK

A. Construct sanitary sewer gravity and force mains.

B. Construct or relocate building sanitary sewer services, stubs, and connections.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

### A. Sanitary Sewer Gravity Main:

1. Trenched:
   a. Measurement: Each type and size of pipe installed in a trench will be measured in linear feet along the centerline of the pipe from center of manhole to center of manhole.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, wyes and other fittings, pipe joints, testing, and inspection.

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of pipe. Additional pipe installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; pipe connections; testing; and inspection.

### B. Sanitary Sewer Gravity Main with Casing Pipe:

1. Trenched:
   a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe, from end of casing to end of casing. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of carrier pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, furnishing and installing annular space fill material, casing spacers, pipe connections, testing, and inspection.

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

b. Payment: Payment will be made at the unit price for each type and size of carrier pipe.
c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

**C. Sanitary Sewer Force Main:**

1. Trenched:
   a. Measurement: Each type and size of pipe installed in an open trench will be measured in linear feet along the centerline of the pipe from the outside wall of the pumping station to the center of manhole, or from the center of manhole to the center of manhole.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, wyes and other fittings, pipe joints, testing, and inspection.

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe. Additional pipe installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; pipe connections; testing; and inspection.

**D. Sanitary Sewer Force Main with Casing Pipe:**

1. Trenched:
   a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe, trench excavation, dewatering, placing bedding and backfill material, furnishing and installing annular space fill material, casing spacers, pipe connections, testing, and inspection.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of carrier pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

**E. Sanitary Sewer Service Stub:** The portion of the sanitary sewer service from the main to a point 10 feet outside of the right-of-way line or as specified in the contract documents (comply with Figure 4010.201).

1. Measurement: Each type and size of pipe will be measured in linear feet along centerline of pipe from end of pipe to centerline of sanitary sewer.

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

3. Includes: Unit price includes, but is not limited to, trench excavation, furnishing bedding material, placing bedding and backfill material, tap, fittings, testing, and inspection.

**F. Sanitary Sewer Service Relocation:** The portion of an existing sanitary sewer service in a zone of conflict will be relocated.

1. Measurement: Each completed relocation will be counted.

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

3. Includes: Unit price includes, but is not limited to, removal of existing pipe, trench excavation, furnishing new pipe and bedding material, placing bedding and backfill material, connection back to existing service, compaction, testing, and inspection.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

**G. Sewage Air Release Valve and Pit:**

1. Measurement: Each completed installation, including valve, accessories, and pit, will be counted.

2. Payment: Payment will be made at the unit price for each sewage air release valve and pit.

3. Includes: Unit price includes, but is not limited to, excavation, furnishing bedding material, placing bedding and backfill material, compaction, and testing.

**H. Removal of Sanitary Sewer:**

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

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

3. Includes: Unit price includes, but is not limited to, removal, disposal, and capping (if specified) of pipe.

**I. Connection to Existing Sanitary Sewer Manhole:**

1. Measurement: Each connection made to an existing sanitary sewer manhole will be counted.

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

3. Includes: Unit price for each connection includes, but is not limited to, coring into the existing sanitary sewer manhole, pipe connectors, grout, and waterstop when required.

## PART 2 - PRODUCTS

### 2.01 SANITARY SEWER (Gravity Mains)

**A. Solid Wall Polyvinyl Chloride Pipe (PVC) 8 inch to 15 inch:**

1. Comply with ASTM D 3034, pipe stiffness per ASTM D 2412, minimum thickness solid wall pipe, SDR 23.5 (153 psi), 26 (115 psi), 35 (46 psi).

2. PVC plastic meeting ASTM D 1784, Cell Classification 12454 or 12364. Do not exceed 10 parts by weight per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.

3. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

**B. Solid Wall Polyvinyl Chloride Pipe (PVC) 18 inch to 27 inch:**

1. Comply with ASTM F 679. Minimum pipe stiffness of 46 psi as per ASTM D 2412.

2. PVC plastic meeting ASTM D 1784, Cell Classification 12454 or 12364. Do not exceed 10 parts by weight per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.

3. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

**C. Corrugated Polyvinyl Chloride Pipe (PVC) 8 inch to 36 inch:**

1. Comply with ASTM F 949, 46 psi stiffness, smooth interior, corrugated exterior.

2. PVC resin meeting ASTM D 1784, Cell Classification 12454. Do not exceed 10 parts by weight per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.

3. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

**2.01 SANITARY SEWER (Gravity Mains) (Continued)**

**D. Closed Profile Polyvinyl Chloride Pipe (PVC) 21 inch to 36 inch:**

1. Comply with ASTM F 1803 (Closed Profile), minimum pipe stiffness 46 psi.

2. PVC plastic meeting ASTM D 1784, Cell Classification 12364. Do not exceed 10 parts by weight per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.

3. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and ASTM F 477.

**E. Polyvinyl Chloride Composite Pipe (truss-type) 8 inch to 15 inch:**

1. Comply with ASTM D 2680 (composite pipe), minimum pipe stiffness 200 psi. Pipe constructed with truss-type structure between inner and outer PVC walls with voids filled with lightweight concrete.

2. PVC plastic meeting ASTM D 1784, Cell Classification 12454. Do not exceed 10 parts by weight per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.

3. Integral bell and spigot joints with elastomeric seals complying with ASTM D 3212 and F 477.

**F. Reinforced Concrete Pipe (RCP) 18 inch to 144 inch:**

1. General:
   a. Comply with ASTM C 76 (AASHTO M 170).
   b. Minimum Class IV (3000D), Wall B.
   c. Tongue and groove joints.
   d. Rubber O-ring flexible joint complying with ASTM C 443 (AASHTO M 315).

2. Pipe Lining:
   a. Coat interior pipe barrel and all joint surfaces with two-component coal-tar epoxy-polyamide black paint or approved equal.
   b. Lining Material: Steel Structures Painting Council (SSPC) Specification No. 16, Table 1.
      1) Minimum epoxy resin content 34 to 35% by dry film weight.
      2) Minimum sag resistance 40 mils.
      3) Minimum solids 80% by volume.
   c. Apply according to lining material manufacturer's recommendations.

## 2.01 SANITARY SEWER (Gravity Mains) (Continued)

### G. Ductile Iron Pipe (DIP) 8 inch to 54 inch:

1. General:
   a. Comply with AWWA C151.
   b. Minimum thickness Class 52.

2. Interior Linings:
   a. Provide interior lining for ductile iron pipe and fittings used for all gravity sewers and drop connections.
   b. Use linings specifically designed for sanitary sewer applications, which may include calcium aluminate, polyethylene, ceramic epoxy, and coal tar epoxy. Other lining types may be allowed upon approval of the Engineer.
   c. Apply lining to interior of unlined ductile iron pipe and fittings according to published specifications from manufacturer.
   d. Seal all cut ends and repair field damaged areas according to the manufacturer's recommendations.

3. Exterior Coating: Asphalt.

4. Joints: Push-on complying with AWWA C111.

5. Fittings: Mechanical complying with AWWA C110 or AWWA C153.

6. Polyethylene Encasement:
   a. Comply with AWWA C105.
   b. Minimum thickness of 8 mils.
   c. Use for all ductile iron pipe and fittings in buried service.

### H. Vitrified Clay Pipe (VCP) 8 inch to 42 inch:

1. Pipe and fittings complying with ASTM C 700.

2. Compression joints complying with ASTM C 425 for plain end pipe or bell and spigot pipe.

3. Test according to ASTM C 301.

## 2.02 SANITARY SEWER FORCE MAINS

**A. Ductile Iron Pipe (DIP) 4 inch to 54 inch:** Comply with the DIP requirements in Section 4010, 2.01. If joint restraints are specified, comply with Section 5010, 2.03.

**B. Polyvinyl Chloride Pipe (PVC):** Comply with the requirements in Section 5010, 2.01 for PVC pipe. Provide restrained joints when specified.

## 2.02 SANITARY SEWER FORCE MAINS (Continued)

**C. Sewage Air Release Valve:**

1. Consists of an elongated tapered or conical body with outward-slanting walls and a float to operate (open and close) under pressure without spillage. Use a float with a flexible connection to the seal plug assembly to prevent irregular air release and protect the connecting rod. Ensure the bottom of the valve is sloped or funnel-shaped to encourage the accumulated sewage and solids to drain from the valve. Preserve a volume of air at all times between the liquid sewage and the seal plug assembly.

2. Materials:
   a. Body and Cover: Stainless steel, fiberglass-reinforced nylon, or other corrosion-resistant materials.
   b. Internal Linkage and Stem: Stainless steel.
   c. Float: Stainless steel, ASTM A 240, Type 304, or foamed polypropylene.
   d. Seal Plug Assembly: Stainless steel, foamed polypropylene, EPDM rubber, and reinforced nylon.

3. Tapping Saddle: Stainless steel or nylon.

4. Pit: Construct according to Figure 4010.202.

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

**E. Tracer Wire Station:**

1. Two internal terminals with shunt.

2. Five to six foot plastic post (color as specified by the Jurisdiction).

3. Removable top cap with lock.

4. Decals indicating “Sewer Force Main” or similar language.

## 2.03 CASING PIPE

Comply with Section 3020, 2.02 for casing pipe requirements.

## 2.04 SANITARY SEWER SERVICES

### A. Connection to Main

1. PVC Main:
   a. Preformed wye or tee service fitting with integral bell and spigot joints with elastomeric seals complying with ASTM D 3034 or ASTM F 949.
   b. Preformed saddle wye or saddle tee for service tap complying with ASTM D 3034 or ASTM F 949.
   c. PVC plastic meeting ASTM D 1784, Cell Classification 12454.

2. PVC Composite Main:
   a. Preformed wye or tee service fitting with integral bell and spigot joints with elastomeric seals complying with ASTM D 3212.
   b. Preformed saddle wye or saddle tee for service tap complying with ASTM D 2680.

3. RCP Main: Preformed saddle wye or saddle tee service tap designed for use with RCP.

4. VCP Main:
   a. Precast VCP wye or tee service fitting complying with ASTM C 700 for pipe and ASTM C 425 for compression joints.
   b. Preformed saddle wye or saddle tee service tap designed for use with VCP.

5. DIP Main:
   a. Use DIP wye or tee fittings complying with AWWA C110 or AWWA C153.
   b. Preformed saddle wye or tee services tap designed for use with DIP. Cut the hole for the tap with equipment designed for application.

**B. Wye and Tee Pipe Stop:** All saddle wye or saddle tee fittings must provide integrally molded pipe stop in the branch for positive protection against service pipe insertion beyond the inside of sewer main pipe wall.

**C. Service Pipe:** Use products as required by local plumbing code or regulations, if applicable. Otherwise, use the following:

1. PVC:
   a. Comply with ASTM D 3034, minimum thickness SDR 23.5 minimum pipe stiffness of 153 psi as per ASTM D 2412.
   b. PVC plastic meeting ASTM D 1784, Cell Classification 12454.
   c. Integral bell and spigot type rubber gasket joint complying with ASTM D 3212.

2. DIP:
   a. As specified for sanitary sewer force main.
   b. Polyethylene encasement as specified.

**D. Connection to Existing Service:** Comply with Section 4050, 2.08.

## 2.05 SANITARY SEWER SERVICE RELOCATIONS

A. Comply with Section 4010, 2.04 for all materials used for sanitary service relocation.

B. For new pipe, use the same size as the existing service being relocated.

C. If existing material does not comply with Section 4010, 2.04, replace with material complying with Section 4010, 2.04.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

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

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

### 3.02 PIPE INSTALLATION

**A. General:**

1. Install watertight plug to prevent water from entering the existing sewer system.

2. Inspect pipe for defects before installation. Do not install damaged or defective pipe.

3. Clean pipe interior and joints prior to installation. Keep pipe clean during construction.

4. Begin at the lowest point in the line. Lay groove or bell end pointing upstream unless specifically noted otherwise.

5. Assemble joints according to Section 4010, 3.04.

6. Cut ends of pipe at manholes and structures with a saw. Do not hammer cut or break pipe.

7. Provide manholes as specified in the contract documents.

8. Install cap, plug, or bulkhead at exposed ends of pipe upon completion of construction or whenever pipe installation is not in progress.

**B. Trenched:**

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

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

3. Lay pipe to design line and grade.
   a. Install pipe to line and grade specified in the contract documents. Set field grades to invert of pipes.
   b. Correct misalignment, displacement, or otherwise defective pipe by removing, relaying, or replacing pipe (at no additional cost to the Jurisdiction).

**3.02 PIPE INSTALLATION (Continued)**

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

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

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

7. Install preformed wye or tee service fitting for each platted lot or building as specified in the contract documents.

**C. Trenchless:** Comply with Section 3020.

**3.03 CARRIER PIPE INSTALLED WITHIN A CASING PIPE**

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

**3.04 GRAVITY MAIN PIPE JOINTING**

**A. General:**

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

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

**B. Polyvinyl Chloride Pipe (PVC) and Polyvinyl Chloride Composite Pipe (truss-type):**

1. Coat rubber gasket and joint with soap-based lubricant immediately prior to closing joint.

2. Seal ends of PVC composite and closed profile pipe at manholes with the coating recommended by the manufacturer.

**C. Reinforced Concrete Pipe (RCP):** Coat rubber gasket and joint with soap-based lubricant immediately prior to closing joint.

**D. Ductile Iron Pipe (DIP):**

1. Push-on Joint: Coat gasket and joint with soap-based lubricant immediately prior to closing joint.

2. Mechanical Joint: Wash plain end, bell socket, and gasket with soap solution. Press gasket into socket, set gland, and tighten bolts uniformly.

## 3.04 GRAVITY MAIN PIPE JOINTING (Continued)

**E. Connections Between Dissimilar Pipes:**

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

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

## 3.05 FORCE MAIN INSTALLATION

**A. General:** Install according to Section 5010.

**B. Tracer Wire:**

1. Required for all force main installations. Comply with Section 5010.

2. Install tracer wire station at each end of the force main and at additional locations specified in the contract documents.

3. Bury end of tracer wire station 2 feet and compact.

## 3.06 SANITARY SEWER SERVICE STUBS

A. Provide sanitary sewer service stubs at locations specified in the contract documents.

B. Install wye or tee for each service connection.

1. Connection of Sanitary Service to New Sewer Main, Except RCP:
   a. Use only factory wye or tees.
   b. Install according to manufacturer's requirements and Section 4010, 2.04 and 3.04 for joints.

2. Connection to Existing Sewer Main and New RCP:
   a. Cut sewer main for service tap with hole saw or sewer tap drill.
   b. Use preformed saddle wye or saddle tee for service tap. Use a gasketed saddle with rigid pipe mains and a solvent-cemented saddle with PVC mains.
   c. Install according to the manufacturer's requirements, but always attach with at least two stainless steel band clamps.

C. Install service stub from sewer main to a location 10 feet beyond the right-of-way line or as specified in the contract documents. Comply with Figure 4010.201.

1. Install service stub with a slope between 1% and 5%.

2. Terminate end of service stub 10 to 12 feet below finished ground elevation or as specified in the contract documents.

**3.06 SANITARY SEWER SERVICE STUBS (Continued)**

3. If the depth of the sewer main causes the service to exceed a depth of 12 feet or a slope of 5%, install a service riser.

4. Install pipe bedding and place backfill material according to Section 3010.

D. For undeveloped properties, extend building sanitary sewer from sanitary sewer main to a point 10 feet outside of the right-of-way or as specified in the contract documents.

1. Place watertight stopper, cap, or plug in end of sanitary sewer service.

2. Mark the end of the service line as required by the Jurisdiction or as specified in the contract documents.

E. For reconnection of existing service pipe and new service pipe, comply with Jurisdiction's plumbing code.

**3.07 SANITARY SEWER SERVICE RELOCATION**

Relocate existing sanitary sewer services that conflict with new storm or sanitary sewer installations.

A. Existing services located within a conflict zone from 6 inches below the bottom of the proposed sewer pipe to 2 inches above the top of the proposed sewer pipe require relocation.

B. When a conflicting service is encountered:

1. Determine grades and elevations of the existing service and proposed main.

2. Determine the extent of service replacement necessary to relocate the service outside of the conflict zone while maintaining a minimum 1% slope on the sewer service.

3. If it is not feasible to maintain a minimum slope of 1% on the relocated service, a special design and additional work may be required. Stop work and contact the Engineer. Do not remove sewer service unless directed by the Engineer.

4. If service relocation with a minimum slope of 1% is feasible, proceed with removal and replacement of the existing sanitary sewer service.
   a. Length of replacement varies. Remove the existing service to the extents necessary to move the service out of the conflict zone.
   b. Use all new materials complying with Section 4010, 2.04.
   c. Re-install the service according to Section 4010, 3.01 through 3.04.
   d. Maintain a minimum 1% grade on relocated service.

## 3.08 SANITARY SEWER ABANDONMENT

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

B. 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.

C. If specified in the contract documents, fill the line to be abandoned with flowable mortar or controlled low strength material (CLSM) (comply with Section 3010) by gravity flow or pumping.

## 3.09 CONNECTION TO EXISTING MANHOLE

Core all new openings in existing manholes unless otherwise specified in the contract documents or approved by the Engineer.

**A. General:**

1. Excavate as required.

2. 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.

3. Carefully core out opening to manhole. Remove existing invert as necessary to install pipe at required elevation and develop hydraulic channel.

**B. Cored Opening:**

1. Insert flexible watertight connector into new opening.

2. Install and tighten internal expansion sleeve to hold flexible connector in place.

3. Insert pipe through flexible connector and tighten external compression ring.

4. Do not grout opening or pour collar for cored opening with flexible connector.

**C. Cut and Chipped Opening (Knock-out):** Use only when specified or allowed.

1. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.

2. Remove concrete and expand opening to a diameter at least 6 inches larger than the outside diameter of the new pipe.

3. Cut off any reinforcing steel protruding from the structure wall.

**3.09 CONNECTION TO EXISTING MANHOLE (Continued)**

4. Remove existing concrete invert as required to accommodate new pipe.

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

6. Install waterstop around new pipe centered within structure wall. Comply with Section 6010, 2.11.

7. Fill opening between structure and pipe with non-shrink grout.

8. Construct concrete collar around pipe and exterior manhole opening.
   a. For new pipes 12 inches or smaller, install two number 3 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to a minimum thickness and width of 6 inches.
   b. 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.

9. 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.

10. Reconstruct structure invert to provide a well defined channel between pipes.

**3. 10 TOLERANCES**

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

**A. Gravity Main:**

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

2. Tolerance is allowed for trenched gravity sewer lines only if design line and grade is sufficient to prevent backslope when tolerance limits are reached.

3. Reverse slope on gravity pipe is prohibited. Remove and reinstall pipe to proper grade.

**B. Force Main:** Do not allow horizontal and vertical alignment of trenched force mains to vary from design line and grade by more than 3 inches.

## 3. 11 CONFLICTS

A. Provide temporary support for existing water, gas, telephone, power, and other utilities or services that cross trench.

B. Compact backfill material under existing utility crossing as specified in Section 3010, or construct utility line supports where specified in the contract documents or as directed by the Engineer.

C. The following separation information is derived from Iowa DNR's *Iowa Wastewater Facilities Design Standards*, Chapter 12, Section 12.5.8:

1. Horizontal Separation of Gravity Sewers from Water Mains: Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet unless:
   a. The top of a sewer main is at least 18 inches below the bottom of the water main, and
   b. The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.
   c. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Section 4010, 2.02. However, provide a linear separation of at least 2 feet.

2. Separation of Sewer Force Mains from Water Mains: Separate sewer force mains and water mains by a horizontal distance of at least 4 linear feet.

3. Separation of Sewer and Water Main Crossovers:
   a. Vertical separation of sanitary sewers crossing under any water main should be at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, the sewer may be placed not closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases.
   b. Where the sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material so both joints are as far as possible from the water main. The sewer and water pipes must be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

## 3.12 TESTING

Clean, inspect, and test sanitary sewer per Section 4060.

END OF SECTION

# Summary of Changes to Section 4020
# Storm Sewers

| | Location | Comments |
|---|---|---|
| 1 | 1.08, A | *Storm Sewer:* Added bid items for trenchless (with and without a casing pipe) and a bid item for open cut sanitary with a casing pipe |
| 2 | 1.08, C | *Removal of Storm Sewer*: Followed Iowa DOT method of payment. No payment for removal of pipe (regardless of size). Filling pipe smaller than 36" with flowable mortar is incidental. Filling pipe larger than 36" is a pay item. |
| 3 | 1.08, D | *Connection to Existing Manhole:* Added an item for "connection to an existing manhole." Previously, this had been in Division 6. |
| 4 | 2.01, A-C | *Concrete Pipe:* Added reference to Iowa DOT's equivalent classification for concrete pipe (i.e. Iowa DOT Class 2000D) |
| 5 | 2.01 G - K | *Culvert Materials:* Brought pipe materials previously listed under culverts, over to the storm sewer section to avoid reference back to the culvert section, creating an issue for use by Iowa DOT. |
| 6 | 3.02 & 3.04 | *Pipe Installation:* Removed section on "line and grade" (laser and batter boards). Line and grade information is provided in the pipe installation section, and the required alignment tolerances are provided. This section is not needed. |
| 7 | 3.02, C | *Trenchless:* Added a reference to 3020 for installation by trenchless methods. |
| 8 | 3.04 | *Pipe Jointing:* Combined several of the pipe jointing requirements. Listing each separately was redundant. |
| 9 | 3.08 | *Connection to Existing Manhole:* Added information regarding connection to existing manholes from Division 6. |
| | | |

# STORM SEWERS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Storm Sewers

B. Abandonment of Storm Sewers

### 1.02 DESCRIPTION OF WORK

A. Construct storm sewers.

B. Abandon storm sewers.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

### A. Storm Sewer:

1. Trenched:
   a. Measurement: Each type and size of pipe installed in a trench will be measured in linear feet along the centerline of the pipe from center of intake or manhole to center of intake or manhole. Where the end of the pipe discharges to a ditch or waterway, measurement will be to the end of the pipe, exclusive of aprons. Lengths of elbows and tees will be included in the length of pipe measured.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, joint wrapping, connectors, testing, and inspection.

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe. Additional pipe installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; pipe connections; testing; and inspection

### B. Storm Sewer with Casing Pipe:

1. Trenched:
   a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, furnishing and installing annular space fill material, casing spacers, pipe connections, testing, and inspection.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of carrier pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.

**C. Removal of Storm Sewer:**

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

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

3. Includes: Unit price includes, but is not limited to, removal, disposal, and capping, if specified, of pipe.

**D. Connection to Existing Storm Sewer Manhole or Intake:**

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

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

3. Includes: Unit price for each connection includes, but is not limited to, coring or cutting into the existing storm sewer manhole or intake, pipe connectors, and grout.

## PART 2 - PRODUCTS

### 2.01 STORM SEWERS

**A. Reinforced Concrete Pipe (RCP):**

1. Comply with ASTM C 76.

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

3. Tongue and groove joints.
   a. Use cold applied bituminous or rubber rope gasket jointing materials, unless otherwise specified.
   b. If specified, use rubber O-ring or profile gasket complying with ASTM C 443.

4. If specified, wrap exterior of each joint with engineering fabric.

**B. Reinforced Concrete Arch Pipe (RCAP):**

1. Use only where specified in the contract documents or approved by the Engineer.

2. Comply with ASTM C 506.

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

4. Tongue and groove joints. Use cold applied bituminous or rubber rope gasket jointing materials, unless otherwise specified.

5. If specified, wrap exterior of each joint with engineering fabric.

**C. Reinforced Concrete Elliptical Pipe (RCEP):**

1. Use only where specified in the contract documents or approved by the Engineer.

2. Comply with ASTM C 507.

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

4. Tongue and groove joints. Use cold applied bituminous or rubber rope gasket jointing materials, unless otherwise specified.

5. If specified, wrap exterior of each joint with engineering fabric.

**2.01 STORM SEWERS (Continued)**

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

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

2. Tongue and groove joints.

3. Comply with ASTM C 361 for rubber O-rings or profile gaskets.

**E. Polyvinyl Chloride Pipe (PVC):**

1. Use pipe complying with the following:
   a. Types of PVC pipes:
      1) Corrugated exterior, smooth interior, ASTM F 949.
      2) Solid wall, ASTM D 3034 or ASTM F 679.
      3) Closed profile, ASTM F 1803.
      4) Composite, ASTM D 2680.
   b. PVC plastic meeting ASTM D 1784, Cell Classification 12454. Do not exceed 10 parts by weight per 100 of PVC resin in the compound for additives and fillers, including but not limited to stabilizers, antioxidants, lubricants, and colorants.
   c. Minimum pipe stiffness of 46 psi.
   d. Integral bell and spigot joints with elastomeric seals according to ASTM D 3212 and ASTM F 477.

2. **Do not use in the right-of-way.** Use only outside the right-of-way in public utility easement areas where no utilities exist or are proposed (running parallel or crossing) or where the trench for the PVC pipe will not be disturbed, and where the Engineer allows.

**F. High Density Polyethylene Pipe (HDPE):**

1. Use pipe complying with the following:
   a. AASHTO M 294, Type S corrugated exterior and smooth interior.
   b. ASTM D 3350 minimum resin Cell Classification 335420 C.
   c. Minimum pipe stiffness at 5% deflection according to ASTM D 2412.
   d. Integral bell and spigot joints with elastomeric seals according to ASTM F 477.
   e. Maximum 5% deflection of the average inside diameter by testing after installation according to Section 4060, 3.05.

2. **Do not use in the right-of-way.** Use only outside the right-of-way in public utility easement areas where no utilities exist or are proposed (running parallel or crossing) or where the trench for the HDPE pipe will not be disturbed, and where the Engineer allows.

**2.01 STORM SEWERS (Continued)**

**G. Corrugated Metal Pipe (CMP):**

1. Use pipe complying with the following:
   a. AASHTO M 36, Type I.
   b. Zinc coating complying with AASHTO M 218.
   c. Corrugated steel circular section with annular or helical corrugations.
   d. Gage of pipe according to Iowa DOT Standard Road Plans RF-32 or as specified in the contract documents.
   e. Coupling bands with annular or helical corrugations to match pipe ends.

2. **Do not use in the right-of-way.** Use only outside the right-of-way in public utility easement areas where no utilities exist or are proposed (running parallel or crossing) or where the trench for the CMP will not be disturbed, and where the Engineer allows.

**H. Spiral Rib Pipe:**

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

2. **Do not use in the right-of-way.** Use only outside the right-of-way in public utility easement areas where no utilities exist or are proposed (running parallel or crossing) or where the trench for the spiral rib pipe will not be disturbed, and where the Engineer allows.

**I. Coated Corrugated Metal Pipe:**

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

2. Comply with AASHTO M 274. Use gage of pipe according to Iowa DOT Standard Road Plans RF-32 or as specified in the contract documents.

3. **Do not use in the right-of-way.** Use only outside the right-of-way in public utility easement areas where no utilities exist or are proposed (running parallel or crossing) or where the trench for the coated CMP will not be disturbed, and where the Engineer allows.

**2.01 STORM SEWERS (Continued)**

**J. Corrugated Metal Arch Pipe (CMAP):**

1. Use pipe complying with the following:
   a. AASHTO M 36, Type II.
   b. Zinc coating complying with AASHTO M 218.
   c. Corrugated steel Type I pipe reformed into a pipe-arch having an approximately flat bottom.
   d. Coupling bands with annular corrugations or helical corrugations to match pipe ends.
   e. Gage of pipe complying with Iowa DOT Standard Road Plan RF32.

2. **Do not use in the right-of-way.** Use only outside the right-of-way in public utility easement areas where no utilities exist or are proposed (running parallel or crossing) or where the trench for the CMAP will not be disturbed, and where the Engineer allows.

**K. Spiral Rib Arch Pipe:**

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

2. **Do not use in the right-of-way.** Use only outside the right-of-way in public utility easement areas where no utilities exist or are proposed (running parallel or crossing) or where the trench for the spiral rib arch pipe will not be disturbed, and where the Engineer allows.

**L. Jointing Material for Concrete Pipe:**

1. 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 AASHTO M 198.

2. Rubber Rope Gasket Jointing Material: Comply with ASTM C 990.

3. Rubber O-ring or Profile Gasket: Comply with ASTM C 443 (for RCP) or ASTM C 361 (for RCPP).

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

**N. Engineering Fabric:** Comply with Iowa DOT Article 4196.01, B.

**2.01 STORM SEWERS (Continued)**

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

**2.02 CASING PIPE**

Comply with Section 3020, 2.02 for casing pipe requirements.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

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

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

### 3.02 PIPE INSTALLATION

**A. General:**

1. Provide proper facilities for lowering the sections into place without damaging the pipe

2. Inspect pipe for defects before carefully lowering into trench. Do not install damaged or defective pipe.

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

4. Begin at the lowest point in the line. Lay groove or bell end pointing upstream unless specifically noted otherwise.

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

6. Assemble joints as specified by the pipe manufacturer. When specified, wrap exterior of storm sewer pipe joints with engineering fabric.

7. Cut ends of pipe at manholes, intakes, and structures with a saw. Do not hammer cut or break pipe.

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

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

**B. Trenched:**

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

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

**3.02 PIPE INSTALLATION (Continued)**

3. Lay pipe to design line and grade.
   a. Install pipe to line and grade specified in the contract documents. Set field grades to invert of pipe.
   b. Correct misalignment, displacement, or otherwise defective pipe by removing, relaying, or replacing pipe at Contractor's expense.

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

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

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

**C. Trenchless:** Comply with Section 3020.

**3.03 CARRIER PIPE INSTALLED WITHIN A CASING PIPE**

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

**3.04 PIPE JOINTING**

**A. General:**

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

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

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

1. Use cold applied bituminous or rubber rope gasket jointing materials unless otherwise specified.
   a. Apply joint material to entire tongue, or to top half of tongue and bottom half of groove, in sufficient quantity to fill joint. Close joint between pipes.
   b. Fill remaining voids in joint, both inside and outside of pipe, with joint material. Smooth the joint material on the inside of pipes 24 inches and larger.

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

3. If wrapped pipe joint is specified, comply with Figure 4020.211. Secure engineering fabric in place to prevent displacement while placing backfill material.

**3.04 PIPE JOINTING (Continued)**

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

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

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

**E. Connections Between Dissimilar Pipes:**

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

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

**3.05 TOLERANCES**

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

A. Ensure horizontal and vertical alignment of gravity sewer lines does not vary from design line and grade at any point along the pipe by more than 1% of the inside diameter of the pipe or 1/4 inch, whichever is larger.

B. Tolerance is allowed only if design line and grade is sufficient to prevent backslope when tolerance limits are reached.

C. Reverse slope on pipe is prohibited. Remove and reinstall pipe to proper grade.

**3.06 CONFLICTS**

A. Provide temporary support for existing water, gas, telephone, power, and other utilities or services that cross the trench.

B. Compact backfill material under existing utility crossing as specified in Section 3010, or construct utility line supports where specified in the contract documents or as directed by the Engineer.

## 3.07 STORM SEWER ABANDONMENT

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

B. 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.

C. If noted on the plans, fill the line to be abandoned with flowable mortar or controlled low strength material (CLSM) (comply with Section 3010) by gravity flow or pumping.

## 3.08 CONNECTION TO EXISTING MANHOLE OR INTAKE

A. Excavate as required.

B. Cut opening to manhole or intake to 3 to 6 inches beyond the outside of the pipe. Remove existing invert as necessary to install pipe at required elevation and develop hydraulic channel.

C. Position end of pipe flush with interior wall of manhole.

D. Fill opening between manhole wall and outside of pipe with concrete. Construct a concrete collar around the pipe.

E. Reconstruct invert according to Section 6010, 2.12.

F. Place backfill material per Section 3010.

## 3.09 TESTING

Clean, inspect, and test storm sewer per Section 4060.

END OF SECTION

# Summary of Changes to Section 4030
# Pipe Culverts

| | Location | Comments |
|---|---|---|
| 1 | General | This is a new section that was extracted from the original Section 4020 (Storm Sewers). Named section "Pipe" Culverts to clarify that they do not include box culverts. |
| 2 | | |
| 3 | 1.08, A | *Pipe Culverts:* Added bid item for trenchless construction. |
| 4 | 1.08, C | *Footings for Concrete Pipe Aprons:* Added a bid item for concrete pipe apron footings |
| 5 | 1.08, D | *Pipe Apron Guards:* Added a bid item for pipe apron guards |
| 6 | 2.01 | *Pipe Culverts:* Moved culvert materials (CMP, spiral rib, coated CMP, etc.) to storm sewer section. These materials could also be used for storm sewer (outside of the ROW). If they were listed in this section and referenced within 4020, it would create a conflict for use by the DOT. |
| 7 | 2.01, A & B | *Roadway / Entrance Culverts:* Split up classification of culverts into roadway and entrance. Roadway culverts are concrete only. Entrance culverts allow RCP or CMP. |
| 8 | 3.01 | *Pipe Culvert Installation:* Provided direction for installing culverts in trenches and embankments. |
| 9 | 3.02 | *Aprons:* Added specifications regarding the installation of pipe aprons. |
| | | |

# PIPE CULVERTS

## PART 1 – GENERAL

### 1.01 SECTION INCLUDES

A. Pipe Culverts

B. Pipe Aprons and Beveled Ends

C. Footings for Concrete Pipe Aprons

D. Pipe Apron Guards

### 1.02 DESCRIPTION OF WORK

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

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

### A. Pipe Culverts:

1. Trenched:
   a. Measurement: Each type and size of pipe installed in a trench will be measured in linear feet from end of pipe to end of pipe along the centerline of pipe, exclusive of aprons. Lengths of elbows and tees will be included in length of pipe measured.
   b. Payment: Payment will be made at the unit price of each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, connectors, testing, and inspection.

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the casing pipe. Additional pipe installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill materials; pipe connections; testing; and inspection.

### B. Pipe Aprons:

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

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

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

### C. Footings for Concrete Pipe Aprons:

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

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

3. Includes: Unit price includes, but is not limited to, excavation, reinforcing steel, and concrete.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

**D. Pipe Apron Guards:**

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

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

## PART 2 – PRODUCTS

### 2.01 PIPE CULVERTS

**A. Roadway Pipe Culverts:** All storm sewer pipe materials specified for use in right-of-way in Section 4020 may be used within right-of-way as a roadway pipe culvert.

**B. Entrance Pipe Culverts:** The following pipe culvert types described in Section 4020 may be used within right-of-way as entrance pipe culverts:

1. Reinforced Concrete Pipe (RCP).
2. Reinforced Concrete Arch Pipe (RCAP).
3. Reinforced Concrete Elliptical Pipe (RCEP).
4. Reinforced Concrete Low Head Pressure Pipe (RCPP).
5. Corrugated Metal Pipe (CMP).
6. Spiral Rib Pipe.
7. Coated Corrugated Metal Pipe.
8. Corrugated Metal Arch Pipe.

**C. Structural Plate Culverts:** Structural plate culverts may be used in the right-of-way as roadway or entrance pipe culverts.

1. Use a galvanized steel structural plate complying with AASHTO M 167.
2. Use bolts and nuts complying with ASTM A 449 and galvanized per ASTM A 153, Class C.
3. Assemble the structure according to the manufacturer's recommendations. Tighten the bolts using an applied torque of between 100 and 300 foot-pounds.
4. Install the structure according to the contract documents, the manufacturer′s recommendations, and AASHTO Standard Specifications for Highway Bridges, Division II, Section 26.
5. Conform the gage of the structure to Iowa DOT Standard Road Plan RF-34 or as specified in the contract documents.

**2.01 CULVERTS (Continued)**

**D. Aluminum Structural Plate Culverts:** Aluminum structural plate culverts may be used in the right-of-way as roadway or entrance pipe culverts.

1. Comply with AASHTO M 219.

2. Use a corrugation profile of 9 inches by 2 1/2 inches.

3. Use aluminum complying with ASTM B 209.

4. Use a minimum thickness of 0.100 inch. Gage of structure complying with manufacturer's requirements or as specified in the contract documents.

5. Use bolts and nuts meeting ASTM A 307 or ASTM A 449 and galvanize per ASTM A 153.

6. Assemble the structure according to the manufacturer's recommendations. Tighten the bolts using an applied torque of between 100 and 300 foot-pounds.

7. Install the structure according to the contract documents, the manufacturer's recommendations, and AASHTO Standard Specifications for Highway Bridges, Division II, Section 26.

8. Meet or exceed the AASHTO Standard Specifications for Highway Bridges, Division I, Section 12.8 for HS 20 loading.

**2.02 PIPE APRONS AND BEVELED ENDS**

Comply with the requirements of Section 4020, 2.01 and Section 4030, 2.01 for the pipe material of which the apron is constructed.

**2.03 APRON FOOTINGS**

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

**2.04 APRON GUARD**

Use smooth or deformed steel bars, ASTM A 615, Grade 40 or merchant quality, in the construction of the apron guard.

## PART 3 - EXECUTION

### 3.01 PIPE CULVERT INSTALLATION

**A. Trenched:**

1. Install pipe in a trench per Section 4020.

2. For culvert pipe installed in embankment, pipe may be installed at the Contractor's option per the contract documents and the following Iowa DOT Specifications sections:

   a. Reinforced Concrete Pipe (circular, arched, and elliptical): Section 2416.

   b. Corrugated Metal and Corrugated Plastic Pipe: Section 2417.

   c. Structural Plate Culverts: Section 2420.

**B. Trenchless:** For trenchless installations, comply with Section 3020.

### 3.02 APRONS

A. Install pipe aprons where specified in the contract documents. Use the same installation methods as used on the pipe to which the apron is being attached.

B. Install apron footings where specified. Construct per Section 6010 and the contract documents.

C. Anchor the last three concrete pipe sections and the apron together with two pipe connections per joint.

D. Install apron guard where specified. Construct as shown on Iowa DOT Standard Road Plan RF-26.

### 3.03 TESTING

Clean, inspect, and test culverts per Section 4060.

END OF SECTION

# Summary of Changes to Section
# 4040 Subdrains

| | Location | Comments |
|---|---|---|
| 1 | General | This is a new section that was extracted from the original Section 4020 (Storm Sewers). |
| 2 | 1.08 C | *Cleanouts:* Added an item for subdrain or footing drain cleanouts. |
| 3 | 1.08, D | *Outlets and Connections:* Added an item for subdrain or footing drain outlets and connections. |
| 4 | 2.01 | *Products:* Re-organized order of pipe materials. No changes to pipe material requirements. Listed all pipe materials out under 2.01. Called out allowable materials under each drain type in 2.02, - 2.04. |
| 5 | 2.05 | *Porous Backfill:* Added a gradation for pea-gravel backfill. |
| 6 | 3.01 | *Subdrains:* Provided installation requirements for subdrains. |
| 7 | 3.03 | *Cleanouts and Outlets:* Provided installation requirements for subdrain cleanouts and outlets. |
| | | |

# SUBDRAINS AND FOOTING DRAIN COLLECTORS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Subdrains

B. Subdrain Cleanouts and Outlets

C. Footing Drain Collectors

D. Storm Sewer Service and Connections

### 1.02 DESCRIPTION OF WORK

A. Construct subdrains, subdrain cleanouts and outlets, and footing drain collectors.

B. Construct storm sewer service and connections.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

### 1.08 MEASUREMENT AND PAYMENT

**A. Subdrains:**

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

**1.08 MEASUREMENT AND PAYMENT (Continued)**

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

3. Includes: Unit price includes, but is not limited to, trench excavation, furnishing and placing bedding and backfill material, engineering fabric, connectors, elbows and tees, and testing.

**B. Footing Drain Collectors:**

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

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

3. Includes: Unit price includes, but is not limited to, trench excavation, pipe, wyes, tap, fittings, and furnishing and placing bedding and backfill material.

**C. Subdrain or Footing Drain Cleanouts:**

1. Measurement: Each type and size of subdrain or footing drain cleanout will be counted.

2. Payment: Payment for each cleanout will be made at the unit price for each type and size of subdrain or footing drain cleanout.

**D. Subdrain or Footing Drain Outlets and Connections:**

1. Measurement: Each type and size of outlet or connection to a structure will be counted.

2. Payment: Payment for each outlet or connection to a structure will be made at the unit price for each type and size installed.

**E. Storm Sewer Service Stub:** The storm sewer service stub is the portion of the storm sewer service from the footing drain collector or storm sewer to a point 10 feet outside of the right-of-way or as specified in the contract documents.

1. Measurement: Each type and size of pipe will be measured in linear feet along centerline of pipe from the centerline of storm sewer or footing drain collector to 10 feet outside of the right-of-way.

2. Payment: Payment will be made at the unit price per linear foot for each type and size of storm sewer service stub.

3. Includes: Unit price includes, but is not limited to, trench excavation, furnishing bedding material, placing bedding and backfill material, tap, fittings, and plugs.

## PART 2 – PRODUCTS

### 2.01 SUBDRAINS AND FOOTING DRAIN COLLECTORS

**A. Polyvinyl Chloride Pipe and Fittings (Solid Wall PVC):**

1. Comply with ASTM D 3034, minimum thickness SDR 35, 46 psi minimum pipe stiffness.

2. Use PVC plastic conforming to ASTM D 1784, Cell Classification 12454.

3. Integral bell and spigot type rubber gasket joint complying with ASTM D 3212 and ASTM F 477.

4. Fabricated or preformed saddle wye or saddle tee for service tap complying with AASHTO M 252 or M 294.

**B. Corrugated Polyvinyl Chloride Pipe and Fittings (Corrugated PVC):**

1. Use corrugated exterior, smooth interior, PVC.

2. Comply with ASTM F 949, minimum pipe stiffness, 46 psi.

3. Use PVC plastic complying with ASTM D 1784, Cell Classification 12454.

4. Integral bell and spigot type rubber gasket joint complying with ASTM D 3212 and ASTM F 477.

**C. High Density Polyethylene (HDPE) Pipe:**

1. Use pipe complying with the following:
   a. AASHTO M 294, Type S corrugated exterior and smooth interior.
   b. ASTM D 3350, minimum resin Cell Classification 335420 C.
   c. Minimum pipe stiffness at 5% deflection per ASTM D 2412.
   d. Integral bell and spigot joints with O-ring rubber gasket meeting ASTM F 477.
   e. Maximum 5% deflection of the average inside diameter by testing after installation per Section 4060, 3.05.

2. Use fabricated or preformed saddle wye or saddle tee for service tap complying with AASHTO M 252 or M 294.

**D. Reinforced Concrete Pipe (RCP):** Comply with Section 4020, 2.01.

## 2.02 TYPE 1 SUBDRAINS

**A. Polyvinyl Chloride Pipe and Fittings (Solid Wall PVC):**

1. Comply with Section 4040, 2.01.

2. Slot subdrain pipe according to ASTM F 949 or perforate with four rows of 1/4 inch to 3/8 inch diameter holes along the bottom of the pipe.

**B. Corrugated Polyvinyl Chloride Pipe and Fittings (Corrugated PVC):**

1. Comply with Section 4040, 2.01.

2. Slot subdrain pipe according to ASTM F 949.

**C. Corrugated Polyethylene Tubing (Corrugated PE):**

1. Comply with AASHTO M 252, Type C, corrugated interior and exterior or Type S, corrugated exterior, smooth interior.

2. Use only fittings supplied or recommended by pipe manufacturer for soil tight service.

3. Slot or perforate, if required, according to AASHTO M 252, Type CP, or Type SP.

## 2.03 TYPE 2 SUBDRAINS

A. Use materials complying with Section 4040, 2.01.

B. Perforate all pipe per the following requirements:

1. Solid Wall PVC Pipe: Comply with ASTM F 949 or perforate with four rows of 1/4 inch to 3/8 inch diameter holes along the bottom of the pipe.

2. Corrugated PVC Pipe: Comply with ASTM F 949.

3. HDPE Pipe: Comply with AASHTO M 252, Type CP, or Type SP.

C. If concrete pipe is specified, wrap exterior of each joint with engineering fabric and do not use joint sealant.

## 2.04 FOOTING DRAIN COLLECTORS

Use materials complying with Section 4040, 2.01.

## 2.05 POROUS BACKFILL MATERIAL

**A. Crushed Stone or Processed Gravel:** Comply with Iowa DOT 4109, Gradation No. 29.

**B. Pea Gravel:** Comply with Iowa DOT 4109, Gradation No. 20 or No. 21.

## 2.06 SUBDRAIN OUTLETS

**A. General:**

1. Match annular or helical corrugations on coupling bands to pipe ends.
2. Rodent guard complying with Iowa DOT Materials I.M. 443.01.

**B. Corrugated Metal Pipe (CMP):**

1. Comply with AASHTO M 36, Type 1.
2. Zinc coating complying with AASHTO M 218.
3. Use a corrugated steel circular section with annular or helical corrugation.
4. Minimum thickness of 0.052 inch.

**B. Corrugated HDPE:**

1. Comply with Section 4040, 2.01.
2. Pipe to be double-walled.

**C. PVC:** Comply with Section 4040, 2.01.

## 2.07 SUBDRAIN OR FOOTING DRAIN CLEANOUTS

**A. Type A-1 or A-2 Cleanouts:**

1. Use 8 inch riser pipe of the same material as the adjacent subdrain or footing drain pipe. Comply with Figure 4040.232.
2. When a PVC cap is used on top of the cleanout, drive a 1-foot length of reinforcing steel into the ground immediately adjacent to the cleanout to allow future location.

**2.07 SUBDRAIN OR FOOTING DRAIN CLEANOUTS (Continued)**

**B. Type B Cleanouts:** Comply with Figure 4040.232.

1. Use 24 inch diameter Class III RCP riser for subdrain 8 inches or smaller. Use 30 inch diameter Class III RCP riser for 10 inch and 12 inch subdrains.

2. Use RCP complying with Section 4020, 2.01.

3. Manufactured cleanouts may be used with the approval of the Engineer.

**C. Castings:** Use a heavy duty cast iron casting complying with Section 6010, 2.10.

**2.08 ENGINEERING FABRIC**

Use fabric complying with Iowa DOT 4196.01B.

**2.09 STORM SEWER SERVICE STUBS**

Use materials complying with Section 4040, 2.01.

## PART 3 - EXECUTION

### 3.01 SUBDRAINS

A. Provide Type 1 or Type 2 subdrain where specified in the contract documents. Comply with Figure 4040.231.

B. Excavate trench and provide pipe bedding and backfill as shown on the figures. Install engineering fabric if specified in the contract documents.

C. Begin subdrain installation at the outlet and continue upgrade.

D. Lay subdrain pipe to the proper line and grade. Place pipe with the perforations down.

E. Place porous backfill material over installed pipe in layers not more than 6 inches thick. Thoroughly tamp each layer with mechanical tampers.

F. Restore pavement subbase material, shoulder material, or ground above subdrain trench as applicable.

G. For combination storm sewer/subdrain or Type 2 subdrain, do not use joint sealant.

### 3.02 SUBDRAIN CLEANOUTS AND OUTLETS

A. Install subdrain cleanouts and outlets at locations specified in the contract documents. Comply with Figures 4040.232 and 4040.233.

B. Construct cleanouts and outlets as specified in the contract documents.

C. Install a rodent guard on all subdrain outlets.

D. Ensure that all outlets are clean and free of debris at the completion of construction.

### 3.03 FOOTING DRAIN COLLECTORS

A. Install footing drain collectors according to Section 3010.

B. If specified, install engineering fabric.

C. Provide cleanouts and connections where specified in the contract documents.

1. Connect footing drain sewer collectors to storm sewer manhole or intake.

2. Provide fabricated or preformed wye or tee service fitting for each platted lot or building.

D. Provide manholes, if specified, according to Section 6010.

## 3.04 STORM SEWER SERVICE STUBS

A. Provide storm sewer service connections and line from storm sewer mains or footing drain sewer mains for each platted lot or building as specified in the contract documents.

B. For new sewer main construction, except RCP sewers, install wye or tee fittings according to the manufacturer's requirements.

C. For existing sewers and all RCP sewers, saw or drill a neat hole in sewer main and install preformed saddle wyes or tees according to the manufacturer's requirements.

D. For undeveloped properties, extend the storm sewer service from the storm sewer or footing drain collector to a point 10 feet outside of the right-of-way line or as specified in the contract documents. Place a watertight stopper or plug in the end of the storm sewer service.

E. For reconnection of existing service pipe to new sewer service pipe, use a manufactured flexible connection.

END OF SECTION

# Summary of Changes to Section
# 4050 Pipe Rehabilitation

| | Location | Comments |
|---|---|---|
| 1 | 1.08, C | *Spot Repairs by Pipe Replacement:* Provided alternate form of bidding with both a count and a length. This is similar to patching. The idea is that there is a lot more work involved in doing three 10 foot spot repairs, than doing a single 30 foot repair. |
| 2 | Part 2 & 3 | Minor formatting. No substantial changes. |
| | | |

# PIPE REHABILITATION

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Slip Lining Pipe

B. Cured-in-Place Pipe Lining

C. Formed-in-Place Pipe Lining

D. Spot Repairs by Pipe Replacement

### 1.02 DESCRIPTION OF WORK

A. Pipe Lining:

1. Resin impregnated, cured in place pipe.

2. Deformed polyethylene for formed in place pipe.

3. Deformed polyvinyl chloride for formed in place pipe.

4. Slip lining.

B. Pipe spot repairs.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants as well as the following:

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

A. Product Information:

1. Product name.

2. Year product first available in United States.

3. Total footage or number of line segments installed in United States.

**1.04 SUBSTITUTIONS (Continued)**

4. Results of all available product testing, including but not limited to leakage, physical properties, pipe stiffness, chemical resistance, strain-corrosion, external loading, flow characteristics, infiltration/inflow reductions, structural capacity, and external hydrostatic loading capacity.

5. Samples of before and after product.

6. Design method.

7. Typical liner thickness for pipe sizes included in the project.

B. Manufacturer Information:

1. Manufacturer name.

2. Years of experience manufacturing the product.

3. Country of manufacture of all product components.

4. Quality control procedures for product manufacture, including inspection requirements, testing procedures, and allowable tolerance levels.

5. Related ASTM standards, or other nationally recognized standards for product manufacturing.

C. Installer Information:

1. Installer name.

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

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

4. Video of installation process, if available.

5. Evidence of properly trained personnel.

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

7. Available equipment list.

**1.04 SUBSTITUTIONS (Continued)**

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

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

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

**1.05 DELIVERY, STORAGE, AND HANDLING**

Follow the General Provisions (Requirements) and Covenants.

**1.06 PUBLIC RELATIONS PROGRAM**

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

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

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

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

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

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

## 1.07 SPECIAL REQUIREMENTS

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

B. Notify the Jurisdiction's water works to use meter and pay for water, if required.

C. Unless otherwise specified, the Owner will provide water for installation of cured-in-place pipe from a nearby hydrant through a separate valve mounted on the hydrant.

## 1.08 MEASUREMENT AND PAYMENT

### A. Pipe Lining:

1. Measurement: Each type and size of pipe lining will be measured in linear feet along centerline of pipe liner from center of manhole to center of manhole.

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

3. Includes: Unit price includes removal of internal obstructions, pipe cleaning, inspection, and all costs associated with the public information and notification program.

### B. Building Sanitary Sewer Service Reconnection:

1. Measurement: Each active existing building sanitary sewer service reconnected to liner pipe, including services reconnected by excavating and reconnecting services or by trenchless reconnection methods, will be counted.

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

3. Includes: Unit price includes, but is not limited to, removal of internal obstructions, pipe cleaning, and all costs associated with the public information and notification program.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

**C. Spot Repairs by Pipe Replacement:** Both of the following methods will be specified for measurement and payment of spot repairs by pipe replacement.

1. Spot repairs by Count:
   a. Measurement: Each spot repair location will be counted.
   b. Payment: Payment will be made at the unit price for each spot repair.
   c. Includes: Unit price includes, but is not limited to, uncovering and removing existing pipe, placing backfill material for replacement pipe, and restoring the surface.

and;

2. Spot Repairs by Linear Foot:
   a. Measurement: Measurement will be in linear feet along the centerline of the pipe.
   b. Payment: Payment will be made at the unit price for linear foot of spot repair.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing replacement pipe and connections.

## PART 2 - PRODUCTS

### 2.01 POLYETHYLENE AND POLYOLEFIN MANUFACTURED PIPE FOR SLIPLINING

**A. Pipe:**

1. Comply with ASTM D 1248, Type III, Class C, Category 5, Grade P 34 or equivalent ASTM D 3350 Cell Classification PE 335434C.

2. Maximum outside diameter and SDR as specified in the contract documents.

**B. Joints:**

1. Joined into continuous length on job site.

2. Fuse butt joints according to the pipe manufacturer's recommendations with approved equipment and complying with ASTM D 2657.

### 2.02 POLYVINYL CHLORIDE PIPE (PVC) MANUFACTURED PIPE 12 INCH TO 36 INCH FOR SLIPLINING

**A. Pipe:**

1. Comply with ASTM F 949, minimum pipe stiffness, 46 psi.

2. PVC plastic complying with ASTM D 1784, Cell Classification 12454.

**B. Joints:** Gasketed joints complying with ASTM F 477 and ASTM D 3212.

### 2.03 POLYVINYL CHLORIDE PIPE (PVC) MANUFACTURED PIPE 21 INCH TO 48 INCH FOR SLIPLINING

**A. Pipe:**

1. Comply with ASTM F 1803, minimum pipe stiffness, 46 psi.

2. PVC plastic complying with ASTM D 1784, Cell Classification 12364.

**B. Joints:** Gasketed joints as complying with ASTM F 477 and ASTM D 3212.

### 2.04 CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR PIPE (CCFRPM) 18 INCH TO 48 INCH FOR SLIPLINING.

**A. Pipe:** Comply with ASTM D 3262.

**B. Joints:** Gasketed joints as complying with ASTM D 4161.

## 2.05 RESIN-IMPREGNATED TUBE FOR CURED-IN-PLACE PIPE (CIPP)

### A. Pipe:

1. Comply with ASTM F 1216.
2. Use one or more layers of flexible needled felt or equivalent non-woven material.
3. Stretch material to fit irregular pipe and negotiate bends.
4. Outside layer plastic coated with a translucent flexible material. No delamination of plastic coating.
5. Fabricated to a size that when installed tightly fits length without joints.
6. Designed as per Equation X-1, ASTM F 1216.

### B. Resin and Catalyst:

1. Unsaturated, styrene-based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible.
2. Cure in the presence of water with temperature in excess of 150°F.
3. Initial structural properties complying with ASTM F 1216. Also comply with the following table.

**Table 4050.01: Cured-in-Place Pipe Properties**

| CIPP Properties | ASTM Test Method | Minimum Value |
|---|---|---|
| Flexural Strength | D 790 | 4,500 psi |
| Flexural Modulus of Elasticity | D 790 | 250,000 psi |

### C. Cured Pipe Dimensions:

1. Use nominal internal diameter and length such that CIPP forms to internal circumference and length of original pipe.
2. Field verify diameter and length.
3. Use one continuous length without joints.

## 2.06 DEFORMED HIGH DENSITY POLYETHYLENE FOR FORMED-IN-PLACE PIPE (HDPE-FIPP)

### A. Pipe:

1. Manufactured in deformed shape from HDPE pipe compound complying with ASTM D 1248, Class C, Category 5 and Grade P 34.

2. Comply with long term hydrostatic strength rating of 1600 psi or more according to ASTM D 2837.

3. Environmental stress crack resistance (ESCR) less than 2,000 hours in 100% solution, Igepal CO-630 at 100°C before failure according to ASTM D 1693, Condition C.

4. Comply with the following table for minimum FIPP structural standards.

**Table 4050.02: Minimum Formed-in-Place Pipe Structural Standards**

| FIPP Properties | ASTM Test Method | Minimum Value |
|---|---|---|
| Flexural Strength | D 790 | 3,300 psi |
| Flexural Modulus of Elasticity | D 790 | 136,000 psi |
| Tensile Strength | D 638 | 3,200 psi |

### B. FIPP Dimensions:

1. Nominal internal diameter and length of existing pipe as specified in the contract documents.

2. Field verify diameter and length.

3. Outside diameter fabricated to fit tightly.

4. Use one continuous length without joints between manholes.

5. Minimum wall thickness complying with Standard Dimension Ratio (SDR) as specified in the contract documents.

## 2.07 DEFORMED POLYVINYL CHLORIDE FOR FORMED-IN-PLACE PIPE (PVC-FIPP)

### A. Pipe:

1. Manufacture in deformed shape complying with ASTM D 1784, Cell Classification 12454 B. Compounds with different cell classifications because one or more properties are superior to those specified are acceptable.

2. Performance requirements complying with ASTM D 3034.

3. Comply with the following table for FIPP structural properties.

**Table 4050.03: Formed-in-Place Pipe Properties**

| FIPP Properties | ASTM Test Method | Minimum Value |
|---|---|---|
| Tensile Modulus of Elasticity | D 638 | 350,000 psi |
| Tensile Strength | D 638 | 6,000 psi |

### B. FIPP Dimensions:

1. Nominal internal diameter and length of existing pipe as specified in the contract documents.

2. Field verify diameter and length prior to manufacturing.

3. Use one continuous length without joints between manholes.

4. Outside diameter fabricated to fit tightly.

5. Minimum wall thickness complying with the specified SDR as specified in the contract documents and complying with ASTM F 1216.

## 2.08 PIPE REPAIR COUPLINGS FOR SPOT REPAIRS BY PIPE REPLACEMENT

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

**B. Length:** 12 inches, minimum.

**C. Materials and Manufacturer:**

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

2. MIG welds, fully passivated.

3. Rubber Gasket:
   a. Full coverage.
   b. Grid pattern.
   c. Per ASTM D 2000, AA415.

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

**D. Bolts:** 1/2 inch or 5/8 inch, Teflon coated threads.

## 2.09 SEWER MAIN PIPE (FOR SPOT REPAIRS)

A. Comply with Section 4010.

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

## PART 3 - EXECUTION

### 3.01 EXAMINATION

Conduct the Public Relations Program.

**A. Cleaning:**

1. Clean and remove soil, grit, debris, and obstructions prior to video inspection and/or insertion of liner pipe.

2. Do not flush debris to downstream sections.

3. Deposit removed material at an approved site.

**B. Video Inspection:**

1. Furnish the Jurisdiction with a recording of sewers both while the flow is being bypassed before lining process, and after the lining process and service reconnections have been completed.

2. Provide an on-screen numerical display of the camera location, indexed from the starting manhole, in feet.

**C. Service and Obstruction Location:**

1. Coordinate and cooperate with the Engineer for service and obstruction location.

2. Locate the active sewer services by one of following:
   a. Use video inspection to observe service locations, breaks, obstructions, and structural failures.
   b. Insert a sounding device through the service, noting its location on the ground surface.
   c. Dye testing.

### 3.02 BYPASSING SEWAGE

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

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

C. Pump flow to a downstream point or adjacent system as directed by the Engineer.

1. Provide pump and bypass lines of adequate capacity to handle all flows.

2. Provide adequate reserve pumps on-site for emergency use and for storm flows.

## 3.03 OBSTRUCTIONS

A. Remove all obstructions.

B. If an obstruction is encountered that cannot be removed by equipment operating within the pipe, excavate and remove the obstruction upon approval of the Engineer.

C. Place backfill, compact, and restore the surface according to the contract documents.

## 3.04 TEMPORARY SEWER SERVICE

If full normal sewer service is not re-established within the times stated, provide temporary facilities or hotel accommodations for affected residents and businesses.

## 3.05 SLIPLINING

**A. Installation:** Install pipe according to the pipe manufacturer′s recommendations and ASTM F 585, unless noted otherwise.

**B. Excavation:**

1. For slip lining insertions, excavate at or near one structure and work from existing manhole at other end of the section to be pulled.

2. Insertion Pit:
   a. For sliplining with segmented pipe (one pipe section at a time), construct the insertion pit as required to accommodate the length of individual pipe sections.
   b. For sliplining with pipe that is to be welded together above ground and pulled into sewer, dig a pit length 12 times the inside pipe diameter and slope the pit end back to the ground surface at a rate of 2.5 (horizontal) to 1.0 (vertical).

**C. Test Head:**

1. Pull the pulling head with one short section of liner pipe through the sewer before inserting the liner to test for taps or obstructions protruding too far into the sewer.

2. Attach cables to both ends of the test head to allow for removal if an obstruction is encountered.

**D. Liner:** Push segmented pipe liner into the host pipe according to the manufacturer's recommendations, or pull in a continuously welded pipe according to ASTM F 585.

**3.05 SLIPLINING (Continued)**

**E. Service Reconnection:**

1. Allow the liner pipe to recover according to the manufacturer's recommendations.

2. Do not leave sanitary service unconnected for more than 24 hours.

3. Complete reconnections involving excavation of service lines according to the local plumbing codes.

4. Reconnect excavated service connections according to local plumbing code, except that the annular space between the host pipe and the slip liner pipe is to be filled with grout.

**F. Grouting:**

1. Before trimming the ends of the pipe and sealing, allow for the pipe to recover its original length according to the manufacturer's recommendations. Recovery time is at least equal to the time required to pull the liner into place.

2. Fill the space between the liner and the host pipe with controlled low strength material (CLSM) complying with Section 3010, 2.11, or other material approved by the Engineer. Pump filler in from the lower end of the liner.

**3.06 RESIN IMPREGNATED CURED-IN-PLACE PIPE (CIPP)**

A. Install according to the manufacturer′s recommendations for this lining process and ASTM F 1216 unless noted otherwise.

B. Use a resin impregnated tube, hydraulically inverted in place with an approved lubricant, and cured-in-place according to ASTM F 1216, Section 7.

C. Make tube continuous between manholes. The tube may span several manhole reaches as allowed by the equipment, properties of the CIPP, and size and condition of the sewer.

D. Ensure the tube is free of uncured spots, lifts (spots cured away from the sewer), and delaminations. Remove and replace deficient sections.

E. Service Reconnections:

1. Do not leave sanitary service unconnected for more than 24 hours.

2. Complete reconnections involving excavation of service lines according to the local plumbing code.

## 3.07 DEFORMED HDPE OR PVC FORMED-IN-PLACE PIPE (FIPP)

Install according to the manufacturer's recommendations for particular lining material and process, unless noted otherwise.

### A. Liner Installation:

1. Designate location where insertion is to begin, subject to the Engineer's approval.

2. Transport FIPP to the site in one continuous length on spools compatible with the manufacturer's designated process.

3. Heat FIPP material at the job site as necessary for insertion. Pull FIPP into sewer with appropriate pulling heads, cables, and heat distribution equipment.

4. Ensure FIPP is continuous between manholes as allowed by the tensile properties of FIPP and the size and condition of the sewer.

5. Connect fully inserted FIPP to the heat source distribution equipment.

6. Round and expand by uniformly distributed heat, steam, and pressure and by mechanical devices.

7. After FIPP has been expanded to a tight fit, cool gradually under pressure until the process is complete.

8. Provide a continuous pipe liner, without joints, over the entire length of pipe.

9. Ensure the liner is free of all material defects, pits, pinholes, cracks, crazing, folds, or unrounded sections.

10. Repair any defects at no additional cost to the Jurisdiction.

### B. Service Reconnections:

1. Do not leave sanitary service unconnected for more than 24 hours.

2. Complete reconnections involving excavation of service lines according to local plumbing code.

## 3.08 SPOT REPAIRS BY PIPE REPLACEMENT

A. Excavate trench according to Section 3010.

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

C. Install replacement pipe of the same nominal size as the existing pipe. Use the materials as specified in the contract documents that comply with Section 4010.

D. Install pipe repair coupling.

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

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

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

E. Reconnect sewer services.

F. Fill area under exposed pavement with CLSM according to Section 3010.

G. Place backfill in trench according to Section 3010.

## 3.09 CLEANUP AND CLOSEOUT

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

B. Submit initial and final video tapes, CDs, or DVDs to the Engineer.

C. Remove all equipment and debris.

END OF SECTION

# Summary of Changes to Section 4060
# Testing

| | Location | Comments |
|---|---|---|
| 1 | Title | Changed title to "Cleaning, Inspection" and Testing. More accurately reflects what is covered in the section. |
| 2 | 1.08 | *Measurement and Payment:* Removed bid item for video inspection. All work under this section is incidental to other sections. |
| 3 | 3.04 | *Sanitary Sewer Leakage Testing:* Reformatted sanitary sewer leakage testing. Included all possible methods under 3.04 |
| 4 | 3.04, B | *Exfiltration Testing:* Revised leakage testing table. Previous table was confusing. Simplified table and instructed user to interpolate for fractions between inches. |
| 5 | 3.04, D | *Vacuum Testing:* Changed pressure measurements from inches of mercury to psi. |
| | | |

# CLEANING, INSPECTION, AND TESTING

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Cleaning, Inspecting, and Testing Sanitary Sewers

B. Cleaning, Inspecting, and Testing Storm Sewers

C. Cleaning and Inspecting Pipe Culverts

D. Cleaning and Inspecting Rehabilitated Pipes

### 1.02 DESCRIPTION OF WORK

A. Clean, inspect, and test sanitary sewers, sanitary sewer force mains, and sanitary sewer service stubs.

B. Clean, inspect, and test storm sewers.

C. Clean and inspect pipe culverts.

D. Clean, inspect, and test rehabilitated pipe.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING

Follow the General Provisions (Requirements) and Covenants, as well as the following:

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

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

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

Cleaning, inspecting, and testing sanitary sewers, storm sewers, pipe culverts, and rehabilitated pipes (including video inspection) is incidental to other project costs and will not be paid for separately.

## PART 2 - PRODUCTS

### 2.01 TESTING EQUIPMENT

**A. General:** Comply with applicable sections of ASTM and other applicable industry standards and codes.

**B. Video Inspection:**

1. Camera:
   a. High-resolution color with adjustable iris focus.
   b. Pan and tilt capabilities.
   c. Integral lighting suitable to allow proper illumination and a clear video image of the entire periphery of the pipe.
   d. Capable of operating in 100% humidity conditions.
   e. Produce a high quality video image.

2. Provide closed-circuit video inspection equipment capable of displaying on-screen footage of distance measured to within 1% of actual distance.

3. Record the inspection in color in the recording media specified by the Engineer. Forward the recording to the Engineer.

## PART 3 - EXECUTION

### 3.01 CLEANING

A. Clean all sanitary sewers, storm sewers, and pipe culverts by flushing with high pressure water and removing debris by vacuum extraction, and by removing sheeting, bracing, shoring, forms, soil sediment, concrete, or other debris.

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

### 3.02 VISUAL INSPECTION

A. Check each section of sanitary sewer, storm sewer, or pipe culvert by lamping.

B. Light should be visible through section of pipe lamped.

C. Visually inspect each run of pipe.

D. Repair or replace defective pipe or joints, or remove and relay pipe not meeting alignment tolerances, as directed by the Engineer.

### 3.03 VIDEO INSPECTION

**A. General:**

1. Conduct video inspection of all new and rehabilitated sanitary sewers after all backfill and compaction operations are completed, but prior to paving.

2. Notify the Engineer the day prior to inspection so the Engineer may be present during the inspection.

3. Low spots in excess of 1 inch or 5% of the pipe diameter, whichever is less, will be considered unacceptable.

4. If unacceptable low spots exist, as indicated by standing water during video inspection, remove and replace sewer as necessary and re-inspect.

**B. Inspection Procedure:**

1. Prior to video inspection, run sufficient water through the pipe to saturate potential low spots so they may be detected during inspection.

2. Inspect each pipe segment between manholes or access points in a single, continuous run. Progress through the entire project in a uniform direction.

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

**3.03 VIDEO INSPECTION (Continued)**

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

5. Do not exceed 30 feet of inspection per minute.

**B. Inspection Reporting:**

1. Provide a copy of the video inspection in the recording media specified by the Engineer. Include on-screen continuous footage, pipe diameter, direction of viewing, and manhole and street location references in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.

2. Also provide a written report of the inspection. In the report, include true-to-scale drawings of all sewer defects and observation locations. Reference the time stamp on each line item entry on the written report.

**3.04 SANITARY SEWER LEAKAGE TESTING**

Perform one or more of the following tests on new sanitary sewers. Test sanitary sewer manholes separately as specified in Section 6030.

**A. Sanitary Sewer Infiltration Testing:**

1. Use only where ground water is more than 2 feet above top of pipe at highest point in section being tested.

2. Provide documented verification of ground water elevations for not less than 24 hours before measurement of infiltration.

3. Measure infiltration in sanitary sewer with a V-notch weir in a downstream manhole.

4. The maximum allowable infiltration for new sanitary sewers, including manholes, is 200 gallons per inch of diameter per mile of pipe per day.

**B. Sanitary Sewer Exfiltration Testing:**

1. General: Use an exfiltration test when ground water level is less than 2 feet above top of pipe at highest point in section being tested. Sectionalize the test section so internal pressure in pipe does not exceed 5 feet of water.

2. Test Procedures:
   a. Install a watertight plug in the inlet of upstream and downstream manhole of sewer section being tested.
   b. Fill sewer and upstream manhole with potable water until the water elevation in the upstream manhole is 2 feet higher than outside top of pipe in section being tested or 2 feet above existing ground water level, whichever is highest elevation.

**3.04 SANITARY SEWER LEAKAGE TESTING (Continued)**

c. Allow the water level to stabilize for 30 minutes, then refill upstream manhole with water to the original level and begin the test.
d. Measure the amount of water lost in the upstream manhole in 1 hour. Use amount to determine exfiltration in a 24 hour period.

3. Exfiltration Rate: The following table may be used to determine exfiltration in gallons per 24 hours by measuring loss that occurs in 1 hour. The table is applicable only for 48 inch diameter manholes.

The maximum allowable exfiltration for new sanitary sewer, including manholes, is 200 gallons per inch of diameter per mile of pipe per day.

**Table 4060.01: Loss in Gallons per 24 Hours for Drop in Water Level per Hour in 48" Diameter Manhole (table may be interpolated to the nearest 1/4" drop)**

| Drop | 0" | 1" | 2" | 3" | 4" | 5" | 6" | 7" | 8" | 9" |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 188 | 376 | 564 | 752 | 940 | 1128 | 1316 | 1504 | 1692 |

For manholes larger than 48 inch diameter use the following formula:

$G = 0.0816(H)(D^2)$

Where:
G = loss in gallons.
D = diameter of manhole in inches.
H = water level drop in manhole in inches.

**C. Sanitary Sewer Low Pressure Air Testing:**

1. General:
   a. A low pressure air test may be used in lieu of an exfiltration test except as noted.
   b. Air test is not recommended when ground water elevation is 2 feet or greater above the top of the pipe, and cannot be used when ground water is greater than 6 feet above top of pipe.
   c. Use extreme care and follow safety precautions during testing operations. No one is allowed in manholes during testing.

2. Test Procedures:
   a. Clean entire line of all debris. Flush or wet line to produce consistent results.
   b. Plug all inlets and outlets to resist the test pressure. Special attention must be given to stoppers and laterals.

### 3.04 SANITARY SEWER LEAKAGE TESTING (Continued)

c. Determine the test duration for the section being tested from the following table. This table ignores pipe length and uses the factor 0.472*d, with "d" being in inches. Pressure holding time based on average holding pressure of 3.0 psi or drop from 3.5 psi to 2.5 psi.

**Table 4060.02: Test Duration**

| Size Pipe (inches) | Test Period Duration (minutes) |
|---|---|
| 8 | 4.0 |
| 10 | 5.0 |
| 12 | 6.0 |
| 15 | 7.0 |
| 18 | 8.5 |
| 21 | 10.0 |
| 24 | 11.5 |
| 27 | 13.0 |
| 30 | 14.0 |
| 36 | 17.0 |
| 42 | 20.0 |
| 48 | 23.0 |
| 54 | 25.5 |
| 60 | 28.5 |

d. Add air to the line segment being tested until the internal air pressure of the sewer line is raised to approximately 4.0 psi greater than average back pressure of any ground water that may be over the top of the pipe. Pressure in the sewer should not exceed 5.0 psi. Allow at least 2 minutes for air pressure to stabilize.
e. When pressure has stabilized and is at or above the starting test pressure of 3.5 psi, commence test. Record the drop in pressure for the test period. The test may be discontinued when the prescribed test time has been completed, even though 1.0 psi drop has not occurred.
f. If the groundwater level at the time of testing is above the pipe invert, add 0.43 psi air per foot of water above the invert to test the air pressure range of 2.5 psi to 3.5 psi stated above.
g. If the pressure drop exceeds 1.0 psi during the test period, the test will be considered to have failed. Repair and retest the line.

## 3.04 SANITARY SEWER LEAKAGE TESTING (Continued)

### D. Sanitary Sewer Vacuum Testing:

1. General:
   a. Vacuum testing may be used in lieu of other specified test methods.
   b. Use extreme care and follow safety precautions during testing operations. Keep personnel out of and away from manholes during testing.
   c. Where practical, clean the pipe prior to testing and wet the pipe surface. Isolate the test segment as necessary, including closing service connections.

2. Test Procedures:
   a. Determine the test time for the size of pipe being tested using the following table.

**Table 4060.03: Minimum Test Time**

| Nominal Pipe Size (inches) | T (time) Minutes/100 feet of pipe |
|---|---|
| 4 | 0.3 |
| 6 | 0.7 |
| 8 | 1.2 |
| 10 | 1.5 |
| 12 | 1.8 |
| 15 | 2.1 |
| 18 | 2.4 |
| 21 | 3.0 |
| 24 | 3.6 |
| 27 | 4.2 |
| 30 | 4.8 |
| 33 | 5.4 |
| 36 | 6.0 |

   b. Test time is the time required for vacuum to drop from 3.5 to 2.5 psi.
   c. Use a vacuum pump with the capacity to evacuate sewer test section in time equal or less than that shown in the Table 4060.03 for the size of pipe being tested.
   d. Evacuate air until internal air pressure of the sewer line is lowered by approximately 4.0 psi. Allow the air pressure to stabilize.

**3.04 SANITARY SEWER LEAKAGE TESTING (Continued)**

e. When the air pressure is stabilized near the starting test vacuum of 3.5 psi, commence the test by allowing gage pressure to drop to 3.5 psi, then commence time recording. Record the drop in vacuum for the test period.
f. If the drop in vacuum is 1.0 psi or less during the test period, the test will be considered successfully passed.
g. If the drop in vacuum is greater than 1.0 psi during the test period, inspect, evaluate, repair, and retest.

**3.05 DEFLECTION TESTING**

A. Perform deflection tests on all flexible sanitary sewer pipes, including PVC, closed-profile PVC, and PVC truss, and on all HDPE storm sewer or culvert pipe 12 inches in diameter or greater.

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

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

D. Pull approved 9-arm deflection mandrel through sewer by hand.

E. The approved mandrel must comply with applicable ASTM Standards.

F. Remove and replace pipe exceeding deflection limits.

G. Handle and divert existing flows during deflection testing.

**3.06 FORCE MAIN TESTING**

A. Clean the force main as specified prior to testing.

B. Provide test pumps, test plugs, pipe, and gages. Make necessary piping connections.

C. Fill the force main with potable water and flush before testing to remove entrapped air. Other water sources may be used if approved by the Engineer.

D. Insert taps as required to remove air. Plug taps after the completion of tests.

E. Use a test pressure of 1.5 times the working pressure at the lowest point along the test section, but not less than 50 psi.

F. Pressurize the test section and allow it to stabilize prior to beginning the leakage test.

**3.06 FORCE MAIN TESTING (Continued)**

G. Pressurize the test section to the specified test pressure and maintain pressure to within 5 psi of test pressure by pumping in potable water as required.

H. Leakage is the quantity of water that must be supplied into the test section to maintain pressure within 5 psi of the specified test pressure during the 2 hour test period.

I. The maximum allowable leakage is determined by the following formula:

$$L = \frac{(S)(D)(P)^{0.5}}{133{,}200}$$

Where:
L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal pipe diameter in inches
P = average test pressure in pounds per square inch

**Table 4060.04: Maximum Allowable Leakage Rate (P = 50 psi, S = 1,000 feet)**

| Nominal Pipe Size (inches) | Allowable Leakage (gallons per hour) |
|---|---|
| 4 | 0.21 |
| 6 | 0.32 |
| 8 | 0.42 |
| 10 | 0.53 |
| 12 | 0.64 |
| 14 | 0.74 |
| 16 | 0.85 |

J. Examine exposed pipe and fittings during testing. Repair all visible leaks.

K. If the test indicates leakage greater than allowed, locate, repair, or replace damaged or defective pipe, and repeat tests until the requirements are met.

END OF SECTION

# Division 5 Specifications
## Water Mains and Appurtenances

# Division 5
# Water Main and Appurtenances

SUDAS staff, in conjunction with its water main committee, prepared the initial revision of this division. Work under this project involved reviewing the draft to ensure that the new specification did not create inconsistencies with the Iowa DOT specifications. The results contained herein contain both the revisions made by SUDAS and the revisions made under this project.

The original organization of Division 5 was retained as follows:

- 5010: Pipe and Fittings
- 5020: Valves, Fire Hydrants, and Appurtenances
- 5030: Testing and Disinfection

Section 5010 covers water main pipe and fittings. Section 5020 covers water main accessories. Section 5020 was renamed from "Valves, Hydrants, and Appurtenances" to "Valves, Fire Hydrants, and Appurtenances." Section 5030 covers Testing and Disinfection of water mains.

All three sections were re-written to the imperative mood. Language redundant with Division 1 was removed. The bid items were converted to a 3-part format indicating the method of measurement, basis of payment, and incidental work for each item.

# Summary of Changes to Section 5010
# Pipe and Fittings

| | Location | Comments |
|---|---|---|
| 1 | 1.08 | *Measurement and Payment:* Developed separate bid items for water main with and without a casing pipe, and for water main installed in a trench or installed with trenchless techniques. |
| 2 | 1.08, C | *Fittings:* Added option to pay for fittings by weight in lieu of count |
| 3 | 2.01, A | *PVC Pipe:* Added joint requirements for restrained joint pipe to accommodate trenchless and casing installation. |
| 4 | 2.08 | *Non-Shrink Grout*: Added specification for non-shrink grout. Previously no guidance was provided. |
| 5 | 2.08 | *Casing Pipe:* Added specification reference for casing pipe requirements. Previously, no guidance was provided. |
| 6 | 3.02 | *Ductile Iron Requirements:* Required use of full length gauged pipe for field cuts, or pipe must be field gauged. |
| 7 | 3.03 | *PVC Requirements:* added additional requirements regarding jointing of PVC pipe. |
| | | |

# PIPE AND FITTINGS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Pipe

B. Fittings

C. Special Fittings

D. Pipeline Accessories

### 1.02 DESCRIPTION OF WORK

Construct water mains and building service pipes.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants as well as the following:

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

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants as well as the following:

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

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

### A. Water Main:

1. Trenched:
   a. Measurement: Each type and size of pipe installed in an open trench will be measured in linear feet along the centerline of the pipe, including the length through the fittings.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, tracer system, testing, disinfection, and polyethylene wrap for ductile iron pipe and fittings.

2. Trenchless:
   a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the casing pipe. Additional pipe installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; tracer system; testing; and disinfection.

### B. Water Main with Casing Pipe:

1. Trenched:
   a. Measurement: Each type and size of pipe with a casing pipe installed in an open trench, will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.
   b. Payment: Payment will be made at the unit price for each type and size of carrier pipe.
   c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, casing spacers, furnishing and installing annular space fill material, tracer system, testing, and disinfection.

2. Trenchless:
   a. Measurement: Each type and size of pipe properly installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe. Additional pipe and casing installed beyond the length specified in the contract documents will not be measured unless the Engineer provides prior authorization.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

b. Payment: Payment will be made at the unit price for each type and size of carrier pipe.
c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; tracer system; testing; and disinfection.

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

1. Fittings by Count:
   a. Measurement: Each type and size of fitting installed as specified in the contract documents or as required for proper installation of the water main will be counted. Fittings not specified in the contract documents, installed at the Contractor's option, will not be counted.
   b. Payment: Payment will be made at the unit price for each type and size of fitting.
   c. Includes: Unit price includes, but is not limited to, restrained joints and thrust blocks.

2. Fittings by Weight:
   a. Measurement: Each type and size of fitting installed as specified in the contract documents or as required for proper installation of the water main will be counted. Fittings not specified in the contract documents, installed at the Contractor's option, will not be counted. Determine the total weight of fittings counted, in pounds, based upon the standard fitting weights published in AWWA C153 for ductile iron compact fittings.
   b. Payment: Payment will be made at the unit price per pound.
   c. Includes: Unit price includes, but is not limited to, restrained joints and thrust blocks.

**D. Water Service Stubs:**

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

2. Payment: Payment will be made at the unit price.

3. Includes: Unit price includes, but is not limited to, corporation, service pipe, stop, and stop box.

## PART 2 - PRODUCTS

### 2.01 WATER MAIN

#### A. Polyvinyl Chloride (PVC) Pipe:

1. Comply with AWWA C900 or AWWA C905 with gray iron pipe equivalent outside diameters.

2. Minimum Wall Thickness:
   a. 4 inch through 24 inch sizes: DR 18.
   b. Sizes over 24 inch: As specified in the contract documents.

3. Joint Type: Use push-on joint type, except as otherwise required in the contract documents or as authorized by the Engineer.
   a. Push-on: According to AWWA C900 or AWWA C905.
   b. Integral Restrained Joint: AWWA C900 or AWWA C905 pipe with restraining system manufactured integrally into pipe end.
   c. Mechanical Restrained Joint: Ductile iron mechanical device designed for joint restraint of AWWA C900 or AWWA C905 pipe complying with the requirements of ASTM F 1674.

4. Markings on Pipe:
   a. Name of manufacturer.
   b. Size and class.
   c. Spigot insertion depth gauge.
   d. National Sanitation Foundation (NSF) seal.

#### B. Ductile Iron Pipe:

1. Minimum Thickness Class:
   a. 4-inch through 24-inch sizes: Special thickness Class 52 per AWWA C151.
   b. Sizes over 24 inches: As specified in the contract documents.

2. Cement-mortar Lined: According to AWWA C104 with asphalt seal coat.

3. External Coating: Asphalt per AWWA C151.

4. Joint Type: Use push-on type, except as otherwise required in the contract documents or as authorized by the Engineer.
   a. Push-on: According to AWWA C111.
   b. Mechanical: According to AWWA C111.
   c. Restrained, Buried: Pipe manufacturer's standard field removable system.
   d. Restrained, in Structures: Restraining gland, flanged or grooved.
   e. Flanged: According to AWWA C111.
   f. Grooved: According to AWWA C606.
   g. Gaskets: According to AWWA C111.

**2.01 WATER MAIN (Continued)**

5. Markings on Pipe:
   a. Name of manufacturer.
   b. Size and class.
   c. Spigot insertion depth gauge.

**C. Prestressed Concrete Cylinder Pipe:**

1. Design and manufacture according to AWWA C301 and AWWA C304 to meet the following minimum conditions:
   a. Internal Pressure: 150 psi.
   b. Earth Loads: Actual trench depth, but not less than 6 feet.
   c. Live Loads: HS 20 vehicle over trench.
   d. Surge Pressure: Allowance 60 psi.
   e. Bedding: Type R2, AWWA C304, Figure 9.
   f. Safety Factor: 2.5.

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

**2.02 BOLTS FOR WATER MAIN AND FITTINGS**

Use corrosion resistant bolts.

**A. Tee-bolts and Hexagonal Nuts for Mechanical Joints:**

1. High-strength, low-alloy steel manufactured according to AWWA C111.

2. Provide ceramic-filled, baked-on, fluorocarbon resin coating for bolts and nuts.

3. Include factory-applied lubricant that produces low coefficient of friction for ease of installation.

**B. Other Bolts and Nuts:**

1. Stainless steel.

2. Ductile iron.

3. Zinc, zinc chromate, or cadmium plated.

## 2.03 FITTINGS

**A. For Ductile Iron and PVC Pipe:**

1. Comply with AWWA C110 or AWWA C153.

2. Joint Type:
   a. For pipe sizes 16 inches and less, use mechanical joint complying with AWWA C111.
   b. For pipe sizes greater than 16 inches, use restrained mechanical joint system. Provide follower gland using breakaway torque bolts to engage thrust restraint.
      1) Minimum pressure rating same as connecting pipe. For fittings between dissimilar pipes, the minimum pressure rating is the lesser of the two pipes.
      2) Suitable for buried service.
      3) Joint restraint system to be field installable, field removable, and re-installable.
   c. Use of alternate restraint systems must be approved by the Engineer.

3. Cement-mortar lined according to AWWA C104 with asphalt coating.

4. Wall Thickness: According to AWWA C153.

5. Gaskets: According to AWWA C111.

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

**C. Flange Adapter:**

1. Body: Ductile iron complying with ASTM A 536.

2. End Rings (Follower Rings): Ductile iron complying with ASTM A 536.

3. Gaskets: New rubber compounded for water service and resistant to permanent set.

4. Bolts and Nuts: High strength, low alloy corrosion resistant steel or carbon steel bolts complying with ASTM A 307.

**D. Pipe Coupling:**

1. Center Sleeve (Center Ring): Steel pipe or tubing complying with ASTM A 53 or ASTM A 512, or formed carbon steel with a minimum yield of 30,000 psi.

2. End Ring (Follower Ring): Ductile iron complying with ASTM A 536, or steel meeting or exceeding the requirements of ASTM A 576, grade 1010-1020.

**2.03 FITTINGS (Continued)**

3. Gaskets: New rubber compounded for water service and resistant to permanent set.

4. Bolts and Nuts: High strength, low alloy corrosion resistant steel.

**2.04 CONCRETE THRUST BLOCKS**

A. Use concrete with a compressive strength of 4000 psi at 28 days.

B. Comply with the contract documents for dimensions and installation of thrust blocks. Comply with Figure 5010.1.

C. Use for all pipe sizes 16 inches in diameter or smaller or when specified.

**2.05 PIPELINE ACCESSORIES**

**A. Polyethylene Wrap:**

1. Use on all ductile iron pipe and fittings in buried service.

2. Comply with AWWA C105.

3. 8 mil minimum thickness.

**B. Tracer System:** Comply with Figure 5010.3.

1. Tracer Wire: #12 AWG solid single copper conductor.
   a. Insulation Material: Linear low-density polyethylene (LLDPE) installation suitable for direct burial applications.
   b. Insulation Thickness: 0.045 inches, minimum.

2. Ground Rod: 3/8 inch diameter, 60 inch steel rod uniformly coated with metallically bonded electrolytic copper.

3. Ground-rod Clamp: High-strength, corrosion-resistant copper alloy.

4. Splice Kit: Inline resin splice kit with split bolt for 1 kV and 5 kV. Insulates and seals single conductor and unshielded cable splices for direct bury and submersible applications.

5. Tracer Wire Station: Contact the Jurisdiction for requirements.

**2.06 SPECIAL GASKETS**

A. For soils contaminated with gasoline, use neoprene or nitrile gaskets. For soils contaminated with volatile organic compounds, use nitrile or fluorocarbon gaskets.

**2.06 SPECIAL GASKETS (Continued)**

B. For other soil contaminants, contact the Engineer for the required gasket.

**2.07 WATER SERVICE PIPE AND APPURTENANCES**

**A. Controlling Standards:** Local plumbing and fire codes.

**B. Materials** (as allowed by Jurisdiction or specified in contract documents)**:**

1. Copper Pipe:
   a. Comply with ASTM B 88.
   b. Wall Thickness: Type K.

2. Ductile Iron Pipe: As specified in Section 5010, 2.01. Polyethylene wrap is required.

3. PVC Pipe: ASTM D 1785, SDR 21, Schedule 80, Type S joints.

4. Brass Pipe: Red, seamless, according to ASTM B 43.

5. Polyethylene Pipe: Class 200, according to AWWA C901.

**C. Corporations and Stop Boxes:** Contact the Jurisdiction for requirements.

**2.08 NON-SHRINK GROUT**

Comply with Iowa DOT I.M. 491.13.

**2.09 CASING PIPE**

Comply with Section 3020.

## PART 3 - EXECUTION

### 3.01 PIPE INSTALLATION

**A. General:**

1. Do not use deformed, defective, gouged, or otherwise damaged pipes or fittings.

2. Keep trench free of water. Clean pipe interior prior to placement in the trench.

3. Install pipe with fittings and valves to the lines and grades specified in the contract documents.

4. Clean joint surfaces thoroughly and apply lubricant approved for use with potable water and recommended by the manufacturer.

5. Push pipe joint to the indication line on the spigot end of the pipe before making any joint deflections.

6. Limit joint deflections to one degree less than pipe manufacturer′s recommended maximum limit.

7. Tighten bolts in a joint evenly around the pipe.

8. Install concrete thrust blocks on pipes 16 inches in diameter or smaller (comply with Figure 5010.1). For pipes larger than 16 inches, install restrained joints; when specified in the contract documents, also install concrete thrust blocks.

9. Keep exposed pipe ends closed with rodent-proof end gates at all times when pipe installation is not occurring.

10. Close the ends of the installed pipe with watertight plugs during nights and non-working days.

11. Do not allow any water from the new pipeline to enter the existing distribution system piping until testing and disinfection are successfully completed.

**B. Trenched:**

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

2. Provide uniform bearing along the full length of the pipe barrel. Provide bell holes.

**C. Trenchless:** Comply with Section 3020.

## 3.02 ADDITIONAL REQUIREMENTS FOR DUCTILE IRON PIPE INSTALLATION

A. Utilize full-length gauged pipe for field cuts. Alternatively, field-gauge pipe selected for cutting to verify the outside diameter is within allowable tolerances.

B. Cut the pipe perpendicular to pipe barrel. Do not damage cement lining. Bevel cut the ends for push-on joints according to the manufacturer's recommendations.

C. Encase all pipe, valves, and fittings with polyethylene wrap. Comply with Figure 5010.2.

## 3.03 ADDITIONAL REQUIREMENTS FOR PVC PIPE INSTALLATION

A. Cut the pipe perpendicular to the pipe barrel. Deburr and bevel cut spigot end of the pipe barrel to match factory bevel. Re-mark the insertion line.

B. When connecting to shallow-depth bells, such as on some cast iron fittings or valves, cut the spigot end square to remove factory bevel. Deburr the end and form a partial bevel on the end.

## 3.04 ADDITIONAL REQUIREMENTS FOR PRESTRESSED CONCRETE CYLINDER PIPE INSTALLATION

A. Install according to AWWA M9.

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

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

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

## 3.05 POLYETHYLENE ENCASEMENT INSTALLATION

A. Apply to all buried iron pipe, fittings, fire hydrants, and appurtenances.

B. Wrap material snugly around pipe, but provide sufficient slack to prevent stretching around irregular areas such as fittings and valves. Comply with Figure 5010.2.

C. Secure and repair encasement material using polyethylene tape, or replace as necessary.

D. The polyethylene encasement is to prevent contact between the pipe and the bedding material, but need not be airtight or watertight.

## 3.06 TRACER SYSTEM INSTALLATION

A. Install with all buried water main piping. Comply with Figure 5010.3 for tracer wire installation.

B. Begin and terminate the system at all connections to existing mains.

C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 2-inch wide, 10 mil thickness polyethylene pressure sensitive tape.

D. Install splices only as authorized by the Engineer. Allow the Engineer to inspect all below-grade splices of tracer wire prior to placing the backfill material.

E. Install ground rods adjacent to connections to existing piping and at locations specified in the contract documents or as directed by the Engineer.

F. Bring two wires to the surface at each hydrant location and terminate with a tracer wire station (comply with Figure 5010.3).

G. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair discontinuities.

## 3.07 CONFLICTS

A. Provide temporary support for existing gas, telephone, power, or other utilities or services that cross the trench.

B. Compact backfill material under existing utility crossing as specified in Section 3010 or construct utility line supports where specified in the contract documents or as directed by the Engineer.

C. The following separation information is derived from Iowa DNR's *Iowa Wastewater Facilities Design Standards*, Chapter 12, Section 12.5.8

1. Horizontal Separation of Gravity Sewers from Water Mains: Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet unless:
   a. The top of a sewer main is at least 18 inches below the bottom of the water main, and
   b. The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.
   c. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Section 4010, 2.02. However, provide a linear separation of at least 2 feet.

**3.07 CONFLICTS (Continued)**

2. Separation of Sewer Force Mains from Water Mains: Separate sewer force mains and water mains by a horizontal distance of at least 4 linear feet.

3. Separation of Sewer and Water Main Crossovers:
   a. Vertical separation of sanitary sewers crossing under any water main should be at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, the sewer may be placed not closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases.
   b. Where the sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material so both joints are as far as possible from the water main. The sewer and water pipes must be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

**3.08 TRANSITIONS IN PIPING SYSTEMS**

Where the specified material of a piping system entering or exiting a structure changes, make the change at the outside of the structure wall, beyond any wall pipe or wall fitting required, unless otherwise specified.

**3.09 STRUCTURE PENETRATIONS**

**A. Wall Pipes:**

1. Install where pipes penetrate and terminate at a wall or floor surface of a concrete structure, or where the pipe protrudes through the concrete wall or floor and the protrusion is otherwise unsupported.

2. Provide a waterstop flange near the center of the embedment length. Waterstop is to be cast integrally with the wall pipe, or fully welded to it around the pipe circumference.

**B. Wall Sleeves:**

1. Install where a pipe passes through a structure wall.

2. Sleeves in concrete walls are to be supplied with a waterstop collar, fully welded, and cast-in-place in the concrete.

### 3.10 WATER SERVICE STUB

A. Install water service pipe, corporations, stops, and stop boxes according to local Jurisdiction requirements.

B. Install 1 inch and smaller corporation valves tapped at 45 degrees above horizontal at a minimum distance of 18 inches from pipe bell or other corporation. Install 1 1/2 inch and 2 inch corporation valves tapped horizontal a minimum distance of 24 inches from pipe bell or other corporation.

C. Construct trench and place backfill material according to Section 3010.

### 3.11 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

# Summary of Changes to Section 5020
# Valves, Fire Hydrants, and Appurtenances

| | Location | Comments |
|---|---|---|
| 1 | 1.08, A | *Butterfly or Gate Valve:* Combined bid items for butterfly and gate valves. |
| 2 | 2.01, A | Valves: made direction of opening counterclockwise as the default. |
| 3 | 2.01, C | *Butterfly Valves:* Updated the material requirements for butterfly valves. |
| 4 | 2.01, D | *Tapping Valves:* Reduced the required pressure rating for tapping sleeves from 200 psi to 150 psi. 150 psi tapping sleeves are much more common, and match the pressure rating of the pipe. |
| 5 | 2.03, C | *Valve Stem Extension:* Added specifications for a valve stem extension. |
| | | |

# VALVES, FIRE HYDRANTS, AND APPURTENANCES

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Butterfly Valves

B. Gate Valves

C. Tapping Valve Assemblies

D. Fire Hydrant Assemblies

E. Flushing Devices (Blowoffs)

F. Valve Boxes

### 1.02 DESCRIPTION OF WORK

Install valves, fire hydrants, and appurtenances for water mains.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants, as well as the following:

Remove valves, fire hydrants, and appurtenances contaminated with mud and surface water from the site; do not use in construction unless thoroughly cleaned, inspected, and approved by the owner.

### 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

### A. Valve (Butterfly or Gate):

1. Measurement: Each type and size of valve will be counted.

2. Payment: Payment will be at the unit price for each type and size of valve.

3. Includes: Unit price includes, but is not limited to, all components attached to the valve or required for its complete installation, including underground or above ground operator, square valve operating nut, valve box and cover, valve box extension, and valve stem extension.

### B. Tapping Valve Assembly:

1. Measurement: Each size of tapping valve assembly will be counted.

2. Payment: Payment will be at the unit price for each tapping valve assembly.

3. Includes: Unit price includes, but is not limited to, tapping sleeve, tapping valve, the tap, valve box and cover, valve box extension, and valve stem extension.

### C. Fire Hydrant Assembly:

1. Measurement: Each fire hydrant assembly will be counted.

2. Payment: Payment will be at the unit price for each fire hydrant assembly.

3. Includes: Unit price includes, but is not limited to, the fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchor pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchor pipe, fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve, except tapping valve assembly if used.

### D. Flushing Device (Blowoff):

1. Measurement: Each size of flushing device will be counted.

2. Payment: Payment will be at the unit price for each flushing device

## PART 2 - PRODUCTS

### 2.01 VALVES

**A. General:**

1. Same size as pipeline in which it is installed, unless otherwise specified in the contract documents.

2. Manufacturer′s name and pressure rating cast on valve body.

3. Direction of Opening: The opening direction is counterclockwise as viewed from the top, unless otherwise specified in the contract documents or as directed by the Jurisdiction.

4. Joints:
   a. For buried installations, use mechanical joints per AWWA C111. Comply with Section 5010 for joint nuts and bolts.
   b. For installation within structures, flanged with dimensions and drillings according to AWWA C110 or ANSI B16.1 class 125.

**B. Gate Valves:**

1. Comply with AWWA C509 (gray iron or ductile iron) or AWWA C515 (ductile iron) and NSF 61.

2. Stem Seals: Double O-rings permanently lubricated between seals. Lubricant certified for use in potable water.

3. External Bolts and Hex Nuts: Stainless steel according to ASTM A 240, Type 304.

**C. Butterfly Valves:**

1. Comply with AWWA C504 class 150B (gray iron or ductile iron) and NSF 61.

2. Disc: Ductile iron or gray iron with plasma applied nickel-chromium edge or stainless steel edge according to ASTM A 240, Type 316, and mechanically fixed stainless steel pins.

3. Stem: Stainless steel according to ASTM A 240, Type 304, turned, ground, and polished.

4. Seat: Synthetic rubber compound bonded or mechanically retained to the body.

5. External Bolts and Hex Nuts: Stainless steel according to ASTM A 240, Type 304.

## 2.01 VALVES (Continued)

**D. Tapping Valve Assemblies:**

1. Tapping Valve: Gate valve complying with AWWA C509 or AWWA C515.

2. Sleeve:
   a. Minimum 14 gauge.
   b. Stainless steel according to ASTM A 240, Type 304.
   c. Working pressure 150 psi.
   d. Must fully surround pipe.
   e. Flanged with dimensions and drillings per AWWA C110 or ANSI B16.1 class 125.

3. Minimum Sleeve Length: Comply with the following table.

**Table 5020.01: Minimum Sleeve Length**

| Outlet Flange Size | Minimum Sleeve Length |
|---|---|
| 4” | 15” |
| 6” | 15” |
| 8” | 20” |
| 10” | 25” |
| 12” | 25” |
| Over 12” | As approved by the Engineer |

4. Gasket:
   a. To completely surround pipe.
   b. Minimum thickness 0.125 inch.
   c. Use nitrile rubber.

5. Outlet Flange:
   a. Stainless steel ASTM A 240, Type 304.
   b. ANSI B16.1, 125 pound pattern.

6. Hex Nuts and Bolts: Stainless steel according to ASTM A 240, Type 304.

7. Use tapping valve assemblies only where specified in the contract documents.

## 2.02 FIRE HYDRANT ASSEMBLY

**A. Material:** Comply with AWWA C502.

**B. Manufacturers:** As allowed by the Jurisdiction or as specified in the contract documents.

**2.02 FIRE HYDRANT ASSEMBLY (Continued)**

**C. Features:**

1. Breakaway stem coupling and breakaway flange.

2. Inlet Nominal Size: 6 inch diameter.

3. Inlet Connection Type: Mechanical joint.

4. Hose Nozzles: Two, each 2 1/2 inches in diameter.

5. Direction of Opening: Counterclockwise, unless otherwise specified.

6. The following items will be specified by the Jurisdiction or contract documents:
   a. Operating nut.
   b. Pumper nozzle.
   c. Nozzle threads.
   d. Main valve nominal opening size.

**D. Painting:**

1. Shop coating according to AWWA C502.

2. Above grade exterior coating type and color will be selected by the Engineer.

**E. External Bolts and Hex Nuts:** Stainless steel according to ASTM A 193, Grade B 8.

**F. Gate Valve:** Comply with Section 5020, 2.01.

**G. Pipe and Fittings:** Comply with Section 5010.

**2.03 APPURTENANCES**

**A. Flushing Device (Blowoff):** As specified in the contract documents.

**B. Valve Box:**

1. Applicability: For all buried valves.

2. Manufacturer: As allowed by the Jurisdiction or specified in the contract documents.

3. Type:
   a. In paved areas, use a slide type.
   b. In all other areas, use a screw extension type.

**2.03 APPURTENANCES (Continued)**

4. Material: Gray iron.

5. Cover: Gray iron, labeled "WATER"

6. Wall Thickness: 3/16-inch, minimum.

7. Inside Diameter: 5 inches, minimum.

8. Length: Adequate to bring top to finish grade, including valve box extensions, if necessary.

9. Factory Finish: Asphalt coating.

10. Valve Box Centering Ring: Include in installation.

**C. Valve Stem Extension:** For all buried valves, provide as necessary to raise 2-inch operating nut to within 3 feet of the finish grade. Stem diameter according to valve manufacturer's recommendations, but not less than 1 inch.

## PART 3 - EXECUTION

### 3.01 GENERAL

A. Install according to the contract documents.

B. Apply polyethylene wrap to all iron pipe, valves, fire hydrants, and fittings.

C. Set tops of valve boxes to finish grade unless otherwise directed by the Engineer.

D. Check the working order of all valves by opening and closing through entire range. Before opening the valves, check with the Jurisdiction on operating requirements.

E. Test and disinfect all valves, fire hydrants, and appurtenances as components of the completed water main according to Section 5030.

### 3.02 FLUSHING DEVICE (BLOWOFF)

Install and construct as specified in the contract documents.

### 3.03 FIRE HYDRANT

A. Install according to Figure 5020.1.

B. If the fire hydrant valve is positioned adjacent to the water main, attach it to an anchor tee.

C. If the fire hydrant valve is positioned away from the water main, restrain all joints between the valve and water main.

D. Fire Hydrant Depth Setting:

1. Use adjacent finish grade to determine setting depth.

2. Set bottom of breakaway flange between 2 and 5 inches above finish grade.

3. If finish grade is not to be completed during the current project, consult with the Engineer for proper setting depth.

E. Coordinate installation with tracer wire installation.

F. Orient fire hydrant nozzles as directed by the Engineer.

END OF SECTION

# Summary of Changes to Section 5030
# Testing and Disinfection

| | Location | Comments |
|---|---|---|
| 1 | 1.08 | *Measurement for Payment:* Clarified that Testing and disinfection are incidental. |
| 2 | 2.01 | *Disinfecting Agent:* Added liquid chlorine as an acceptable disinfecting agent. |
| 3 | 3.01 | *Sequence of Testing and Disinfection:* Renamed section from Sequence of Operation and added tablet method as an alternative disinfection method. Reordered the sequence of testing and disinfection to require disinfection of the line prior to pressure testing. |
| 4 | 3.02 | *Initial Flushing:* Added table indicating required flow rate to achieve flushing velocity. |
| 5 | 3.03 | *Disinfection:* Added provisions to accommodate the tablet method of disinfection. |
| 6 | 3.05 | *Pressure and Leak Testing:* Revised equation for determining allowable leakage rate. |
| 7 | 3.06 | *Bacteria Testing:* Added new section on bacteria sampling |
| | | |

# TESTING AND DISINFECTION

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Pressure and Leak Testing of Water System

B. Disinfection of Potable Water Systems

### 1.02 DESCRIPTION OF WORK

Test and disinfect water mains, valves, fire hydrants, and appurtenances.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

A. Notify the Engineer two working days in advance of testing or disinfection operations to coordinate the operations.

B. The Engineer or his/her representative must be in attendance during testing or disinfection.

### 1.07 SPECIAL REQUIREMENTS

Comply with the standards of the Iowa Department of Natural Resources.

### 1.08 MEASUREMENT AND PAYMENT

Testing and disinfection of water systems is incidental to the construction of pipe and fittings.

## PART 2 - PRODUCTS

### 2.01 DISINFECTION AGENT - CHLORINE

A. Liquid Chlorine, according to AWWA B300 and AWWA B301.

B. Sodium Hypochlorite, according to AWWA B300.

C. Calcium Hypochlorite, according to AWWA B300.

D. All disinfecting agents to be NSF 60 certified. Supply and store in the original container.

## PART 3 - EXECUTION

### 3.01 SEQUENCE OF TESTING AND DISINFECTION

A. Perform operations according to AWWA C651 in the following sequence:

1. Continuous-Feed or Slug Method (After Water Main Installation): The sequence of testing and disinfection may be modified with approval of the Engineer.

   a. Perform initial flush.

   b. Perform disinfection.

   c. Flush after disinfection.

   d. Perform pressure and leak testing.

2. Tablet Method (Concurrent with Water Main Installation): Use this method only if approved by the Engineer. Modify the procedure for flushing, disinfection, and pressure and leak testing as needed if tablet method is used.

   a. Perform disinfection.

   b. Flush after disinfection.

   c. Perform pressure and leak testing.

B. Successfully complete each operation before continuing to the next operation.

C. The Jurisdiction will provide reasonable quantities of water for flushing and testing.

### 3.02 INITIAL FLUSHING

**A. Flushing:**

1. Coordinate flushing with Jurisdiction.

2. Flush pipe prior to disinfection using potable water.

3. Measure flushing velocity.

4. Obtain a minimum flushing velocity of 2.5 feet per second in the pipe to be disinfected.

**3.02 INITIAL FLUSHING (Continued)**

**B. Minimum Flushing Rate:** According to AWWA C651, Table 3, based on 40 psi residual pressure (see table below).

**Table 5030.01: Minimum Flushing Rate**

| Pipe Diameter (inches) | Flow Rate for Flushing (gpm) | Number of Taps[2] | | | Number of 2-1/2" Fire Hydrant Outlets[1] |
|---|---|---|---|---|---|
| | | 1" | 1-1/2" | 2" | |
| 4 | 100 | 1 | - | - | 1 |
| 6 | 200 | - | 1 | - | 1 |
| 8 | 400 | - | 2 | 1 | 1 |
| 10 | 600 | - | 3 | 2 | 1 |
| 12 | 900 | - | - | 2 | 2 |
| 16 | 1,600 | - | - | 4 | 2 |

[1]With a 40-psi pressure in the main with the hydrant flowing to atmosphere, a 2-1/2 inch fire hydrant outlet will discharge approximately 1,000 gpm; and a 4-1/2 inch fire hydrant outlet will discharge approximately 2,500 gpm.

[2]Number of taps on pipe based on discharge through 5 feet of galvanized iron pipe with one 90° elbow.

**C. Property Protection:** Protect public and private property from damage during flushing operations.

**3.03 DISINFECTION**

**A. General:**

1. Disinfect according to AWWA C651. The tablet method contained in AWWA C651 is not to be used unless approved by the Engineer.

2. Keep piping to be chlorinated isolated from lines in service and from points of use.

3. Coordinate disinfection and testing with the Engineer.

4. Obtain and test water samples, unless otherwise provided by the Engineer.

**B. Procedure:**

1. Induce flow of potable water through the pipe.

2. Introduce highly chlorinated water to the pipe at a point within 5 pipe diameters of the pipe's connection to an existing potable system, or within 5 pipe diameters of a closed end, if there is no connection to an existing system.

### 3.03 DISINFECTION (Continued)

3. Introduce water containing a minimum of 25 mg/L free chlorine until the entire new pipe contains a minimum of 25 mg/L free chlorine.

4. Retain chlorinated water in pipe for at least 24 hours and no more than 48 hours.

### 3.04 FINAL FLUSHING

A. Flush pipe using potable water until chlorine residual equals that of the existing potable water system.

B. Dispose of chlorinated water, which is flushed from the new piping, to prevent damage to the environment. Dechlorinate highly chlorinated water from testing before releasing into the ground or sewers. Obtain Jurisdiction approval prior to flushing activities.

1. Check with the local sewer department for the conditions of disposal to the sanitary sewer.

2. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in the following table.

**Table 5030.02: Amounts of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water**

| Residual Chlorine Concentration mg/L | Sulfur Dioxide ($SO_2$) lb | Sodium Bisulfite ($NaHSO_3$) lb | Sodium Sulfite ($Na_2SO_3$) lb | Sodium Thiosulfate ($Na_2S_2O_3 + 5H_2O$) lb | Ascorbic Acid ($C_6O_8H_6$) lb |
|---|---|---|---|---|---|
| 1 | 0.8 | 1.2 | 1.4 | 1.2 | 2.1 |
| 2 | 1.7 | 2.5 | 2.9 | 2.4 | 4.2 |
| 10 | 8.3 | 12.5 | 14.6 | 12.0 | 20.9 |
| 50 | 41.7 | 62.6 | 73.0 | 60.0 | 104 |

## 3.05 PRESSURE AND LEAK TESTING

A. Remove debris from within the pipe. Clean and swab out pipe, if required.

B. Secure unrestrained pipe ends against uncontrolled movement.

C. Isolate new piping from the existing water system.

D. Fill and flush all new piping with potable water. Ensure all trapped air is removed.

E. Pressurize the new pipe to the test pressure at the highest point in the isolated system. Do not pressurize to more than 5 psi over the test pressure at the highest point in the isolated system.

F. Test and monitor the completed piping system at 1.5 times the system working pressure or 150 psi, whichever is greater, for 2 continuous hours.

G. If at any time during the test the pressure drops to 5 psi below the test pressure, repressurize the pipe by pumping in potable water in sufficient quantity to bring the pressure back to the original test pressure.

H. Accurately measure the amount of water required to repressurize the system to the test pressure.

I. Maximum allowable leakage rate according to AWWA C600:

$$L = \frac{(N)(D)(P)^{1/2}}{7{,}400}$$

Where:
L = allowable leakage, in gallons per hour.
N = number of joints in pipe test section.
D = pipe diameter, in inches.
P = average test pressure, psig.

**3.05 PRESSURE AND LEAK TESTING (Continued)**

The following table assumes an average test pressure of 150 psi, 18 foot pipe lengths, and no fittings.

**Table 5030.03: Maximum Allowable Leakage Rate**

| Pipe Diameter (inches) | Maximum Allowable Leakage Rate (gallons per hour per 1,000 feet of pipe) |
|---|---|
| 4 | 0.37 |
| 6 | 0.55 |
| 8 | 0.74 |
| 10 | 0.92 |
| 12 | 1.10 |
| 14 | 1.29 |
| 16 | 1.47 |
| 18 | 1.66 |
| 20 | 1.84 |
| 24 | 2.21 |
| 30 | 2.76 |
| 36 | 3.31 |

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

K. If the measured pressure loss does not exceed 5 psi, the test will be considered acceptable.

L. Repair all visible leaks regardless of the amount of leakage.

**3.06 BACTERIA SAMPLING**

Test water mains according to AWWA C651. If the initial disinfection procedure fails to produce satisfactory bacteriological results or if other water quality is affected, repeat the disinfection procedure.

**3.07 PUTTING WATER MAIN IN SERVICE**

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

END OF SECTION

# Division 6 Specifications
## Structures for Sanitary and Storm Sewers

# Division 6
# Structures for Sanitary and Storm Sewers

Division 6 was reorganized. Originally, Division 6 was organized as follows:

- Section 6010: Concrete (Structural)
- Section 6020: Manholes
- Section 6030: Intakes
- Section 6040: Testing

Sections 6010 through 6030 were combined into a single specification. There were two reasons for this change. First, the Iowa DOT specifications already contain information concerning structural concrete, generally for use with bridge and culvert structures. Having a separate section titled structural concrete, intended only for use with utility structures, created confusion within the Iowa DOT Specification. While combining the three sections, much of the information within SUDAS concerning structural concrete was removed and replaced with a reference to the Structural Concrete section of the Iowa DOT specifications in order to avoid conflicts. The second reason for the combination is that work and materials involved in manhole and intake construction are nearly identical. There did not appear to be a valid reason for keeping these two items separate.

The original Section 6020 also contained specifications for manhole rehabilitation. After combining Sections 6010 through 6030 into a single specification, the rehabilitation items wer no longer appropriate for the combined specification. A new Section 6020 was developed to address manhole rehabilitation.

The revised organization of Division 6 is as follows:

- Section 6010: Structures for Sanitary and Storm Sewers
- Section 6020: Rehabilitation of Existing Manholes
- Section 6030: Testing and Inspection

All sections were re-written to the imperative mood. Language redundant with Division 1 was removed. The bid items were converted to a 3-part format indicating the method of measurement, basis of payment, and incidental work for each item.

# Summary of Changes to Section 6010
# Structures for Sanitary and Storm Sewers

| | Location | Comments |
|---|---|---|
| 1 | General | Sections 6010, 6020, and 6030 were combined into a single section. |
| 2 | 1.08 A & B | *Measurement and Payment for Manholes and Intakes:* Measurement and Payment of manholes and intakes will be by each (regardless of depth). There was a proposal to change this to include additional payment for manholes and intakes greater than 10 feet deep, but the SUDAS districts rejected it. |
| 3 | 1.08 C | *Measurement and Payment for Drop Connections:* Measurement and payment for drop connections was changed from vertical feet to each as requested by the districts. |
| 4 | 1.08 E | *Measurement and Payment for Minor Adjustment:* Manhole or Intake Adjustment, Minor: This item was changed from incidental, to a pay item by "each." Incidental items were clarified to include a new casting, chimney seal, and pavement repair. |
| 5 | 1.08 F | *Measurement and Payment for Major Adjustment:* Manhole or Intake Adjustment, Major: The incidental items were clarified to include the new intake or manhole sections. |
| 6 | 1.08 | *Manhole Rehabilitation:* The manhole rehabilitation items were moved to a new section: 6020 – Rehabilitation of Existing Manholes. |
| 7 | 1.08 | *CMP Slotted Drain:* The CMP slotted drain intake item was removed from the specifications. |
| 8 | 2.01 | *Manhole and Intake Types:* A combined table showing intake and manhole types was moved to the front of the products section. |
| 9 | 2.02, A | *Precast Concrete Materials:* Added a reference to ASTM specifications for Precast structures. |
| 10 | 2.02, B | *Cast-in-place Concrete Materials:* The current specifications call for Class C concrete and then reference either the Iowa DOT specifications or Section 7010 (which then references the Iowa DOT specifications). The specifications were revised to call for Class C concrete and then reference the Iowa DOT specifications directly. |
| 11 | 2.04 | *Non-Shrink Grout:* A reference to the Iowa DOT specification was added. Currently, there is no specification for non-shrink grout anywhere in the SUDAS manual, although it is specified in a number of locations. |
| 12 | 2.10 | *Castings:* Two types of castings are now defined: Standard and light duty. Standard duty are required in all traffic areas. |
| 13 | 3.01 C | *Subbase:* A clarification was made that for precast structures, an 8" granular base is required. This was shown in some figures, but was never included in the specifications. |
| 14 | 3.02 | *Construction of Cast-In-Place Structures:* Most of the existing sections made reference to Iowa DOT 2403 (Structural Concrete), but then included additional information or requirements, much of which was redundant to 2403. The sections were reviewed and the redundant information was removed. |
| 15 | 3.03, A | *Precast Structures:* A specific allowance was made to permit the substitution of precast structures for cast-in-place structures. The remaining items were pulled together from existing sections. |
| 16 | 3.05 | *Connection to Existing Manhole or Intake:* The sections for connection to an existing manhole or intake were moved to Division 4. |
| | | |

# 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

Follow the General Provisions (Requirements) 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.

**1.03 SUBMITTALS (Continued)**

F. Gradation and soil classification reports for structure bedding and backfill materials.

G. Dewatering plan.

**1.04 SUBSTITUTIONS**

Follow the General Provisions (Requirements) and Covenants.

**1.05 DELIVERY, STORAGE, AND HANDLING**

Follow the General Provisions (Requirements) and Covenants as well as the following:

A. Store reinforcing steel only on pallets or lagging. Replace any damaged materials.

B. Follow the aggregate storage and concrete transport requirements in Iowa DOT Article 2301.13.

**1.06 SCHEDULING**

Follow the General Provisions (Requirements) and Covenants as well as the following:

Schedule intake or manhole construction to coordinate with other work, such that trenching, backfilling, and other work can proceed in an orderly manner. Also schedule construction to provide the greatest protection for new work.

**1.07 SPECIAL REQUIREMENTS**

Do not place concrete when stormy or inclement weather will prevent good quality work. Cold weather placement is restricted per Iowa DOT Article 2403.11.

## 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, placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), chimney seals, castings, adjustment rings, and all appurtenances necessary for proper installation. Inspection of completed manhole and repair of any construction defects are incidental to this item.

**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, placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), castings, adjustment rings, and all appurtenances necessary for proper installation. Inspection of completed intake and repair of any construction defects are incidental to this item.

**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 necessary to construct the drop connection as specified in the contract documents.

**D. Casting Extension Rings:** Install casting extension rings only when allowed by the Engineer.

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 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 for each minor adjustment includes, but is not limited to, sawing and removing existing pavement when applicable, removing existing casting and existing adjustment rings, furnishing and installing adjustment rings, furnishing and installing new casting, installing new chimney seal (sanitary sewer manholes only), and pavement repair.

**F. Manhole or Intake Adjustment, Major:**

1. Measurement: Each 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: The unit price for each major adjustment 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 chimney seal (sanitary sewer manholes only); backfill; compaction; and all other necessary appurtenances.

**G. 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 | Previous Type | Description |
|---|---|---|---|---|
| Sanitary Sewer Manholes | 6010.301 | SW-301 | A | Circular Sanitary Sewer Manhole |
| | 6010.302 | SW-302 | E | Cast-in-place Flat-top Sanitary Sewer Manhole |
| | 6010.303 | SW-303 | F | Rectangular/Circular Sanitary Sewer Manhole |
| | 6010.304 | SW-304 | I | Sanitary Sewer Manhole Over Existing Sewer |
| | 6010.305 | SW-305 | J | Tee-section Sanitary Sewer Manhole |
| | | | | |
| Storm Sewer Manholes | 6010.401 | SW-401 | M-A | Circular Storm Sewer Manhole |
| | 6010.402 | SW-402 | M-B | Rectangular Storm Sewer Manhole |
| | 6010.403 | SW-403 | M-C | Deep-well Rectangular Storm Sewer Manhole |
| | 6010.404 | SW-404 | M-D | Rectangular/Circular Storm Sewer Manhole |
| | 6010.405 | SW-405 | M-E | Tee-section Storm Sewer Manhole |
| | | | | |
| Intakes | 6010.501 | SW-501 | M-E | Single Grate Intake |
| | 6010.502 | SW-502 | M-A | Circular, Single Grate Intake |
| | 6010.503 | SW-503 | M-B | Single Grate Intake with Manhole |
| | 6010.504 | SW-504 | M-C | Single Grate Intake with Flush-top Manhole |
| | 6010.505 | SW-505 | M-D | Double Grate Intake |
| | 6010.506 | SW-506 | M-E | Double Grate Intake with Manhole |
| | 6010.507 | SW-507 | M-F | Small Single Open-throat Intake |
| | 6010.508 | SW-508 | M-F (modified) | Large Single Open-throat Intake |
| | 6010.509 | SW-509 | M-I | Small Double Open-throat Intake |
| | 6010.510 | SW-510 | M-I (modified) | Large Double Open-throat Intake |
| | 6010.511 | SW-511 | M-H | Rectangular Area Intake |
| | 6010.512 | SW-512 | RCP Area | Circular Area Intake |
| | 6010.513 | SW-513 | M-G | Open-Sided Area Intake |

## 2.02 CONCRETE MATERIALS

**A. Precast:** Comply with ASTM C 478.

**B. Cast-in-place:** 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 – Mineral Admixtures
   h. 4109 – Aggregate Gradations
   i. 4110 – Fine Aggregate for Portland Cement Concrete
   j. 4115 – Coarse Aggregate for Portland Cement Concrete

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 – Inspection and Acceptance of Chemical Admixtures for Concrete
   d. 528 – Structural Concrete Plant Inspection
   e. 529 – Portland Cement Concrete Proportions
   f. 533 – Mobile Mixer Inspection

## 2.03 REINFORCEMENT

Comply with Iowa DOT Article 2404. and Section 4151.

## 2.04 NON-SHRINK GROUT

Comply with Iowa DOT 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.

**2.05 PRECAST RISER JOINTS (Continued)**

**B. Joint Sealant:**

1. Sanitary Sewers:
   a. Rubber O-ring or profile gasket, flexible joint, according to 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 AASHTO M 198.
   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 required by 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 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 CONNECTION**

**A. New Sanitary Sewer Manhole:** Fabricated or cored circular openings.

1. Flexible, watertight gasket according to ASTM C 923.

2. Install drop connection where specified in the contract documents. Comply with Figure 6010.307.

**B. New Storm Sewer Manhole or Intake:**

1. Precast Manholes: Fabricated or cored openings.

2. Cast-in-place Structures: Structure wall placed around pipe stub.

**2.08 PIPE CONNECTION (Continued)**

**C. Existing Sanitary Sewer Manhole:** Cored opening with flexible, watertight connection according to ASTM C 923. Knock-out opening allowed only when specified or allowed by the Engineer.

**2.09 MANHOLE OR INTAKE ADJUSTMENT RINGS (Grade Rings)**

A. Utilize one of the following methods 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 to 5 x 10$^3$ lb./in$^2$ |

b. Do not use polyethylene grade adjustment rings when they are exposed to HMA pavement.
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.

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.

C. Construct manholes and intakes with the following adjustment ring stack heights:

1. Minimum: 4 inches for new manholes and intakes.

2. Maximum: 12 inches for new manholes and intakes; 16 inches for existing manholes.

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

**A. Gray Cast Iron:** AASHTO M 306.

**B. Load Capacity:** Standard or light duty as shown on the casting figures.

1. Standard: Casting certified for 40,000 pound proof-load according to AASHTO M 306.

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

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.

**C. 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 | A | 2 | Fixed[2] | Yes | No | Yes[1] |
| | 6010.601 | B | 3 | Adjustable[3] | No | No | Yes[1] |
| | 6010.601 | C | 2 | Fixed[2] | Yes | Yes | Yes[1] |
| | 6010.601 | D | 3 | Adjustable[3] | No | Yes | Yes[1] |
| Storm Sewer | 6010.602 | E | 2 | Fixed[2] | Yes | No | No |
| | 6010.602 | F | 3 | Adjustable[3] | 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.

2. Intakes: Comply with the Figures 6010.601 through 6010.604 and the contract documents.

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. Chimney Seal:**

1. External Rubber 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.
      3) Comply with Figure 6010.301 for dimensional requirements.
   b. Compression Bands:
      1) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces.
      2) 16 gauge ASTM A 240, Type 304 stainless steel, minimum 1 inch width, minimum adjustment range of 4 inches more than the manhole outside diameter.
      3) For standard two-piece castings, shape top band to lock sleeve to manhole frame's base flange. For three-piece adjustable castings, shape top band to lock sleeve to upper piece of adjustable frame.
      4) Stainless steel fasteners complying with ASTM F 593 and 594, Type 304.

2. Internal Rubber Seal:
   a. Rubber Sleeve and Extension:
      1) Double pleated, minimum thickness 3/16 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.
      4) Comply with Figure 6010.301 for dimensional requirements.
   b. Expansion Bands:
      1) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces.
      2) 16 gauge ASTM A 240, Type 304 stainless steel, minimum 1 3/4 inch width, minimum adjustment range of 2 inches more than the manhole inside diameter.
      3) Stainless steel locking mechanism of studs and nuts complying with ASTM F 923 and ASTM F 594, Type 304.

**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).

**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.

## 2.12 INVERT

A. Construct manhole or intake invert up to one-half of pipe diameter to produce a smooth half pipe shape between pipe inverts. Establish a full seal between the base and base riser section. Slope invert top toward pipe 1/4 inch per foot perpendicular to flow line. Shape to provide a smooth transition between pipe inverts.

B. Use a precast invert on all precast sanitary manhole base sections, unless otherwise allowed by the Engineer. Comply with Figure 6010.301.

## 2.13 STEPS

A. Provide steps 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

**A. Material:** Stainless steel or hot-dipped galvanized.

**B. Diameter:** Minimum 1/2 inch diameter.

**C. 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 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 base and/or subbase.

2. Fill Sections: Compact to 95% of maximum Standard Proctor Density and hand grade to accurate elevation required to place base and/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 granular bedding a minimum of 12 inches outside footprint of the structure.

**D. Installation of Manhole or Intake Structure:**

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. 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.

2. Precast Storm Sewer Manholes or Intakes: Fill inside pipe/riser joint with non-shrink grout.

3. Precast Sanitary Sewer Manholes: Connect to structure with flexible watertight gasket according to Section 6010, 2.08.

4. Sanitary Sewer Manholes on Existing Pipe: Install waterstop according to Section 6010, 2.11.

**3.01 INSTALLATION OF MANHOLES AND INTAKES (Continued)**

**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 manhole joints.

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. Invert:** Install invert if not precast. If precast, remove any projections and repair any voids to ensure a hydraulically smooth channel between pipe ends.

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

**I. Adjustment Ring(s):** Bed each concrete ring with bituminous jointing material in trowelable or rope form. Bed each polyethylene ring with manufacturer's approved product. Do not install more than total ring stack height of 12 inches. For greater adjustment, modify lower riser section(s).

**J. Casting:** Install casting and adjust to proper grade. Where manhole or intake is to be in a paved area, adjust slope to match finished surface. When specified, attach casting frame to the structure with bolts.

**K. Chimney Seal:** For sanitary sewer manholes, install internal or external rubber chimney seal.

**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, and 7 days after initial concrete placement, after all pipes have been connected. If concrete strengths is not determined, place backfill 14 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 or wing faces using pneumatic or hand tampers only. Ensure proper and uniform compaction of backfill around structure.

## 3.02 CONSTRUCTION OF CAST-IN-PLACE CONCRETE STRUCTURES

### A. Forms:

1. Comply with Iowa DOT Article 2403.07, E.

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 36 diameters, unless otherwise specified in the contract documents.

### C. Concrete Mixing:

1. Comply with Iowa DOT Article 2403.06.

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

### D. Concrete Placing:

1. Comply with Iowa DOT Article 2403.08.

2. 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.

3. Comply with Iowa DOT Article 2403.09 for concrete vibration.

4. Do not place concrete when the air temperature is less than 40°F without the approval of the Engineer. When allowed, comply with Iowa DOT Article 2403.11.

5. Provide a broom finish on portions of structure that are to become part of exposed concrete floors or sidewalks.

### E. Stripping and Cleaning:

1. Remove forms for manhole and intake walls and tops according to Iowa DOT Article 2403.18. 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 roofs.

2. Finish surfaces according to Iowa DOT Article 2403.21. Give exposed surface a Class 2 finish.

**3.02 CONSTRUCTION OF CAST-IN-PLACE CONCRETE STRUCTURES (Continued)**

**F. Curing:**

1. Comply with Iowa DOT Article 2403.10.

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 2403.19.

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 damage areas. Remove any concrete webs or protrusions.

**I. Concrete Testing:**

1. General:
   a. Provide required testing by a testing service approved by the Engineer, unless such services are provided by the Jurisdiction.
   b. Review and test proposed mix design when required by the Engineer.
   c. Obtain production samples of the job-delivered concrete mix after any needed water has been added and the concrete has been remixed.
   d. Take at least one slump test, one air test, and one strength test for each 100 cubic yards or fraction thereof, or at least once per structure.

2. Slump Testing: Unless otherwise specified in the contract documents, the Engineer will conduct testing. ASTM C 143 will be used to determine the slump of the concrete sample and whenever consistency of concrete mix appears to vary.

3. Air Testing: Unless otherwise specified in the contract documents, the Engineer will conduct testing. The air content of the concrete sample will be determined according to ASTM C 231, ASTM C 173, or ASTM C 138.

4. Strength Testing: Unless otherwise specified in the contract documents, the Contractor is responsible for strength testing by a certified testing service.
   a. Mold and cure three specimens per ASTM C 31 for each strength test. When the total quantity is less than 50 cubic yards, the Engineer may waive the strength tests.
   b. Test the specimens according to ASTM C 39. Test one specimen at 7 days. Test two specimens at 28 days. Average the compressive strength of the two specimens tested at 28 days. If one of the 28 day specimens manifests evidence of improper sampling, molding, or testing, discard and use the strength of the remaining specimen as the test result.

## 3.03 CONSTRUCTION OF PRECAST CONCRETE STRUCTURES

**A. Substitutions:** Precast structures may be substituted for designated cast-in-place structures so long as structure is constructed as specified in the contract documents and complying with the requirements of Section 6010, 3.02.

**B. Cast-in-place Base:**

1. Place Class C concrete base on undisturbed ground or prepared subgrade / granular base as specified in the contract documents. 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 and cover plug and hole with non-shrink grout.

## 3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE

**A. Casting Extension Rings:**

1. Only install casting extension rings when allowed by 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 allowed by the contract documents.

4. Replace chimney seal for sanitary sewer manhole using only new materials.

**3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE (Continued)**

**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, as appropriate.
4. Install new frame and cover or grate. Existing casting may be reinstalled when allowed by the contract documents.
5. Replace chimney seal for sanitary sewer manhole using only new materials.

**3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE**

A. Sanitary Sewer: Comply with Section 4010, 3.09.

B. Storm Sewer: Comply with Section 4020, 3.08.

**3.06 CHIMNEY SEAL:** Install chimney seals on all sanitary sewer manholes.

A. Do not install 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.

## 3.07 REMOVAL OF MANHOLE OR INTAKE

A. Unless otherwise specified, remove the entire structure to a minimum of 10 feet below top of subgrade in paved areas or 10 feet below finish 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 controlled low strength material (CLSM) (comply with Section 3010) by gravity flow or pumping.

C. Fill remaining structure using flowable mortar.

D. Place compacted backfill over remaining structure as required for embankment or compacted backfill.

## 3.08 MANHOLE TESTING

Comply with Section 6030.

END OF SECTION

# Summary of Changes to Section 6020
# Rehabilitation of Existing Manholes

| | Location | Comments |
|---|---|---|
| 1 | General | This section was pulled out of the existing Manhole specification section, and re-written as a stand-alone section. |
| 2 | 1.08, A | *Rubber Chimney Seal:* This item was moved from the existing manhole section. Chimney seals are incidental to all new or adjusted manholes, and having this item in that section seemed to imply that it was a pay item. This item is intended to cover rehabilitation projects, where an existing manhole does not have a chimney seal. |
| 3 | 1.08, B | *Urethane chimney seal:* This product is included in the existing specifications, but no pay item was provided. A new bid item was developed for rehabilitation work. |
| 4 | 1.08, C | *In-Situ Manhole Replacement, Cast-in-Place Concrete:* A new bid item was developed for rehabilitation work. |
| 5 | 1.08, D | *In-Situ Manhole Replacement, Cast-in-Place Concrete with Plastic Liner:* A new bid item was developed for rehabilitation work. |
| 6 | 1.08, E | *Manhole Lining with Centrigugally Cast Cementitious Mortar Liner with Epoxy Seal:* A new bid item was developed for rehabilitation work. |
| 7 | 1.08, C-E | *Manhole Rehabilitation:* Clarified that new castings are required on all rehabilitated manholes. |
| | | |

# 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 chimney seals.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) 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

Follow the General Provisions (Requirements) and Covenants

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING

Follow the General Provisions (Requirements) and Covenants.

### 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

### A. Rubber Chimney Seal:

1. Measurement: Each rubber chimney seal installed on an existing manhole will be counted.

2. Payment: Payment will be made at the unit price for each chimney seal.

3. Includes: Unit price includes, but is not limited to, all necessary compression or expansion bands and extension sleeves as necessary to complete chimney seal.

### B. Urethane Chimney Seal:

1. Measurement: Each urethane chimney seal installed on an existing manhole will be counted.

2. Payment: Payment will be at the unit price for each urethane chimney seal.

### C. 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 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.

### D. 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.

**1.08 MEASUREMENT AND PAYMENT (Continued)**

**E. 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 CHIMNEY SEAL

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

**B. Urethane Chimney Seal:**

1. Use only when specified in the contract documents.

2. 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, 4000 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. Provide mixed mortar with a paste-like consistency that may be sprayed, cast, pumped, or gravity-flowed into any area 1/2 inch and larger.

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<br>Initial Set / Final Set | 240 minutes / 440 minutes |
| Modulus of Elasticity ASTM C 469<br>24 hours / 28 days | 180,000 psi / 1,150,000 psi |
| Flexural Strength ASTM C 293<br>24 hours / 28 days | 650 psi / 800 psi |
| Compressive Strength ASTM C 109<br>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 CHIMNEY SEAL

**A. Rubber Chimney Seal:** Comply with Section 6010, 3.06.

**B. Urethane Chimney Seal:**

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.

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

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.

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 any 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.

**3.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL (Continued)**

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.

END OF SECTION

# Summary of Changes to Section 6030
# Testing and Inspection

| | Location | Comments |
|---|---|---|
| 1 | General | This section was moved from previous 6040 due to the combining of 6010, 6020, & 6030. |
| 2 | Title | The title of this section was changed from “Testing” to “Testing and Inspection” to better reflect the work involved. |
| 3 | Part 2 | This section was eliminated. There are no products required. |
| 4 | 3.03 | The repair requirements were removed and a reference back to the repair requirement of 6010 was added. |
| 5 | 3.04 | Section was reorganized to cover miscellaneous requirements under a “General” section. |
| 6 | 3.04 | Pressure measurements were changed from inches of mercury to psi. |
| | | |

# TESTING AND INSPECTION

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

Testing of sanitary sewer manholes and inspection of storm and sanitary sewer manholes, intakes, and other utility structures.

### 1.02 DESCRIPTION OF WORK

Test sanitary sewer manholes and inspect sanitary and storm sewer manholes, intakes, and other utility structures.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants.

### 1.06 SCHEDULING

Follow the General Provisions (Requirements) 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

All required testing and inspection under this section is considered incidental to items for construction of structure.

## 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 new sanitary sewer manholes unless otherwise specified in the contract documents. Infiltration testing and low-pressure air testing will not be allowed on new manholes.

2. Conduct the final test after manhole construction is complete, all repairs and connections have been made, and invert has been installed.

### 3.04 SANITARY SEWER MANHOLE TESTING (Continued)

**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 this specification.

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.

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

7. Evacuate the manhole to 5 psi. 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 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 |

## 3.04 SANITARY SEWER MANHOLE TESTING (Continued)

### C. Exfiltration Test:

1. Applicable to new manholes (when allowed) or rehabilitated manholes.

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

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

4. Plug the manhole inlet and outlet.

5. Fill the manhole with water to 2 feet above the outside top of the connecting pipe. If groundwater is present, fill the manhole to not less than 2 feet nor more than 5 feet above the groundwater level. Do not fill above the top of the standard barrel sections.

6. Mark the water level.

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

8. 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.

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

## 3.05 TEST FAILURE

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

END OF SECTION

# Division 7 Specifications
## Streets and Related Work

# Section 7030
# Recreational Trails, Sidewalks, and Driveways

Section 7030, Recreational Trails, Sidewalks, and Driveways is part of Division 7, Streets and Related Work. Only Section 7030 was revised in conjunction with this project.

The Iowa DOT does not intent to modify their current specifications to follow the revised SUDAS specifications for 7030 at this time. However, this may be done in the future. Regardless, there was a desire to eliminate inconsistencies with the Iowa DOT's specifications since the items covered in this section are often constructed by both local jurisdictions and the DOT.

The entire section was re-written to the imperative mood. Language redundant with Division 1 was removed. The bid items were converted to a 3-part format indicating the method of measurement, basis of payment, and incidental work for each item.

# Summary of Changes to Section 7030
# Recreational Trails, Sidewalks, and Driveways

| | Location | Comments |
|---|---|---|
| | | |
| 1 | 1.08 | *Measurement and Payment:* Rearranged bid items to follow order of installation. |
| 2 | 1.08, A | *Removal of Recreational Trail, Sidewalk, or Driveway:* renamed from Sidewalk/Driveway |
| 3 | 1.08, B | *Removal of Curb:* Added new item for curb grinding/sawing for installation of ramps and driveways. |
| 4 | 1.08, C | *Recreational Trail:* Changed measurement to plan quantity. |
| 5 | 1.08, D | *Special Subgrade Preparation for Recreational Trail:* Made general subgrade preparation incidental to recreational trail construction (Iowa DOT natural subgrade prep.). Added a new item for special subgrade preparation (scarify, mix, and compact with Type A compaction). |
| 6 | 1.08, F | *Brick Sidewalk:* Revised bid item so concrete base and setting bed are included. Previously, these had been separate bid items. |
| 7 | 1.08, I | *Recreational Trail, Sidewalk, and Driveway Assurance Testing:* Clarified that any concrete or HMA testing will be provided by the jurisdiction. Added a new pay item for situations where the contractor is required to provide testing. |
| 8 | | |
| 9 | 2.01, A | *Portland Cement Concrete:* Clarified that concrete is to be Class B or Class C. Previously said Class B "or better." |
| 10 | 2.02 | *Hot Mix Asphalt:* Gave contractor the option of binder grade 58-28 or 64-22. Revised HMA mixture for recreational trails that also function as a shoulder from 1,000,000 ESAL mix to 300,000 ESAL mix. |
| 11 | 2.05 | *Neoprene Modified Asphalt Adhesive for Brick:* Clarified testing requirements and values. Removed reference to proprietary product. |
| 12 | 2.07 | *Detectable Warnings:* Eliminated stamped detectable warnings. |
| 13 | 2.08 | *Granular Driveway Surfacing:* Added a material specification for granular driveway surfacing (Iowa DOT driveway surfacing). |
| 14 | Old 3.01 | *Utility Protection*: Removed. This information is covered in Division 1. |
| 15 | Old 3.02 | *Grading*: Removed. This section is redundant with 2010. |
| 16 | 3.02, A | *Subgrade Preparation:* Current specifications require the same subgrade prep as for roadway construction (i.e. scarify top 12 inches and recompact).<br><br>Revised subgrade prep for recreational trails so default follows Iowa DOT 2109 (Natural Subgrade). Iowa DOT's Natural Subgrade requires the top 6 inches to be rolled firm and uniform. Any soft spots are scarified and recompacted.<br><br>A Special Subgrade Preparation item was added for use when specified. Requires scarification of top 6 inches and Type A compaction across entire subgrade. |
| 17 | 3.02, B | *Sidewalk and Driveway Subgrade Prep:* Current specifications require driveways to be prepared the same as roads. Reduced subgrade preparation requirements for sidewalks and driveways to: stripping organic material, tamping any fill material, removal and replacement of soft spots with suitable backfill.. |

# Summary of Changes to Section 7030
# Recreational Trails, Sidewalks, and Driveways

| | | |
|---|---|---|
| 18 | 3.03 | *Adjustment of Fixtures:* Referenced appropriate sections for fixture adjustment. |
| 19 | 3.04 | *PCC Recreational Trails, Sidewalks, and Driveways:* Revised section to reference Section 7010 where possible, eliminating duplicate information and possibility for conflicts. |
| 20 | 3.12 | *Testing:* summarized the requirements for testing when testing is the contractor's responsibility. Frequency and location is the same as previous specification. |

# RECREATIONAL TRAILS, SIDEWALKS, AND DRIVEWAYS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Removal of Recreational Trails, Sidewalks, and Driveways

B. Installation of Recreational Trails, Sidewalks, and Driveways

### 1.02 DESCRIPTION OF WORK

A. Remove existing recreational trails, sidewalks, and driveways.

B. Install recreational trail.

C. Install sidewalk.

D. Install driveway.

### 1.03 SUBMITTALS

Follow the General Provisions (Requirements) and Covenants, as well as the following:

A. PCC mix design.

B. HMA mix design.

C. Brick source, absorption, compressive strength; samples of brick showing texture and color.

D. Submit type and color of detectable warnings.

E. Results of required testing.

### 1.04 SUBSTITUTIONS

Follow the General Provisions (Requirements) and Covenants.

## 1.05 DELIVERY, STORAGE, AND HANDLING

Follow the General Provisions (Requirements) and Covenants, as well as the following:

**A. Portland Cement Concrete:** See Section 7010.

**B. Hot Mix Asphalt:** See Section 7020.

## 1.06 SCHEDULING AND CONFLICTS

Follow the General Provisions (Requirements) and Covenants.

## 1.07 SPECIAL REQUIREMENTS

None.

## 1.08 MEASUREMENT AND PAYMENT

### A. Removal of Recreational Trail, Sidewalk, or Driveway:

1. Measurement: Measurement will be in square yards for quantity of recreational trails, sidewalks, or driveways removed.

2. Payment: Payment will be at the unit price per square yard for the area of recreational trail, sidewalk, or driveway removal.

3. Includes: Unit price includes, but is not limited to, sawing, hauling, and disposal of material removed.

### B. Removal of Curb:

1. Measurement: Measurement will be in linear feet for removal of curb by grinding or sawing, measured along the back of curb.

2. Payment: Payment will be at the unit price per linear feet for the removal of curb.

3. Includes: Unit price includes, but is not limited to, hauling and disposal of materials removed.

### C. Recreational Trail:

1. Measurement: Each type and thickness of recreational trail will be measured in square yards. Deductions will not be made for the area of pavement for manholes, intakes, or other fixtures.

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

3. Includes: Unit price includes, but is not limited to, subgrade preparation, jointing, sampling, smoothness testing and correction, and testing.

## 1.08 MEASUREMENT AND PAYMENT (Continued)

### D. Special Subgrade Preparation for Recreational Trail:

1. Measurement: Measurement will be in square yards for special subgrade preparation. Measured area will include 2 feet outside of the pavement on either side of the trail.

2. Payment: Payment will be at the unit price for the area of special subgrade preparation.

3. Includes: Unit price includes, but is not limited to, water required to bring subgrade moisture content to within the required limits.

### E. PCC Sidewalk:

1. Measurement: Each thickness of PCC sidewalk will be measured in square yards. Deductions will not be made for the area of pavement for manholes, intakes, or other fixtures.

2. Payment: Payment will be at the unit price for each thickness of PCC sidewalk.

3. Includes: Unit price includes, but is not limited to, minor grade adjustments at driveways and other intersections, subgrade preparation, formwork, additional thickness at thickened edges, jointing, sampling, smoothness testing and correction, and testing.

### F. Brick Sidewalk:

1. Brick Sidewalk with Sand Base:
   a. Measurement: Measurement will be in square yards for the area of brick sidewalk placed on a sand base.
   b. Payment: Payment will be at the unit price for the area of sidewalk.
   c. Includes: Unit price includes, but is not limited to, subgrade preparation, brick edge restraints, furnishing and placing compacted sand base, and sand/cement joint filler.

2. Brick Sidewalk with Concrete Base:
   a. Measurement: Measurement will be in square yards for the area of brick sidewalk placed on a concrete base. The area of concrete base will not be measured separately.
   b. Payment: Payment will be at the unit price for the area of sidewalk.
   c. Includes: Unit price includes, but is not limited to, subgrade preparation, concrete base, HMA setting bed, neoprene asphalt adhesive for asphalt setting bed, and sand/cement joint filler.

## 1.08 MEASUREMENT AND PAYMENT (Continued)

### G. Detectable Warnings:

1. Measurement: Measurement will be in square feet for the area of detectable warnings placed. Paved area beneath detectable warnings will be measured with sidewalk or recreational trail item.

2. Payment: Payment will be at the unit price for the area of detectable warning placed.

3. Includes: Unit price includes, but is not limited to, steel bar supports and manufactured detectable warning panels.

### H. Driveways:

1. Paved Driveways:
   a. Measurement: Each type and thickness will be measured in square yards. Deductions will not be made for the area of pavement for manholes, intakes, or other fixtures.
   b. Payment: Payment will be at the unit price for each type and thickness of driveway.
   c. Includes: Unit price includes, but is not limited to, excavation, subgrade preparation, jointing, sampling, and testing.

2. Granular Surfacing for Driveways:
   a. Measurement: Measurement will be in square yards or tons, as specified in the contract documents, for the quantity of granular surfacing placed.
   b. Payment: Payment will be at the unit price per square yard or ton, as specified.
   c. Includes: Unit price includes, but is not limited to, excavation and preparation of subgrade.

## 1.08 MEASUREMENT AND PAYMENT (Continued)

### I. Recreational Trail, Sidewalk, and Driveway Assurance Testing:

1. The Contractor will not be responsible for concrete compression or HMA density testing unless otherwise specified in the contract documents.

2. If the contract documents specify that the Contractor is responsible for concrete compression and HMA density testing performed by an independent testing laboratory hired by the Contractor, measurement and payment will be as follows:
   a. Measurement: Measurement will be a lump sum.
   b. Payment: Payment will be at the unit price for the lump sum.

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

## PART 2 - PRODUCTS

### 2.01 PORTLAND CEMENT CONCRETE

A. Class B or C concrete with materials complying with Section 7010. Use coarse aggregate of Class 2 durability or better.

B. Comply with the following for PCC mixes for recreational trails, sidewalks, and driveways unless otherwise approved by the Engineer.

**Table 7030.01: PCC Mixes**

| | **Machine Finish** | **Hand Finish** |
|---|---|---|
| Type of concrete | Class B or C | Class B or C |
| Slump Minimum | 1/2 in. | 1/2 in. |
| Slump Maximum | 2 1/2 in. | 4 in. |
| Percent Air Content | | |
| • Target | 7% | 7% |
| • Minimum | 6% | 6% |
| • Maximum | 8 1/2% | 8 1/2% |

### 2.02 HOT MIX ASPHALT

Comply with Section 7020 for mix design.

A. Use 100,000 ESAL, 3/8 inch mix.

B. For recreational trails adjacent to pavement that also functions as the pavement shoulder, use 300,000 ESAL, 1/2 inch mix.

C. Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28 or 64-22.

### 2.03 BRICK

Use 8 inch by 4 inch by 2 1/4 inch thick paving bricks manufactured to comply with ASTM C 902, Class SX, Type I. Unless specified in the contract documents, provide samples for color selection and surface texture for approval by the Engineer.

## 2.04 HMA SETTING BED FOR BRICK

**A. Mixture:** Proportion mix using 7% asphalt binder and 93% fine aggregate. Apportion each ton in the approximate ratio of 145 pounds asphalt binder to 1,855 pounds sand. Maintain mix temperature at approximately 250°F during placement.

**B. Asphalt Binder:** Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28 or 64-22.

**C. Fine Aggregate:** Use clean, hard sand with durable particles free from adherent coating, lumps of clay, alkali salts, and organic matter. Use sand that is uniformly graded from coarse to fine with all passing the No. 4 sieve and meeting AASHTO T 27.

## 2.05 NEOPRENE MODIFIED ASPHALT ADHESIVE FOR BRICK

**A. Mastic (Asphalt Adhesive):**

| | |
|---|---|
| Solids (base): | 74% to 76% |
| Pounds per gallon | 8 to 8 1/2 pounds |
| Solvent: | Mineral spirits with a flash point above 100° F |

**B. Base (2% Neoprene, 10% Asbestos-free Fiber, 88% Asphalt):**

| | |
|---|---|
| Melting Point: | 200° F minimum according to ASTM D 36 |
| Penetration: | 23 to 27 according to ASTM D 5 |
| Ductility: | 1250 mm minimum according to ASTM D 113 @ 25° C, and a rate of 50 mm/minute |

## 2.06 BRICK JOINT FILLER

Dry sand-cement mixture consisting of one part masonry cement complying with ASTM C 91 and three parts sand complying with ASTM C 144 and passing the No. 16 sieve. Provide colored cement to match bricks.

## 2.07 DETECTABLE WARNINGS

Use manufactured detectable warning panels or brick pavers with a non-slip surface and raised truncated domes. Comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) for contrast and dimension requirements.

## 2.08 GRANULAR DRIVEWAY SURFACING

Comply with Iowa DOT Section 2315. Use aggregate as specified in the contract documents.

## PART 3 - EXECUTION

### 3.01 REMOVALS

A. Remove recreational trials, sidewalks, driveways, brick, and curbs to the removal limits specified in the contract documents.

B. Saw pavement full depth in straight lines to the specified removal limits.

C. Remove to the specified removal limits without damage to adjacent property, trees, utilities, or pavement that are to remain in place.

D. Salvage and stockpile all brick removed.

E. Grind or saw existing curbs at locations specified in the contract documents to install recreational trails, sidewalks, and driveways.

F. Dispose of rubble and debris resulting from removal operations.

### 3.02 SUBGRADE PREPARATION

**A. Recreational Trails:**

1. Subgrade Preparation: Comply with Iowa DOT Section 2109.

2. Special Subgrade Preparation:
   a. Construct subgrade to final elevation.
   b. Scarify and mix the top 6 inches of subgrade material to a width equal to that of the proposed pavement, plus 2 feet on each side.
   c. Compact loose subgrade material with Type A compaction complying with Section 2010.
   d. Proof roll compacted subgrade according to Section 2010.

**B. Sidewalks and Driveways:**

1. Remove all vegetation and roots from ground surface.

2. Construct grade to final subgrade elevation.
   a. Cut area: Remove all material that will be displaced by the sidewalk.
   b. Fill area: Scarify the surface to be covered with embankment to a depth of at least 6 inches and compact. Construct embankment in lifts of 6 inches or less and compact each lift. Tamp surface with a mechanical tamper until firm and unyielding.
3. Remove all soft, spongy, or yielding spots and fill the void with suitable backfill material.

## 3.03 ADJUSTMENT OF FIXTURES

A. Adjust fixtures to conform to the finished pavement surface. Cooperate and coordinate with the utility agency to ensure proper fixture adjustment.

B. Comply with Sections 5020, 6010, or 8020 as appropriate.

## 3.04 PCC RECREATIONAL TRAILS, SIDEWALKS, AND DRIVEWAYS

**A. Form Setting:** Comply with Section 7010 with the following additional requirements and exceptions.

1. Slip form paving equipment may be allowed in lieu of setting forms, if approved by the Engineer.

2. Wood forms are allowed.

3. Use of an automated subgrade trimmer is not required.

4. Set forms true to line and grade and hold them rigidly in place by stakes placed outside the forms and flush with or below the top edge of the forms.

**B. Concrete Pavement Placement:**

1. Recreational Trails: Comply with Section 7010.

2. Sidewalk:
   a. Maintain moist subgrade in front of paving operation
   b. Deposit concrete on the subgrade as required to minimize rehandling to prevent segregation.
   c. Hand spread with shovels, not rakes.
   d. Place concrete as required to slightly overfill the space between the forms.
   e. Consolidate with vibrators and smooth by use of a straightedge.
   f. Do not contaminate freshly mixed concrete with earth or other foreign materials.

3. Driveways: Comply with Figures 7030.3 to 7030.7 and Section 7010. The use of a paving machine is not required.

**C. Finishing:**

1. Recreational Trails and Driveways:
   a. Comply with Section 7010.
   b. Provide a burlap drag or broom finish.

**3.04 PCC RECREATIONAL TRAILS, SIDEWALKS, AND DRIVEWAYS (Continued)**

2. Sidewalks:
   a. Use a wood float to depress the large aggregate and create a dense surface.
   b. Allow concrete to set until all shine has disappeared from the surface.
   c. Smooth with a metal trowel until surface is free from defects and blemishes.
   d. Construct joints by sawing or by using a jointer or groover tool.
   e. Finish edges of sidewalk or driveway with an edging tool having a radius of approximately 1/2 inch. Ensure tool marks do not appear on the finished surface.
   f. Brush with a soft broom at right angles to the side forms to provide a non-skid surface.

**D. Curing:** When curing is specified in the contract documents, comply with Section 7010.

**E. Form Removal:** Comply with Section 7010.

**F. Jointing:**

1. Construction Joints:
   a. Locate construction joints to provide uniform joint spacing.
   b. Place a construction joint at the close of each day's work or when depositing of concrete is stopped for 45 minutes or more.
   c. Form construction joint by using a header board. Set perpendicular to the surface and at right angles to the centerline.

2. Transverse Contraction Joints:
   a. Recreational Trails:
      1) Space transverse joints equal to the width of the recreational trail, or as specified in the contract documents.
      2) Saw contraction joints according to Section 7010.
   b. Sidewalks and Driveways:
      1) Space sidewalk contraction joints equal to the width of the sidewalk.
      2) Space driveway contraction joints so panel length does not exceed 12 feet.
      3) Form transverse contraction joints to a depth of 1 1/4 inches with a pointed trowel or jointing tool. In lieu of forming, joints may be sawed within 12 hours of placement with a 1/8 inch blade saw. Use a straightedge if joints are sawed with a hand-held saw.

## 3.04 PCC RECREATIONAL TRAILS, SIDEWALKS, AND DRIVEWAYS (Continued)

3. Longitudinal Contraction Joints:
   a. Recreational Trails and Sidewalks: If longitudinal joints are specified in the contract documents, saw joint to 1/8 inch wide and to a depth of 1/3 the pavement thickness.
   b. Driveways:
      1) Space longitudinal contraction joints so panel width does not exceed 12 feet.
      2) Form with pointed trowel or jointing tool. In lieu of forming, joints may be sawed to a depth of T/3.

4. Isolation Joints:
   a. Install isolation joints where recreational trails, sidewalks, or driveways abut street pavement, buildings, and structures.
   b. If an intersecting sidewalk is constructed with a driveway, install an isolation joint on the property side of the sidewalk and a 'C' joint on the street side of the sidewalk.
   c. Install a 1/2 inch or 3/4 inch thick strip of preformed resilient joint material, according to Section 7010, to the full depth of concrete. Trim any isolation joint material protruding above the finished work to the level of the abutting concrete.

5. Do not seal construction or contraction joints in recreational trails, sidewalks, or driveways.

## 3.05 HMA RECREATIONAL TRAILS AND DRIVEWAYS

Comply with Section 7020. Use Class IC Compaction.

## 3.06 BRICK SIDEWALKS

### A. Brick Sidewalk with a Sand Base

1. Comply with Figure 7030.15.

2. Use a cross-section and patterns as specified in the contract documents or approved by the Engineer.

3. Do not use broken bricks or materials with stained faces in the paving areas.

4. Set edge restraints true to line and grade along both edges of brick sidewalk.

5. Place bricks on smooth, compacted bedding sand and tightly set in place without gaps.

**3.06 BRICK SIDEWALKS (Continued)**

6. Compact bricks using a 3 to 5 ton roller or machine with a vibratory plate weighing a minimum of 100 pounds.

7. Tightly compact joints with brick sand/cement.

**B. Brick Sidewalks with a Concrete Base**

1. General:
   a. Comply with Figure 7030.15.
   b. Use a cross-section and patterns as specified in the contract documents or approved by the Engineer.
   c. Do not use broken bricks or materials with stained faces in the paving areas.
   d. Construct the concrete base to comply with PCC sidewalk construction specifications.

2. HMA Setting Bed:
   a. Place 3/4 inch depth control bars on the base to serve as guides for the striking board. Shim depth control bars as necessary to adjust bedding thickness and to ensure the top surface of pavers will be at the required finished grade.
   b. Place HMA bedding material between the parallel depth control bars. Pull striking board over bars several times. After each pass, spread fresh bedding material over low or porous spots to produce a smooth and even setting bed. After placing and smoothing each section, advance depth control bars to next section. After removal of depth control bars and shims, carefully fill any depressions that remain.
   c. While still hot, roll the HMA bedding with a power roller to a nominal depth of 3/4 inch.
   d. Ensure the joints in the concrete base do not project through the HMA setting bed.
   e. Apply neoprene modified asphalt adhesive over the top surface of the cooled asphalt setting bed with notched trowel with serration not exceeding 1/16 inch. Allow adhesive to dry to the touch before placing pavers.

3. Brick Pavers:
   a. Place the pavers by hand in straight courses with hand tight joints and uniform top surface.
   b. Sweep dry joint filler into joints until the joints are completely filled.
   c. Fog surface lightly with water to cure cement.
   d. Clean any cement stains from brick surface. Remove stains from other concrete surfaces.

**3.06 BRICK SIDEWALKS (Continued)**

4. Protect newly laid pavers at all times using panels of plywood. Panels can be advanced as work progresses; however, keep the plywood protection in areas that will be subjected to movement of materials, workers, and equipment. Take precautions in order to avoid depressions and protect paver alignment until cured and ready for pedestrian or vehicle traffic.

**3.07 DETECTABLE WARNING INSTALLATION**

**A. Manufactured Panels:**

1. Comply with Figure 7030.14.

2. Support precast panels on all four corners with reinforcing steel or reinforcing chairs.

3. Set panels in fresh concrete.

**B. Brick Pavers:**

1. Comply with Figure 7030.14.

2. Install according to Section 7030, 3.06.

**3.08 TOLERANCES**

A. Check finished surface with a 10 foot straightedge placed parallel to the centerline.

B. Ensure the cross-section and profile of the pavement is constructed to within a tolerance of 1/4 inch in 10 feet (0.2%).

C. Mark areas showing bumps of more than 1/4 inch in 10 feet and grind down with an approved grinding tool to an elevation where the area will not show deviations in excess of 1/8 inch.

**3.09 GRANULAR DRIVEWAY SURFACING**

Comply with Iowa DOT Section 2315.

## 3.10 CLEANING RECREATIONAL TRAILS, SIDEWALKS, AND DRIVEWAYS

A. Remove all litter and construction materials or tools immediately after the end of the curing period.

B. Remove excess dirt from the site.

C. Broom clean completed recreational trails, sidewalks, and driveways.

## 3.11 TESTING

**A. General:** When testing is specified in the contract documents as the Contractor's responsibility, provide testing using the services of an independent testing laboratory approved by the Engineer.

**B. Concrete Compression Tests:** Prepare at least two concrete compression cylinders for each 200 cubic yards placed. Prepare a minimum of at least two cylinders each day concrete is placed. Provide 7 and 28 day tests according to ASTM C 39.

**C. HMA Density and Thickness Tests:** Prepare at least two cores per day or one core every 2,000 square yards.

END OF SECTION

# REVISED FIGURES

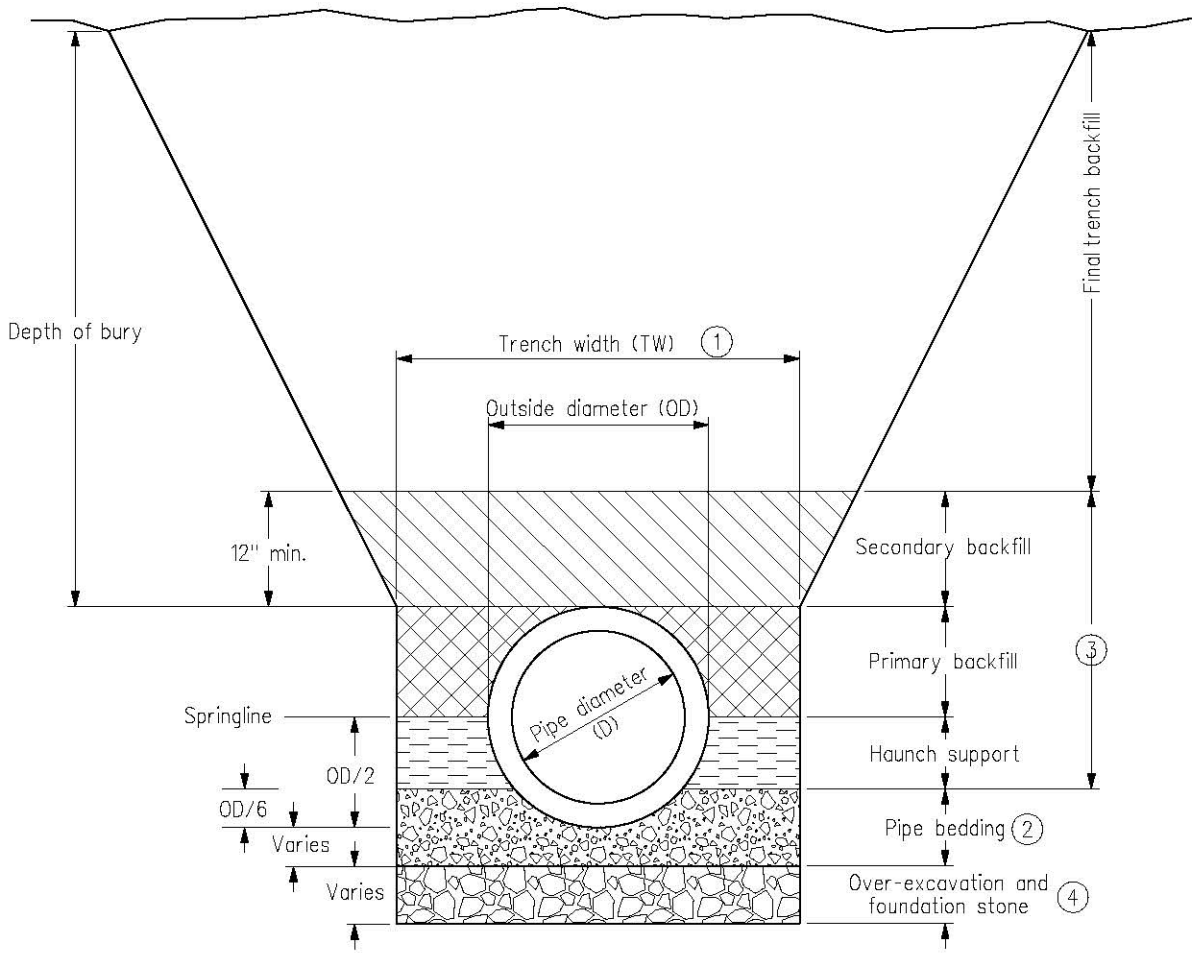
# Division 3 Figures
## Trench and Trenchless Construction

## Division 3 - Trench and Trenchless Construction

| Current # | Current SUDAS Name | Proposed SUDAS # | Proposed Iowa DOT # | Proposed Name |
|---|---|---|---|---|
| 3010.1 | Pipe Embedment Details | 3010.101 | SW-101 | General Trench Bedding and Backfill |
| New | | 3010.102 | SW-102 | Rigid Pipe Trench Bedding |
| 3010.3 | P.C. Concrete Arch | | | |
| 3010.7 | Class A Concrete Cradle | | | |
| 3010.8 | Bedding for Reinforced Concrete Arch Pipe | | | |
| New | | 3010.103 | SW-103 | Flexible Pipe Trench Bedding |
| New | | 3010.104 | SW-104 | Pressure Pipe Trench Bedding |
| 3010.2 | P.C. Concrete Encasement | 3010.105 | SW-105 | Miscellaneous Pipe Bedding |
| 3010.9 | Flowable Mortar Pipe Backfill | | | |
| 3010.1 | Waterstop for Trenches | 3010.106 | SW-106 | Waterstop for Trenches |
| 3010.4 | Sewer Pipe Support Over Existing Utility | 3010.901 | None | Sewer Pipe Support Over Exisiting Utility |
| 3010.5 | Reinforced P.C. Concrete Beam Utility Line Support | 3010.902 | None | Reinforced P.C. Concrete Beam Utility Line Support |
| 3010.6 | Flowable Mortar Fill Utility Line Support | 3010.903 | None | Flowable Mortar Fill Utility Line Support |
| | | | | |

This figure indicates the location of the various bedding and backfill zones described in Section 3010. Refer to the contract documents for specific material and placement requirements.

1. Trench width is based upon pipe diameter and pipe material.
2. Bedding materials and dimensions vary based upon pipe diameter, pipe material, and flow condition (gravity or pressure).
3. Backfill material requirements vary based upon pipe material, depth of bury, and flow condition (gravity or pressure).
4. Over-excavation and placement of foundation stone is required only when specified in the contract documents or directed by the Engineer.

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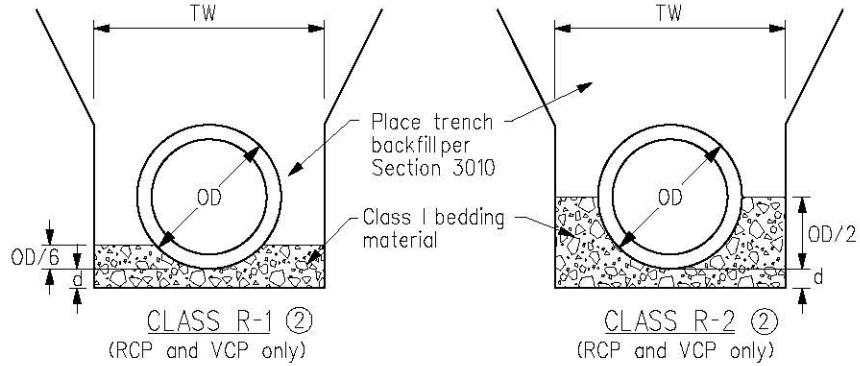
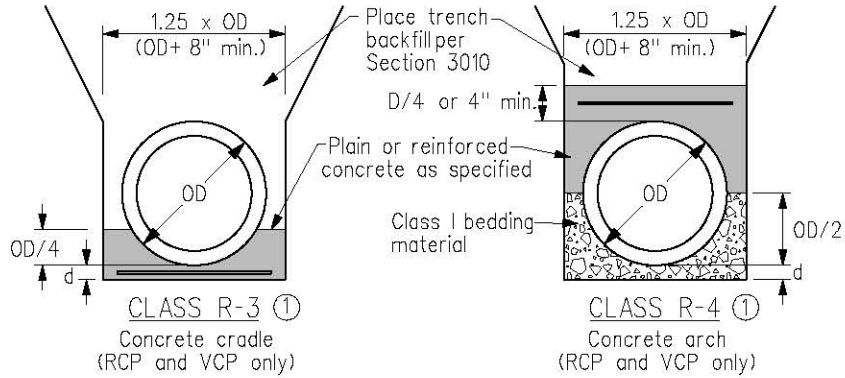
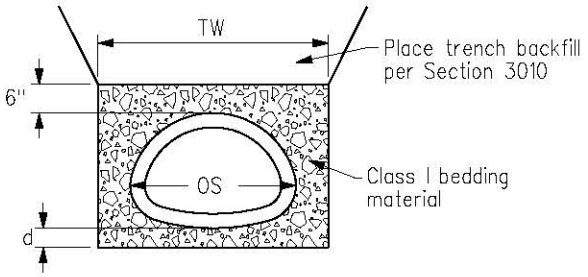
| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 3010.101 | SHEET 1 OF 1 |

# GENERAL TRENCH BEDDING AND BACKFILL

FIGURE: 3010.101 SHEET 1 OF 1




Comply with the contract documents for bedding requirements for elliptical pipe

① Bedding class allowed only when specified in the contract documents. Provide reinforcing as specified.

② Unless specified in the contract documents, Class R-1 or Class R-2 bedding may be used for concrete or clay pipe, subject to the depth of bury restrictions shown in the tables on Sheet 2.

Key

OD = Outside diameter of pipe
OS = Outside span of pipe
TW = Trench width at top of pipe:
- Min. width: OD+18 inches
- Max. width: 1.25xOD+12 inches or 54 inches (whichever is greater)

d = Depth of bedding material below pipe OD/8 or OS/8, 4 inches min. (whichever is greater)

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FIGURE: 3010.102

SHEET 1 OF 2

# RIGID GRAVITY PIPE TRENCH BEDDING

FIGURE: 3010.102 SHEET 1 OF 2

# ALLOWABLE BURY DEPTH

## CLASS III RCP

| Pipe diameter (inches) | Class R-1 bedding | Class R-2 bedding | Class R-3 & R-4 bedding | | |
|---|---|---|---|---|---|
| | | | No steel | As=0.4% | As=1.0% |
| 12 | 7' | 10' | 15' | 19' | 27' |
| 15 | 8' | 10' | 16' | 19' | 27' |
| 18 | 8' | 11' | 16' | 20' | 40' |
| 21 | 8' | 11' | 18' | 26' | 40' |
| 24 | 8' | 12' | 23' | 36' | 40' |
| 27 | 10' | 15' | 30' | 40' | 40' |
| 30 | 11' | 15' | 29' | 40' | 40' |
| 33 | 11' | 15' | 28' | 40' | 40' |
| 36 | 11' | 15' | 27' | 40' | 40' |
| 42 | 11' | 15' | 26' | 38' | 40' |
| 48 | 11' | 15' | 26' | 36' | 40' |
| 54 | 11' | 15' | 25' | 34' | 40' |
| 60 | 11' | 15' | 25' | 33' | 40' |
| 66 | 11' | 15' | 24' | 32' | 40' |
| 72 | 11' | 15' | 24' | 32' | 40' |
| As = Area of steel reinforcing | | | | | |

## CLASS IV RCP

| Pipe diameter (inches) | Class R-1 bedding | Class R-2 bedding | Class R-3 & R-4 bedding | | |
|---|---|---|---|---|---|
| | | | No steel | As=0.4% | As=1.0% |
| 12 | 12' | 15' | 23' | 28' | 40' |
| 15 | 12' | 16' | 23' | 30' | 40' |
| 18 | 13' | 16' | 29' | 40' | 40' |
| 21 | 13' | 18' | 40' | 40' | 40' |
| 24 | 16' | 23' | 40' | 40' | 40' |
| 27 | 19' | 30' | 40' | 40' | 40' |
| 30 | 19' | 29' | 40' | 40' | 40' |
| 33 | 19' | 28' | 40' | 40' | 40' |
| 36 | 19' | 28' | 40' | 40' | 40' |
| 42 | 18' | 27' | 40' | 40' | 40' |
| 48 | 18' | 26' | 40' | 40' | 40' |
| 54 | 18' | 25' | 40' | 40' | 40' |
| 60 | 18' | 25' | 40' | 40' | 40' |
| 66 | 18' | 25' | 40' | 40' | 40' |
| 72 | 18' | 24' | 40' | 40' | 40' |
| As = Area of steel reinforcing | | | | | |

## CLASS V RCP

| Pipe diameter (inches) | Class R-1 bedding | Class R-2 bedding | Class R-3 & R-4 bedding | | |
|---|---|---|---|---|---|
| | | | No steel | As=0.4% | As=1.0% |
| 12 | 18' | 23' | 35' | 40' | 40' |
| 15 | 19' | 24' | 40' | 40' | 40' |
| 18 | 19' | 30' | 40' | 40' | 40' |
| 21 | 25' | 40' | 40' | 40' | 40' |
| 24 | 34' | 40' | 40' | 40' | 40' |
| 27 | 40' | 40' | 40' | 40' | 40' |
| 30 | 40' | 40' | 40' | 40' | 40' |
| 33 | 40' | 40' | 40' | 40' | 40' |
| 36 | 40' | 40' | 40' | 40' | 40' |
| 42 | 37' | 40' | 40' | 40' | 40' |
| 48 | 35' | 40' | 40' | 40' | 40' |
| 54 | 33' | 40' | 40' | 40' | 40' |
| 60 | 32' | 40' | 40' | 40' | 40' |
| 66 | 31' | 40' | 40' | 40' | 40' |
| 72 | 31' | 40' | 40' | 40' | 40' |
| As = Area of steel reinforcing | | | | | |

## EXTRA STRENGTH VCP

| Pipe diameter (inches) | Class R-1 bedding | Class R-2 bedding | Class R-3 & R-4 bedding | | |
|---|---|---|---|---|---|
| | | | No steel | As=0.4% | As=1.0% |
| 6 | 25' | 30' | 30' | 30' | 30' |
| 8 | 20' | 26' | 30' | 30' | 30' |
| 10 | 18' | 23' | 30' | 30' | 30' |
| 12 | 16' | 20' | 30' | 30' | 30' |
| 15 | 15' | 19' | 28' | 30' | 30' |
| 18 | 14' | 18' | 30' | 30' | 30' |
| 21 | 15' | 22' | 30' | 30' | 30' |
| 24 | 18' | 28' | 30' | 30' | 30' |
| 27 | 20' | 30' | 30' | 30' | 30' |
| 30 | 19' | 29' | 30' | 30' | 30' |
| 33 | 20' | 30' | 30' | 30' | 30' |
| 36 | 20' | 30' | 30' | 30' | 30' |
| 39 | 19' | 29' | 30' | 30' | 30' |
| 42 | 18' | 26' | 30' | 30' | 30' |
| As = Area of steel reinforcing | | | | | |

## REINFORCED CONCRETE ARCH PIPE

| Pipe size (in. x in.) | Equiv. diameter (inches) | Class A-III | Class A-IV |
|---|---|---|---|
| 18x11 | 15 | 6' | 11' |
| 22x13 | 18 | 6' | 11' |
| 26x15 | 21 | 6' | 13' |
| 29x18 | 24 | 7' | 15' |
| 36x22 | 30 | 8' | 15' |
| 44x27 | 36 | 8' | 14' |
| 51x31 | 42 | 8' | 15' |
| 58x36 | 48 | 8' | 15' |
| 65x40 | 54 | 8' | 15' |
| 73x45 | 60 | 8' | 14' |
| 88x54 | 72 | 9' | 14' |
| Allowable bury depths for arch pipe are for Class R-5 bedding. | | | |

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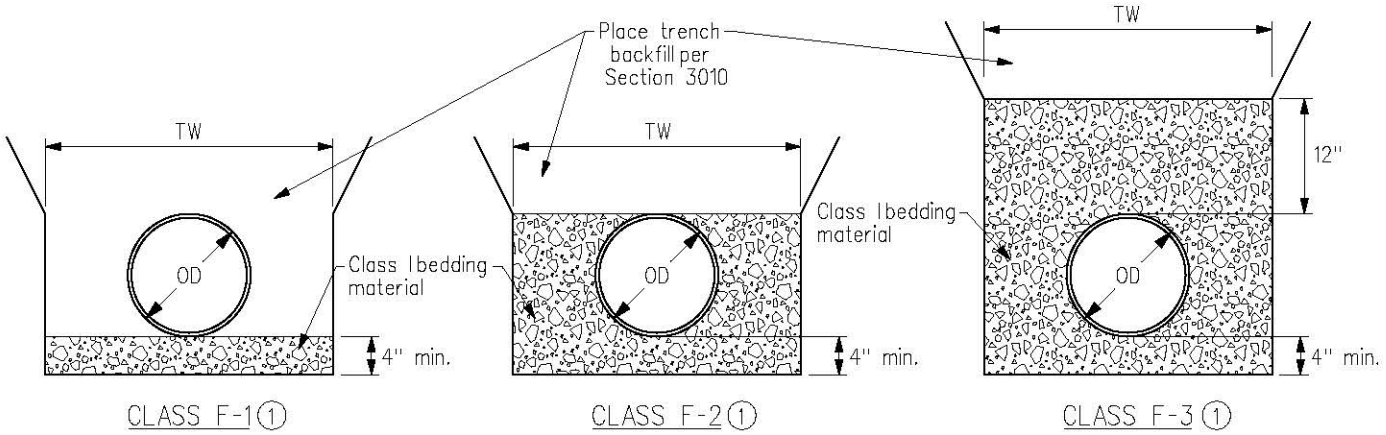
FIGURE: 3010.102

SHEET 2 OF 2

# RIGID GRAVITY PIPE TRENCH BEDDING




CLASS F-1 ① CLASS F-2 ① CLASS F-3 ①

① The following flexible pipe bedding classes are allowed for the pipe material and sewer types shown. Use of bedding class is subject to the maximum allowable depth of bury shown in the tables:

| Pipe Material | Storm Sewer | Sanitary Sewer |
|---|---|---|
| Ductile Iron | F-1, F-2, F-3 | F-1, F-2, F-3 |
| HDPE | F-2, F-3 | Not allowed |
| PVC | F-2, F-3 | F-3 |

Key

OD = Outside diameter of pipe

TW = Trench width at top of pipe:
Min. width: OD+18 inches or
1.25xOD+12 inches (whichever is greater)

## ALLOWABLE BURY DEPTH

### PVC PIPE

For bedding class F-2 or F-3

| Pipe diameter (inches) | ASTM D 3034 | | | ASTM F 679 | ASTM F 949 | ASTM F 1803 | ASTM D 2680 |
|---|---|---|---|---|---|---|---|
| | Solid wall | | | Solid wall | Corrug. exterior | Closed profile | Composite (Truss type) |
| | SDR 23.5 | SDR 26 | SDR 35 | SDR 35 | | | |
| 8 | 30' | 28' | 24' | --- | 24' | --- | 32' |
| 10 | 30' | 28' | 24' | --- | 24' | --- | 32' |
| 12 | 30' | 28' | 24' | --- | 24' | --- | 32' |
| 15 | 30' | 28' | 24' | --- | 24' | --- | 32' |
| 18 | --- | --- | --- | 24' | 24' | --- | --- |
| 21 | --- | --- | --- | 24' | 24' | 24' | --- |
| 24 | --- | --- | --- | 24' | 24' | 24' | --- |
| 27 | --- | --- | --- | 24' | --- | 24' | --- |
| 30 | --- | --- | --- | 24' | 24' | 24' | --- |
| 33 | --- | --- | --- | 24' | --- | --- | --- |
| 36 | --- | --- | --- | 24' | 24' | 24' | --- |
| 42 | --- | --- | --- | 24' | --- | 24' | --- |
| 48 | --- | --- | --- | 24' | --- | 24' | --- |
| 54 | --- | --- | --- | --- | --- | 24' | --- |
| 60 | --- | --- | --- | --- | --- | 24' | --- |

### DUCTILE IRON, AWWA C151, CLASS 52

For bedding class as shown

| Pipe diameter (inches) | Class F-1 bedding | Class F-2 bedding | Class F-3 bedding |
|---|---|---|---|
| 4 | 40' | 40' | 40' |
| 6 | 40' | 40' | 40' |
| 8 | 40' | 40' | 40' |
| 10 | 40' | 40' | 40' |
| 12 | 37' | 40' | 40' |
| 14 | 31' | 40' | 40' |
| 16 | 28' | 37' | 40' |
| 18 | 25' | 34' | 40' |
| 20 | 23' | 32' | 40' |
| 24 | 20' | 29' | 38' |
| 30 | 18' | 23' | 31' |
| 36 | 18' | 22' | 30' |
| 42 | 17' | 21' | 29' |
| 48 | 16' | 19' | 27' |
| 54 | 16' | 19' | 27' |

### HDPE PIPE

For bedding class F-2 or F-3

| Pipe diameter (inches) | AASHTO M294 |
|---|---|
| 12 | 8' |
| 15 | 9' |
| 18 | 9' |
| 24 | 9' |
| 30 | 9' |
| 36 | 9' |
| 42 | 8' |
| 48 | 8' |
| 54 | 8' |
| 60 | 8' |

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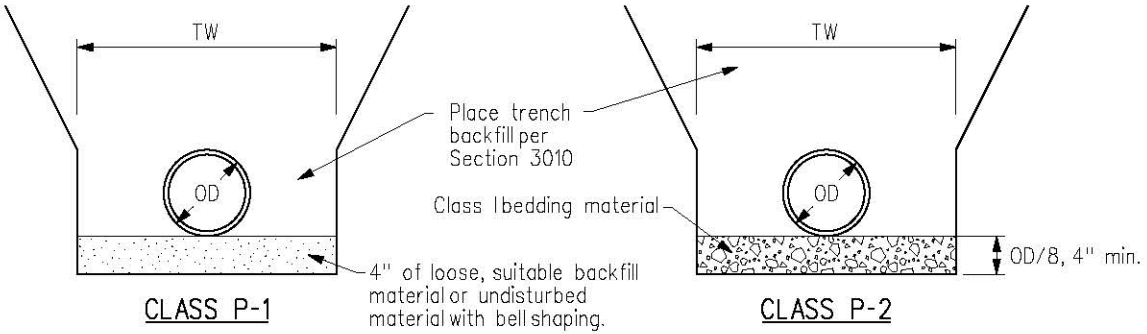
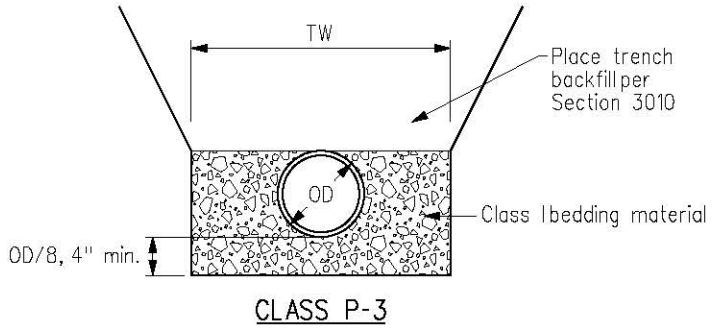
FIGURE: 3010.103

SHEET 1 OF 1

# FLEXIBLE GRAVITY PIPE TRENCH BEDDING

FIGURE: 3010.103 SHEET 1 OF 1




Key

OD = Outside diameter of pipe

TW = Trench width at top of pipe:
Min. width: OD+18 inches or
1.25xOD+12 inches (whichever is greater)

## ALLOWABLE BURY DEPTH

DUCTILE IRON, AWWA C151, CLASS 52

| Pipe diameter (inches) | Class P-1 bedding | Class P-2 bedding | Class P-3 bedding |
|---|---|---|---|
| 4 | 40' | 40' | 40' |
| 6 | 40' | 40' | 40' |
| 8 | 40' | 40' | 40' |
| 10 | 36' | 40' | 40' |
| 12 | 31' | 40' | 40' |
| 14 | 26' | 40' | 40' |
| 16 | 23' | 37' | 40' |
| 18 | 20' | 34' | 40' |
| 20 | 18' | 32' | 40' |
| 24 | 16' | 29' | 38' |
| 30 | 13' | 23' | 31' |
| 36 | 13' | 22' | 30' |
| 42 | 13' | 21' | 29' |
| 48 | 13' | 19' | 27' |
| 54 | 13' | 19' | 27' |

PVC, AWWA C900 & C905, DR18

| Pipe diameter (inches) | Class P-1 bedding | Class P-2 bedding | Class P-3 bedding |
|---|---|---|---|
| 4 | 19' | 23' | 40' |
| 6 | 19' | 23' | 40' |
| 8 | 19' | 23' | 40' |
| 10 | 19' | 23' | 40' |
| 12 | 19' | 23' | 40' |
| 14 | 19' | 23' | 40' |
| 16 | 19' | 23' | 40' |
| 18 | 19' | 23' | 40' |
| 20 | 19' | 23' | 40' |
| 24 | 19' | 23' | 40' |

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FIGURE: 3010.104

SHEET 1 OF 1

# PRESSURE PIPE TRENCH BEDDING

FIGURE: 3010.104 SHEET 1 OF 1

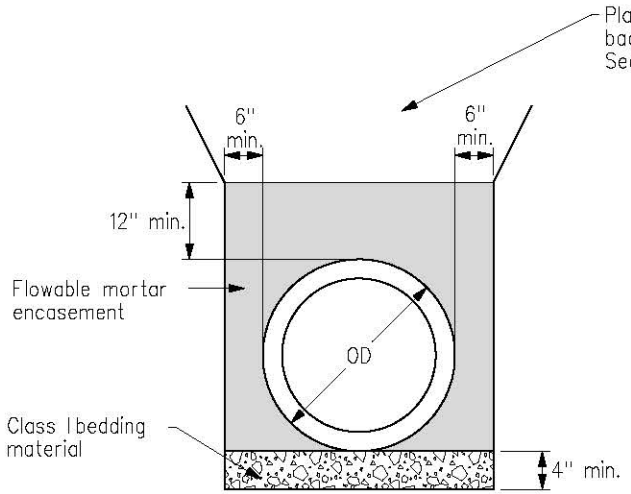
Install flowable mortar or concrete pipe encasement at locations specified in the contract documents.

(1) Place encasement material in two lifts, or as required to prevent pipe flotation. Allow previous lift to reach initial set prior to placing subsequent lifts.

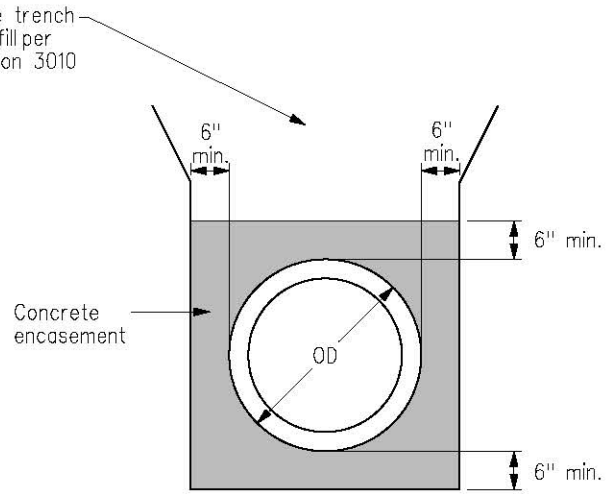
(2) Drive reinforcing bars into trench wall as required to anchor pipe. 10 foot maximum spacing.

Key

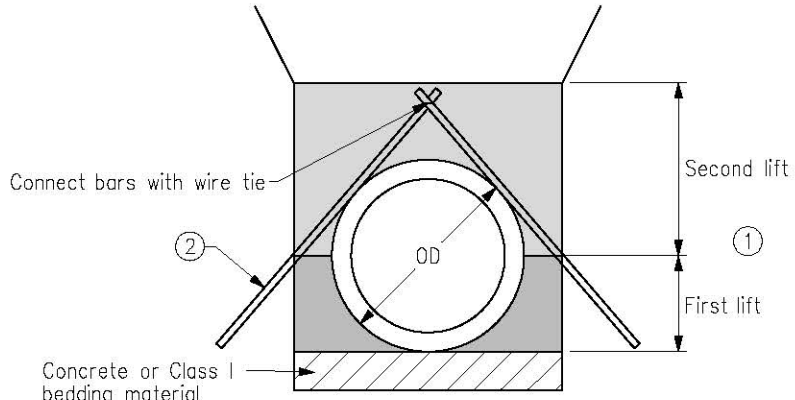
OD = Outside diameter of pipe




FLOWABLE MORTAR ENCASEMENT




PCC ENCASEMENT




PIPE RESTRAINT DETAIL

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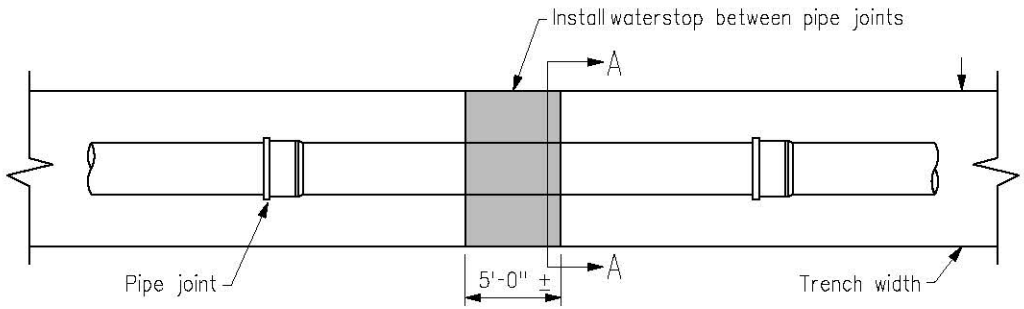
FIGURE: 3010.105

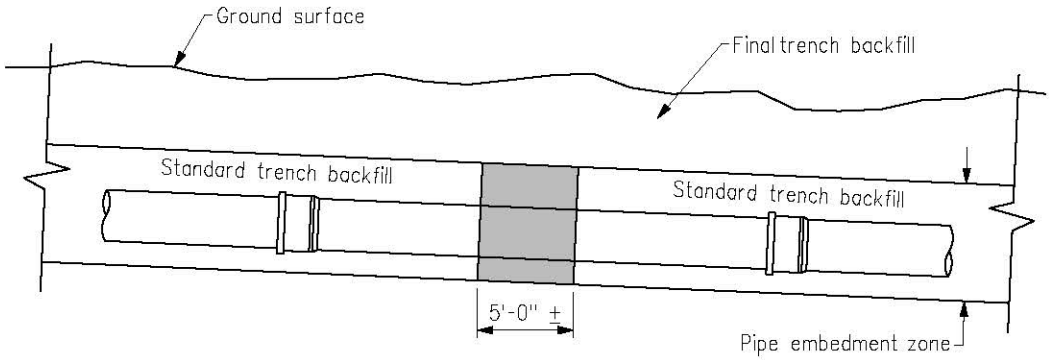
SHEET 1 OF 1

# MISCELLANEOUS PIPE BEDDING

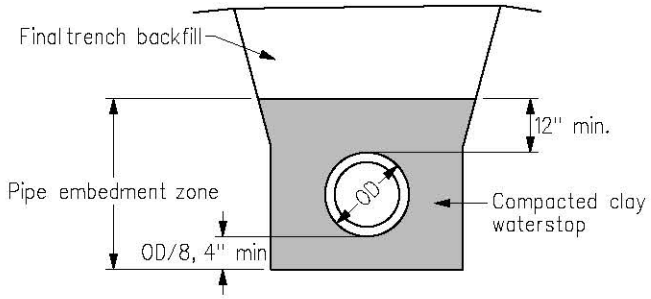
FIGURE: 3010.105 SHEET 1 OF 1




PLAN




PROFILE




SECTION A-A

Install waterstops when specified in the contract documents.

When waterstops are required, install at a nominal spacing of 800 feet or at locations as specified.

Place clay backfill material from the trench bottom to 12 inches over the pipe. Compact to a minimum of 95% Standard Proctor Density. If trench stabilization material is required, extend waterstop through stabilization material to bottom of trench.

Comply with Section 3010 for placement of final backfill material above waterstop.

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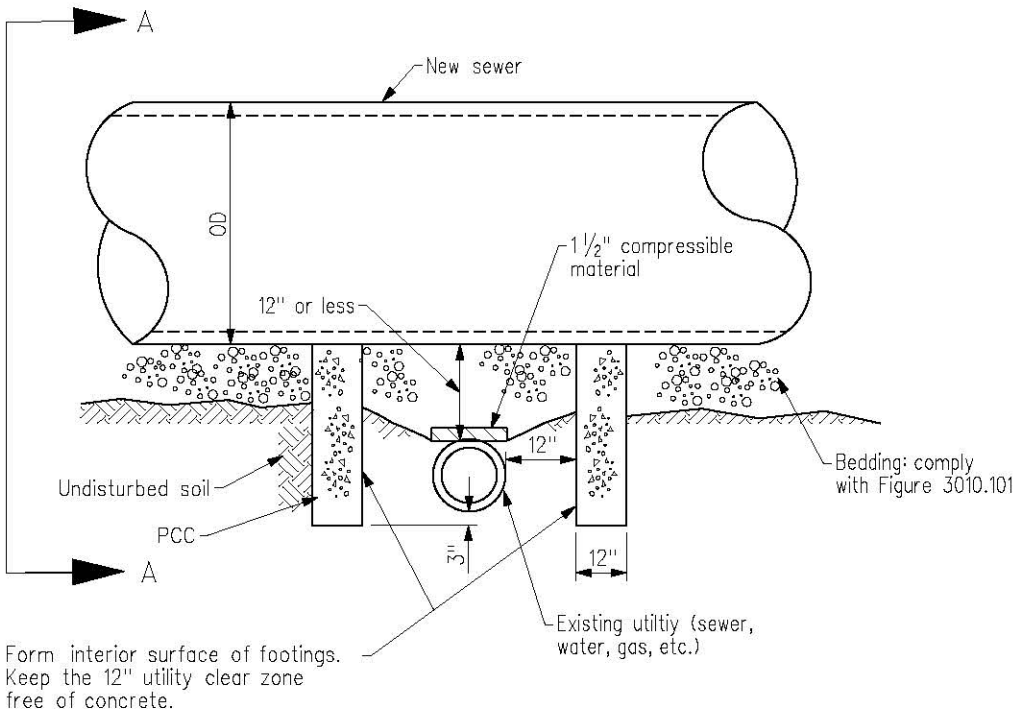
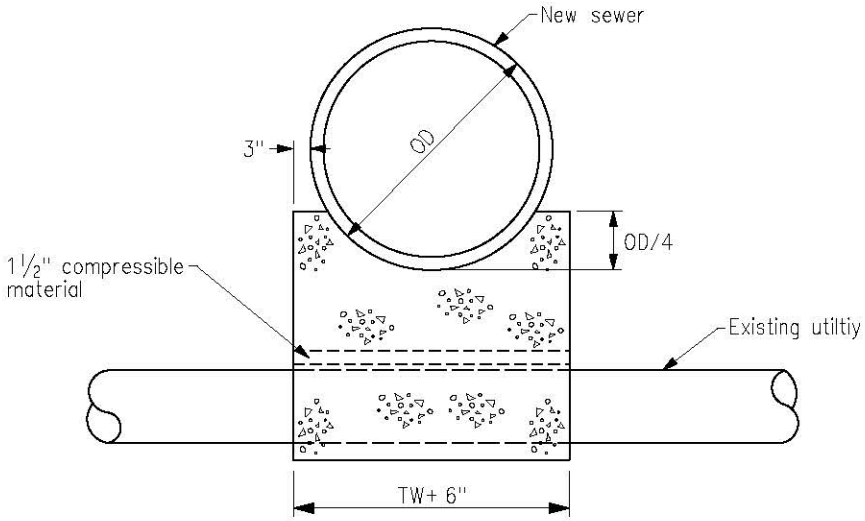
FIGURE: 3010.106

# WATERSTOP FOR TRENCHES

FIGURE: 3010.106 SHEET 1 OF 1




SECTION A-A

NOTE:

Install pipe support for all new sewers 12 inches in diameter or larger when clearance between bottom of new sewer and top of existing line is 12 inches or less.

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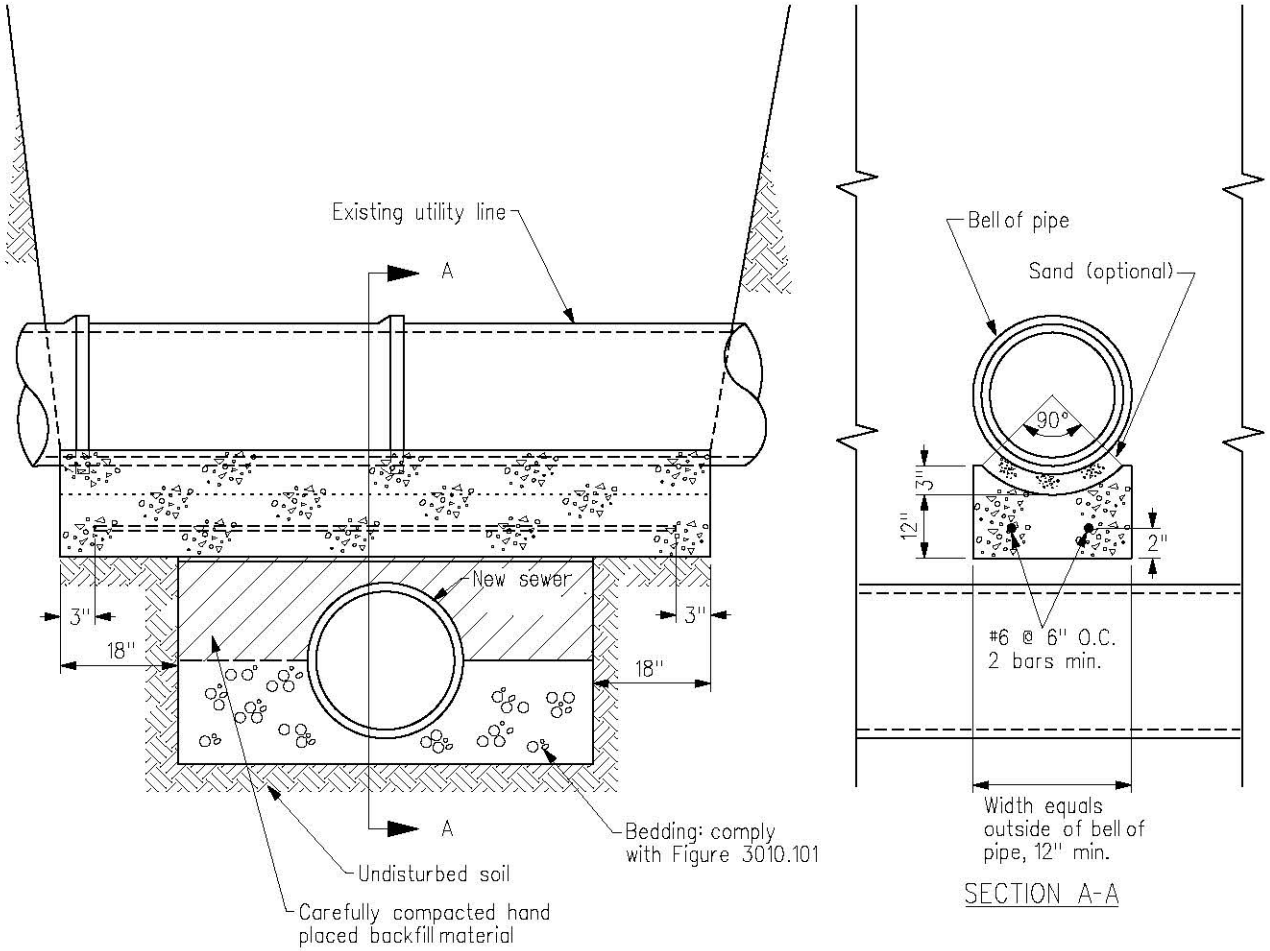
FIGURE: 3010.901

# SEWER PIPE SUPPORT OVER EXISTING UTILITY

FIGURE: 3010.901 SHEET 1 OF 1







SECTION A-A

NOTES:

Reinforced concrete beam utility line support to be used when new sewer excavation is crossing under an existing utility line (sewer lines, water lines, gas lines, etc.) as directed by the Engineer.

Allow concrete to cure a minimum of 48 hours before placing backfill material.

Special design required for trench width greater than 7 feet or trench depth greater than 15 feet.

FIGURE: 3010.902 | SHEET 1 OF 1

SUDAS

| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 3010.902 | SHEET 1 OF 1 |

# REINFORCED PCC BEAM UTILITY LINE SUPPORT

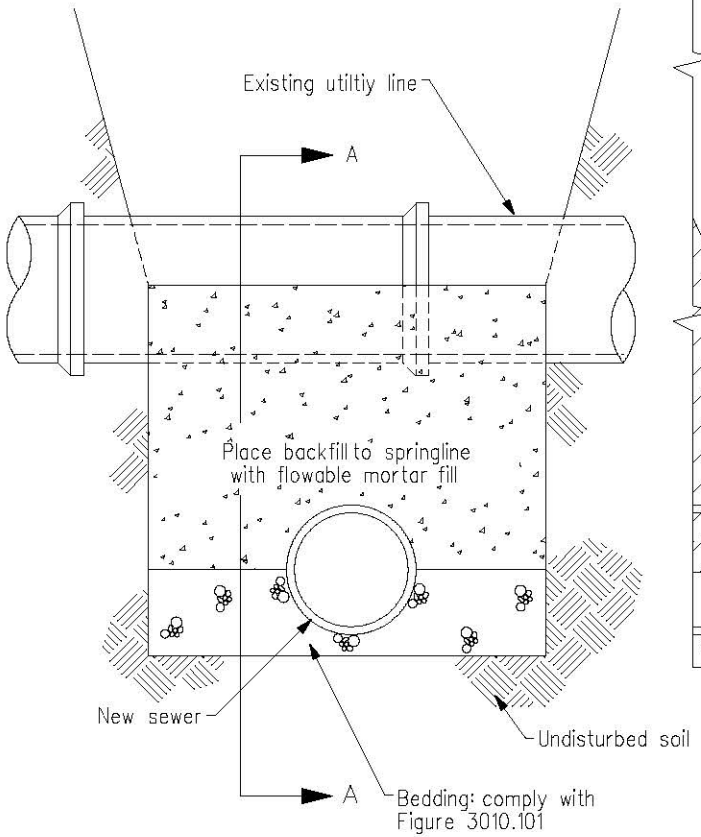
NOTES:

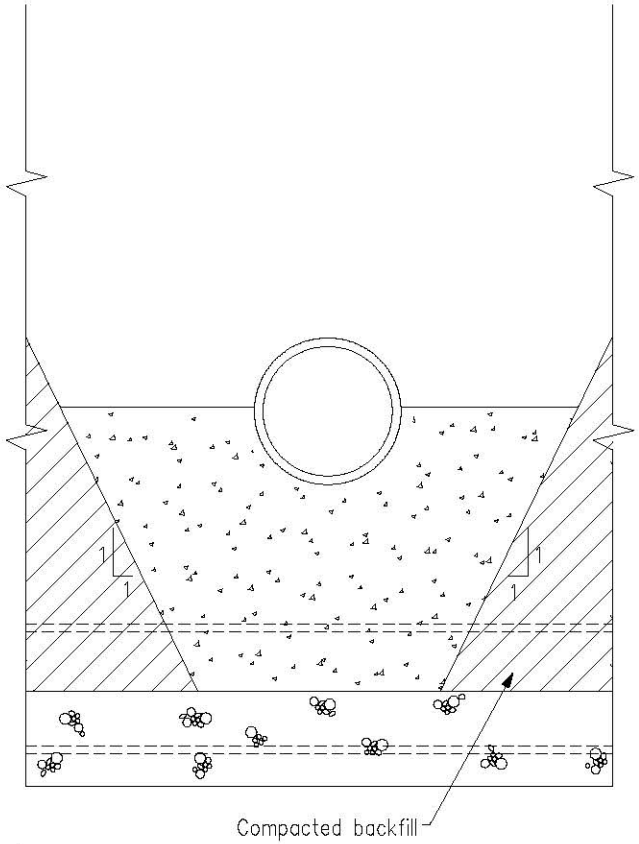
Flowable mortar utility line support to be used when new utility excavation is crossing under an existing utility line (sewer lines, water lines, gas lines, etc.) as directed by the Engineer.

Allow flowable mortar fill to cure a minimum of 24 hours before placing backfill material.

Trim uncompacted backfill material away from slopes before pouring flowable mortar.

Side slopes of flowable mortar fill to be 1:1 or greater. See Section A-A.




SECTION A-A

| | |
|---|---|
| SUDAS | REVISION NO. --- |
| | REVISION DATE 10/21/08 |
| FIGURE: 3010.903 | SHEET 1 OF 1 |

# FLOWABLE MORTAR FILL UTILITY LINE SUPPORT

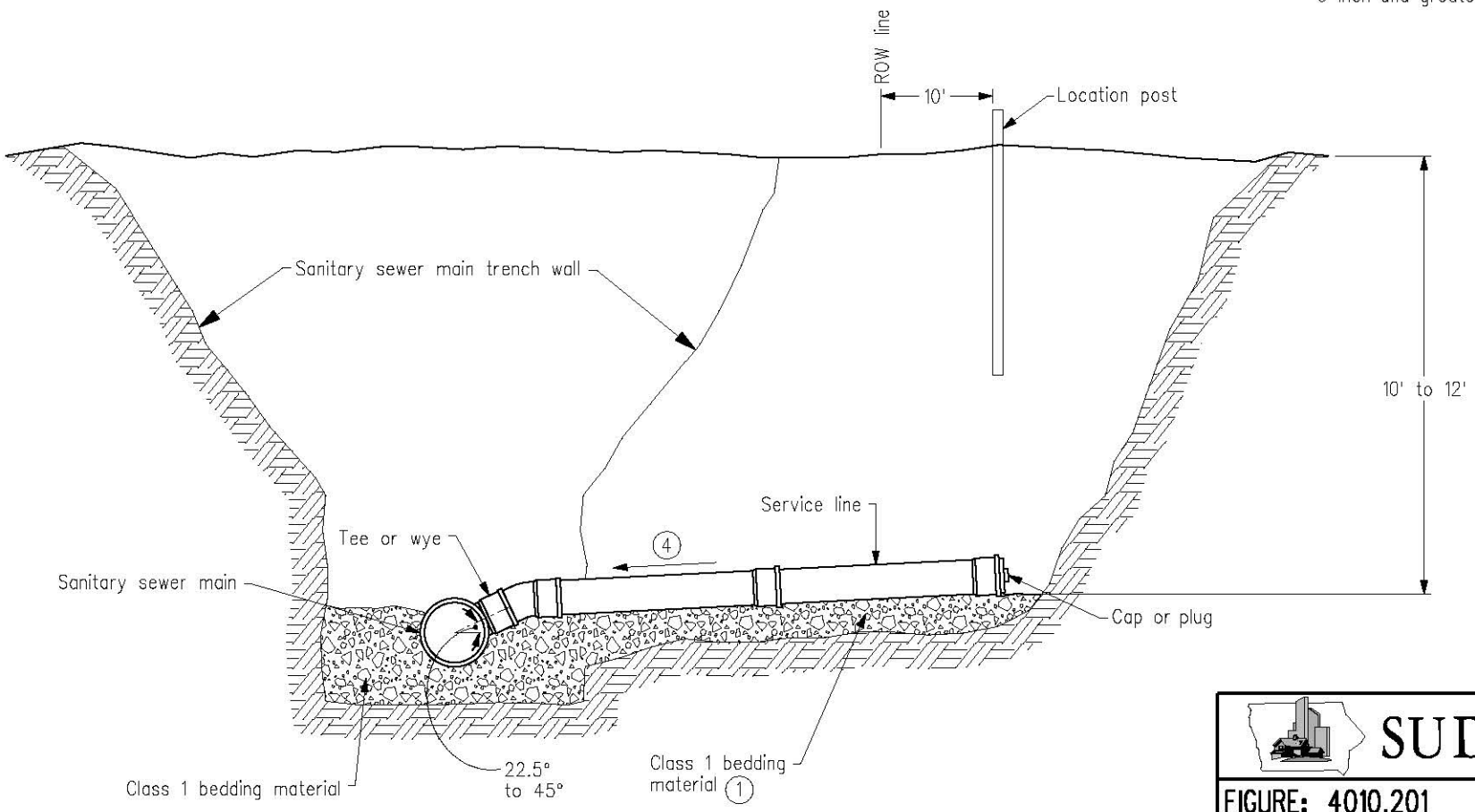
FIGURE: 3010.903 SHEET 1 OF 1

# Division 4 Figures
## Sewers and Drains

## Division 4 - Sewers and Drains

| Current # | Current SUDAS Name | Proposed SUDAS # | Proposed Iowa DOT # | Proposed Name |
|---|---|---|---|---|
| 4010.1A | Typcial Sanitary Sewer Service Stub (Depth of 12' or less) | 4010.201 | SW-201 | Sanitary Sewer Service Stub |
| 4010.1B | Typcial Sanitary Sewer Service Stub (Depth greater than 12') | | | |
| 4010.3 | Sewage Air Release Valve Pit | 4010.202 | SW-202 | Sewage Air Release Valve Pit |
| 4010.4 | Relocate Sanitary Sewer Service in Conflict with New Sewer | 4010.901 | None | Relocate Sanitary Sewer Service in Conflict with New Sewer |
| 4020.1A | Pipe Connection Details (Storm Sewer) | 4020.211 | SW-211 | Special Pipe Connections for Storm Sewer |
| 4020.2 | RCP Apron Section Footing Detail | 4030.221 | None | RCP Apron Section Footing |
| 4020.5A | Subdrains, Type I Longitudinal Subdrains | 4040.231 | None | Subdrains |
| 4020.5B | Subdrains, Type I Longitudinal Subdrains | | | |
| 4020.6 | Subdrain Cleanouts and Connections | 4040.232 | None | Subdrain Cleanouts |
| | | 4040.233 | None | Subdrain Outlets |
| 4010.2 | Standard Sewer Plug for Abandonment | Archive | None | |
| 4020.1B | Pipe Connection Details (Culvert) | Archive | RF-14 | Connected Pipe Joints |
| 4020.3 | Flared End Section Apron Guard | Archive | RF-26 | Pipe Apron Guard |
| 4020.4A | Curtain Wall Details for 30" Diameter Culvert | Archive | None | |
| 4020.4B | Curtain Wall Details for 36" Diameter Culvert | Archive | None | |
| 4020.7 | Trench Drain | Archive | RF-19A | Subdrain for Fill or Foundation Drain (Standard) |
| 4020.8 | Details of Beveled Pipe and Guard | Archive | RF-5 | Metal Pipe Aprons and Beveled Ends |
| 4020.9 | Concrete Pipe Apron | Archive | RF-3 | Concrete Pipe Aprons |
| 4020.10 | Metal Pipe Aprons and Beveled Ends | Archive | RF-44 | Metal Safety Slope Apron - 6:1 Slopes |
| 4030.1 | Replacing Sections of Existing VCP Sanitary Sewer | Archive | None | |
| 4030.2 | Couplings for Replacing Sections of Sanitary Sewer | Archive | None | |
| | | | | |

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



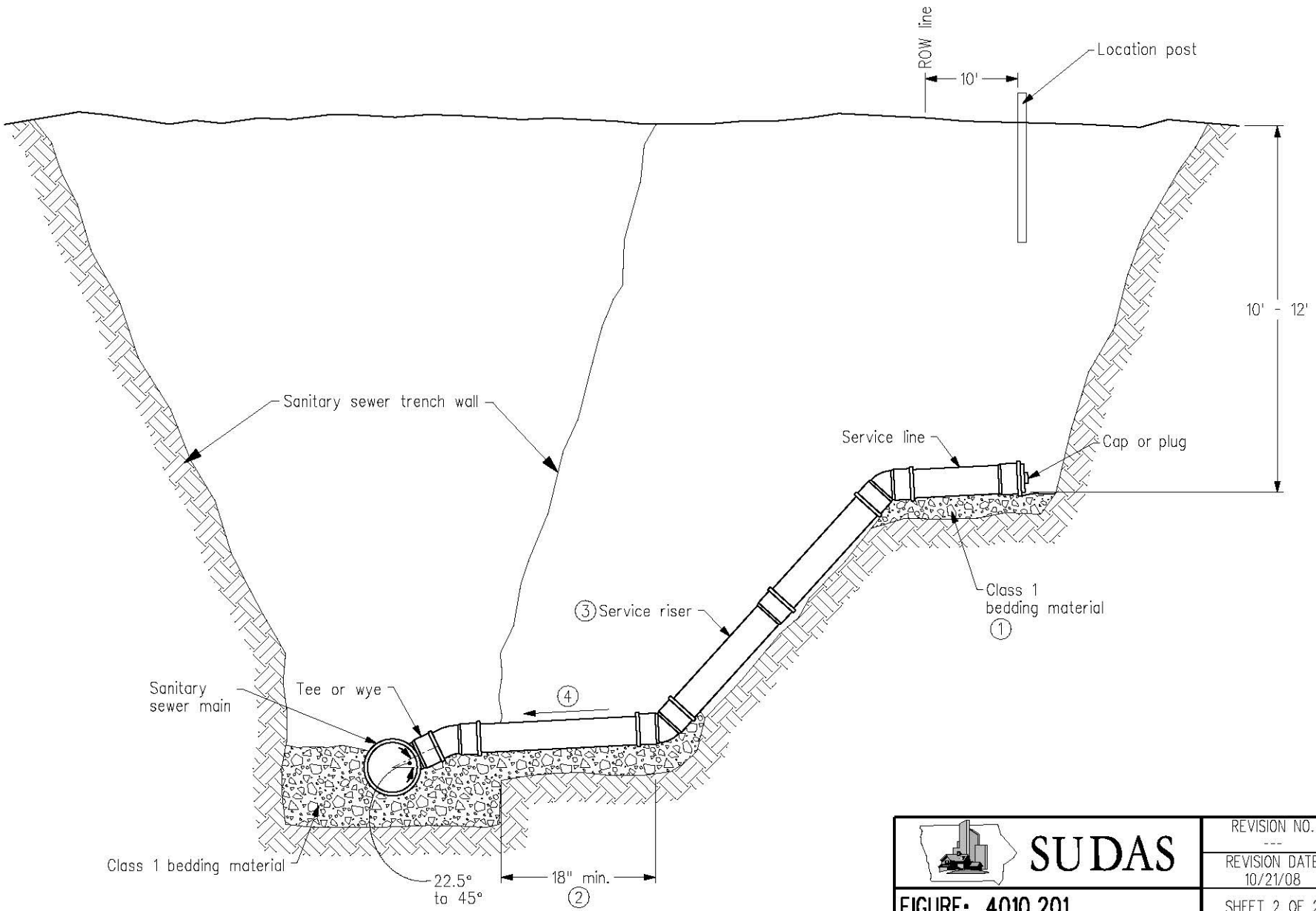

SANITARY SEWER SERVICE STUB

SUDAS

| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 4010.201 | SHEET 1 OF 2 |

SANITARY SEWER SERVICE STUB

FIGURE: 4010.201 SHEET 1 OF 2




SANITARY SEWER SERVICE STUB WITH RISER

SUDAS

| REVISION NO. |
| --- |
| --- |
| REVISION DATE |
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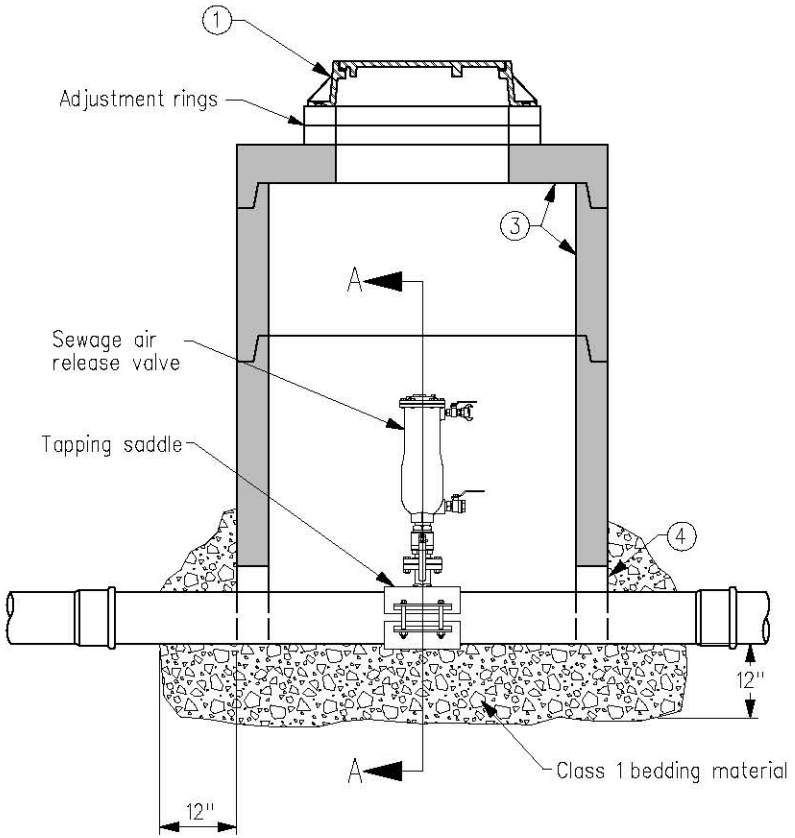
| SHEET 2 OF 2 |

FIGURE: 4010.201

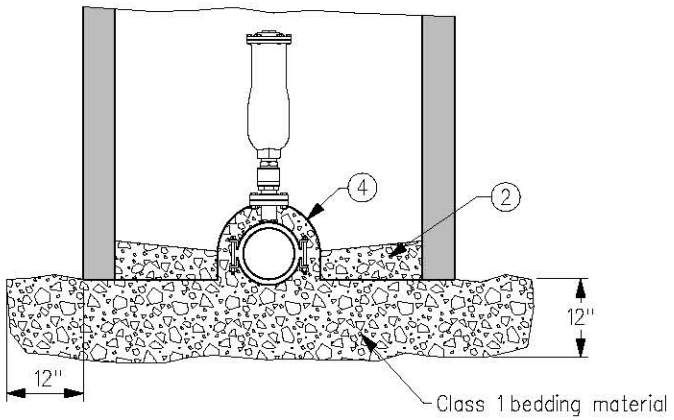
SANITARY SEWER SERVICE STUB

FIGURE: 4010.201 SHEET 2 OF 2

1. Type A or Type G ring and cover.
2. Place pipe bedding material to springline of pipe.
3. Standard 48 inch diameter precast manhole and top.
4. Pipe boxout: Provide gap between pipe and manhole section to prevent manhole from bearing on pipe.




TYPICAL SECTION




SECTION A-A

FIGURE: 4010.202 SHEET 1 OF 1

SUDAS

| | |
|---|---|
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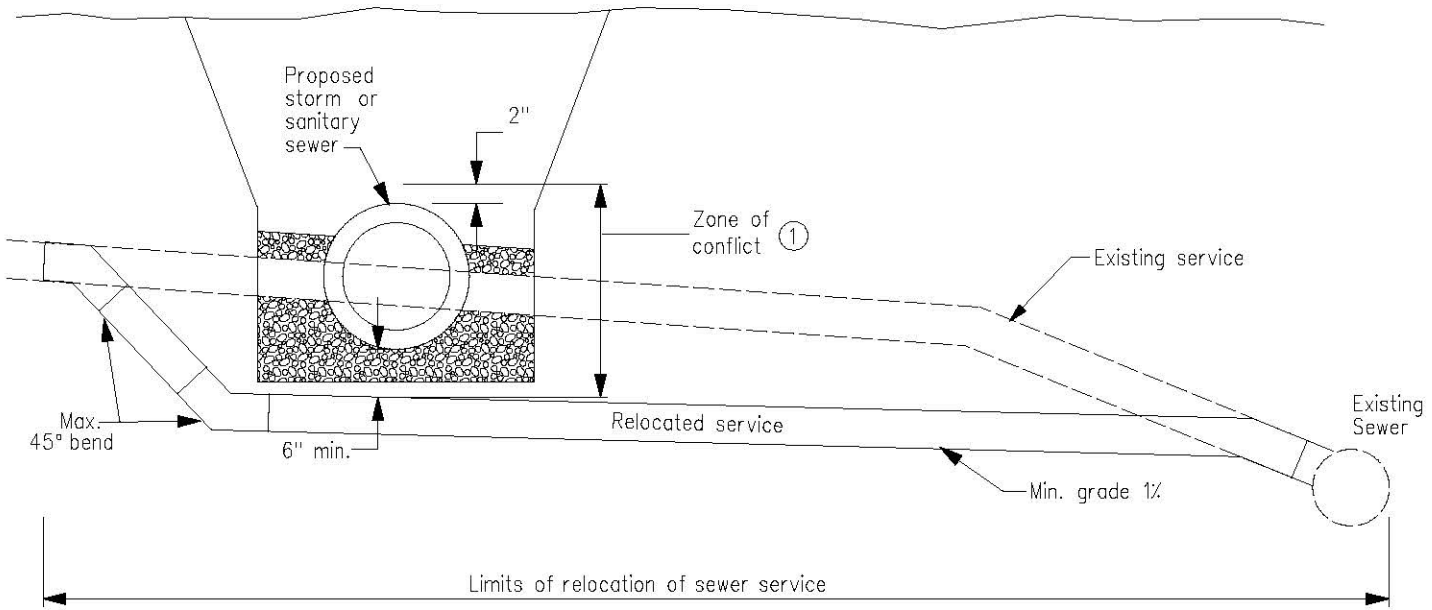
| REVISION DATE | 10/21/08 |
| FIGURE: 4010.202 | SHEET 1 OF 1 |

# SEWAGE AIR RELEASE VALVE PIT

① Zone of conflict is from 6 inches below the bottom of the sewer pipe to 2 inches above the top of pipe.




| | Service Status | Contractor's Responsibility | Compensation |
|---|---|---|---|
| 1. | Service located outside zone of conflict. | Provide protection. If damaged, repair in compliance with plumbing code. | Incidental to other work. |
| 2. | Service located in zone of conflict. | Relocate service according to Section 4010, 3.07. | Bid item: Relocate sanitary sewer service. |
| 3. | Service located in zone of conflict, but elevationns do not allow simple relocation as detailed above. Special design required. | Relocate service as directed by the Engineer. | Change order. |

FIGURE: 4010.901 SHEET 1 OF 1

SUDAS

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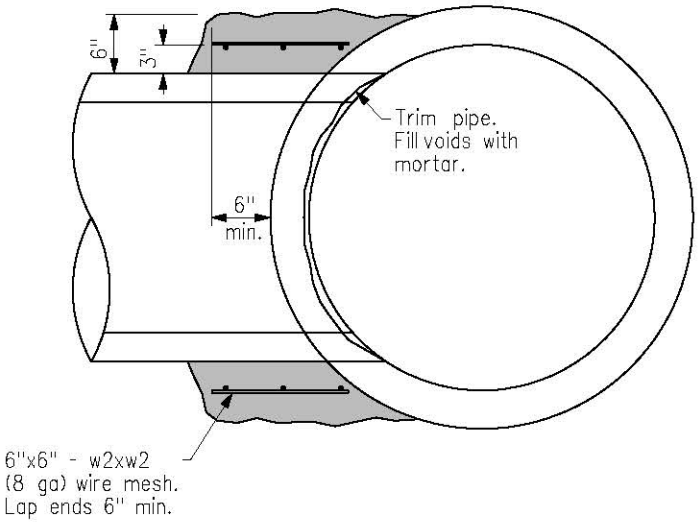
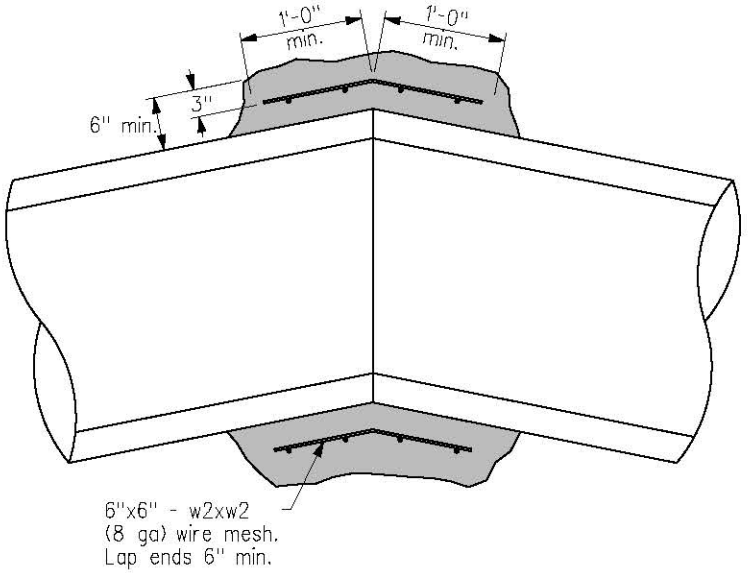
FIGURE: 4010.901

SHEET 1 OF 1

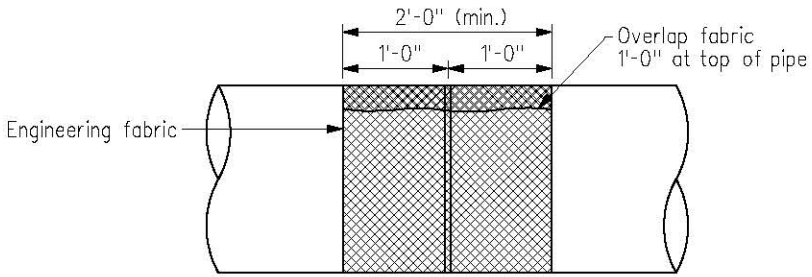
# RELOCATE SANITARY SEWER SERVICE IN CONFLICT WITH NEW SEWER




TYPE PC-1 CONCRETE COLLAR CONNECTION




TYPE PC-2 CONCRETE COLLAR CONNECTION




PIPE JOINT WRAPPING

FIGURE: 4020.211 SHEET 1 OF 1

SUDAS

| | |
|---|---|
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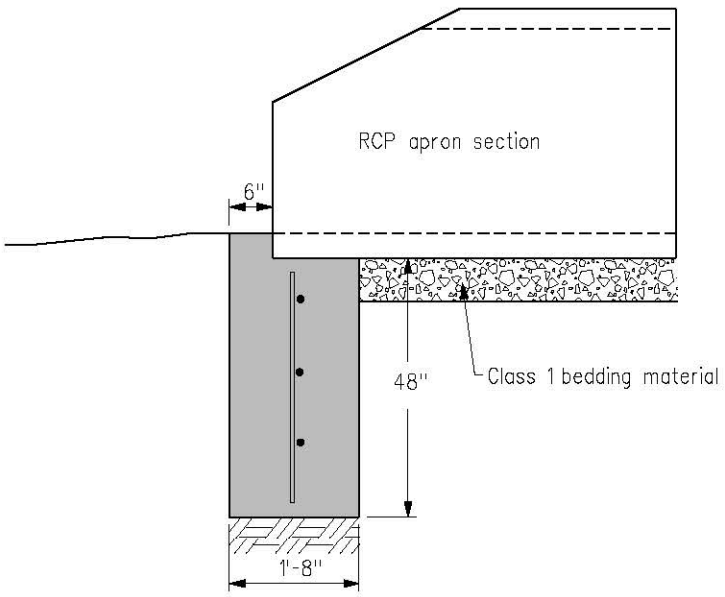
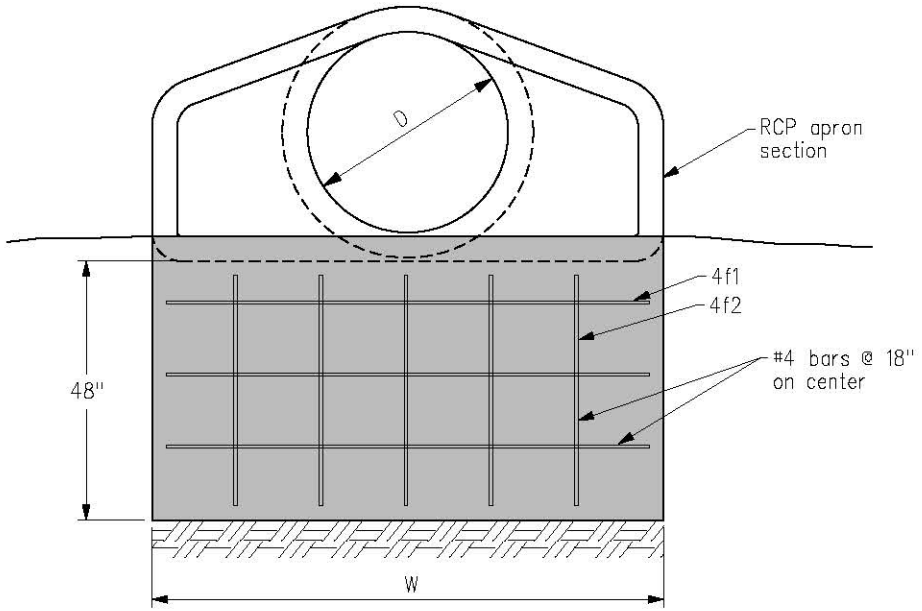
| FIGURE: 4020.211 | SHEET 1 OF 1 |

# SPECIAL PIPE CONNECTIONS FOR STORM SEWER




TYPICAL SECTION




ELEVATION

REINFORCING BAR LIST

| D | W | Mark | Size | Length | Count |
|---|---|---|---|---|---|
| 12" | 2'-4" | 4f1 | 4 | 2'-0" | 3 |
| | | 4f2 | 4 | 3'-8" | 2 |
| 15" | 2'-10½" | 4f1 | 4 | 2'-6 ½" | 3 |
| | | 4f2 | 4 | 3'-8" | 2 |
| 18" | 3'-5" | 4f1 | 4 | 3'-1" | 3 |
| | | 4f2 | 4 | 3'-8" | 3 |
| 24" | 4'-6" | 4f1 | 4 | 4'-2" | 3 |
| | | 4f2 | 4 | 3'-8" | 3 |
| 30" | 5'-7" | 4f1 | 4 | 5'-3" | 3 |
| | | 4f2 | 4 | 3'-8" | 4 |
| 36" | 6'-8" | 4f1 | 4 | 6'-4" | 3 |
| | | 4f2 | 4 | 3'-8" | 5 |
| 42" | 7'-3" | 4f1 | 4 | 6'-11" | 3 |
| | | 4f2 | 4 | 3'-8" | 5 |

| D | W | Mark | Size | Length | Count |
|---|---|---|---|---|---|
| 48" | 7'-10" | 4f1 | 4 | 7'-6" | 3 |
| | | 4f2 | 4 | 3'-8" | 6 |
| 54" | 8'-5" | 4f1 | 4 | 8'-1" | 3 |
| | | 4f2 | 4 | 3'-8" | 6 |
| 60" | 8'-11" | 4f1 | 4 | 8'-7" | 3 |
| | | 4f2 | 4 | 3'-8" | 6 |
| 66" | 8'-11" | 4f1 | 4 | 8'-7" | 3 |
| | | 4f2 | 4 | 3'-8" | 6 |
| 72" | 10'-0" | 4f1 | 4 | 9'-8" | 3 |
| | | 4f2 | 4 | 3'-8" | 7 |
| 78" | 10'-7" | 4f1 | 4 | 10'-3" | 3 |
| | | 4f2 | 4 | 3'-8" | 7 |
| 84" | 11'-1" | 4f1 | 4 | 10'-9" | 3 |
| | | 4f2 | 4 | 3'-8" | 8 |

FIGURE: 4030.221 SHEET 1 OF 1

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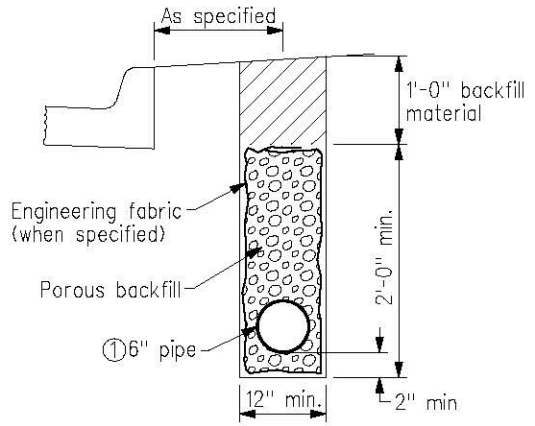
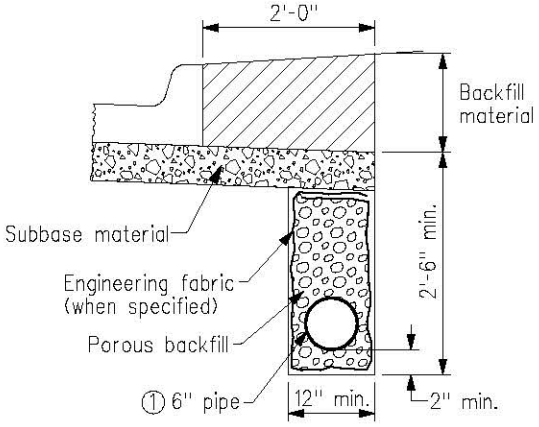
| FIGURE: 4030.221 | SHEET 1 OF 1 |

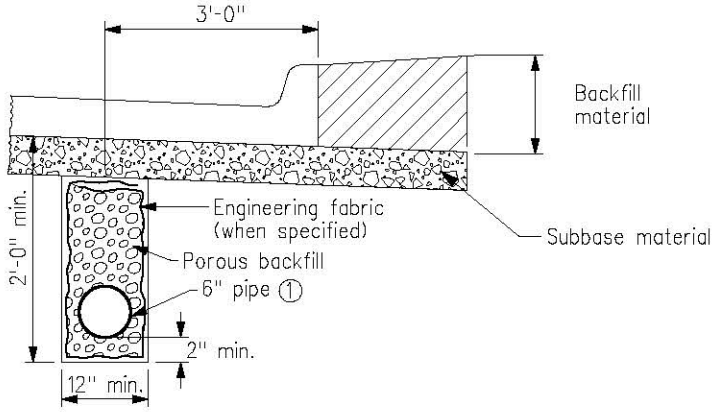
# RCP APRON SECTION FOOTING



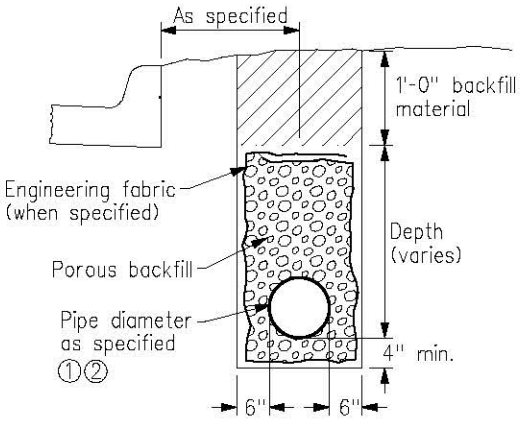

CASE A
TYPE 1



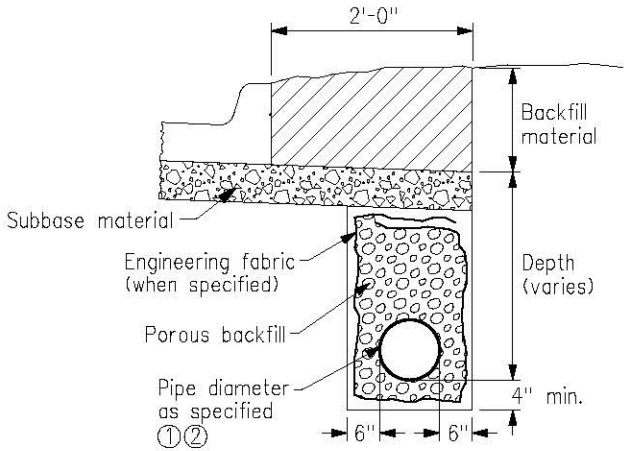

CASE B
TYPE 1




CASE C
TYPE 1




CASE D
TYPE 2




CASE E
TYPE 2

Note: Type 1 installation is for longitudinal subdrain only. Type 2 installation is for combination subdrain/footing drain collectors.

(1) Place perforations down for all installations.

(2) When concrete pipe is specified, wrap pipe joints with engineering fabric. Do not apply joint sealant. Comply with Figure 4020.211.

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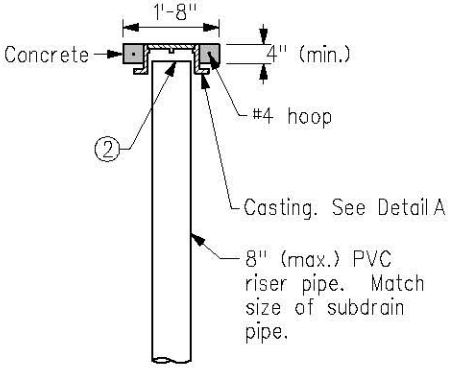
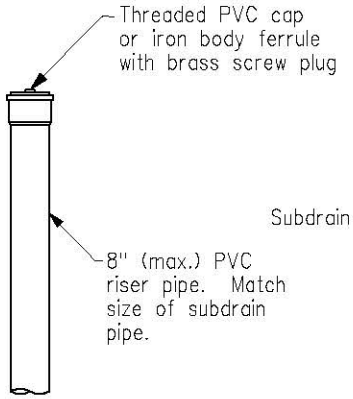
FIGURE: 4040.231

# SUBDRAINS

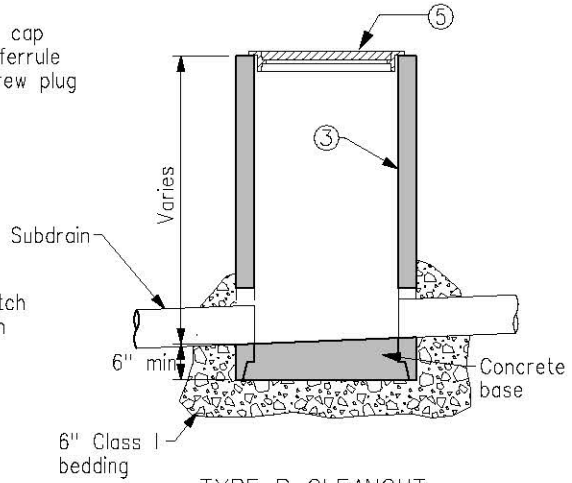
FIGURE: 4040.231 | SHEET 1 OF 1




TYPE A-1 CLEANOUT




TYPE A-2 CLEANOUT
(Non-traffic areas only)




TYPE B CLEANOUT
(Non-traffic areas only)

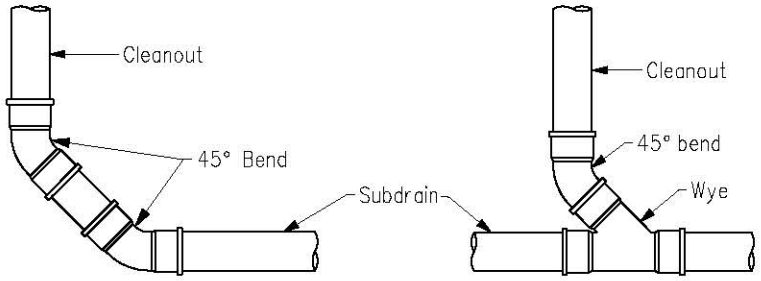
① Heavy duty casting. Mark lid with "Storm" or "Storm C.O."

② Do not allow casting to bear on top of riser pipe; provide 2 inch clearance, minimum.

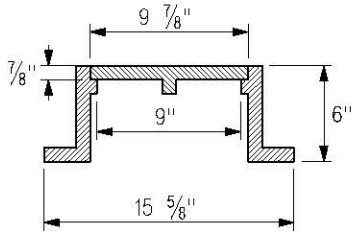
③ 24 inch diameter RCP for subdrain 8 inches or smaller; 30 inch diameter RCP for 10 to 12 inch subdrain. A manufactured cleanout may be used in lieu of a Type B cleanout, if approved by the Engineer.

④ Design is intended for use in conjunction with 8 inch PVC riser pipe. Other sized caps may be used with smaller pipe, as approved by the Engineer.

⑤ Provide Type G casting, as required to fit pipe size.




TYPE A CLEANOUT CONNECTIONS




DETAIL A ①④
(Dimensions are nominal)

FIGURE: 4040.232 | SHEET 1 OF 1

SUDAS

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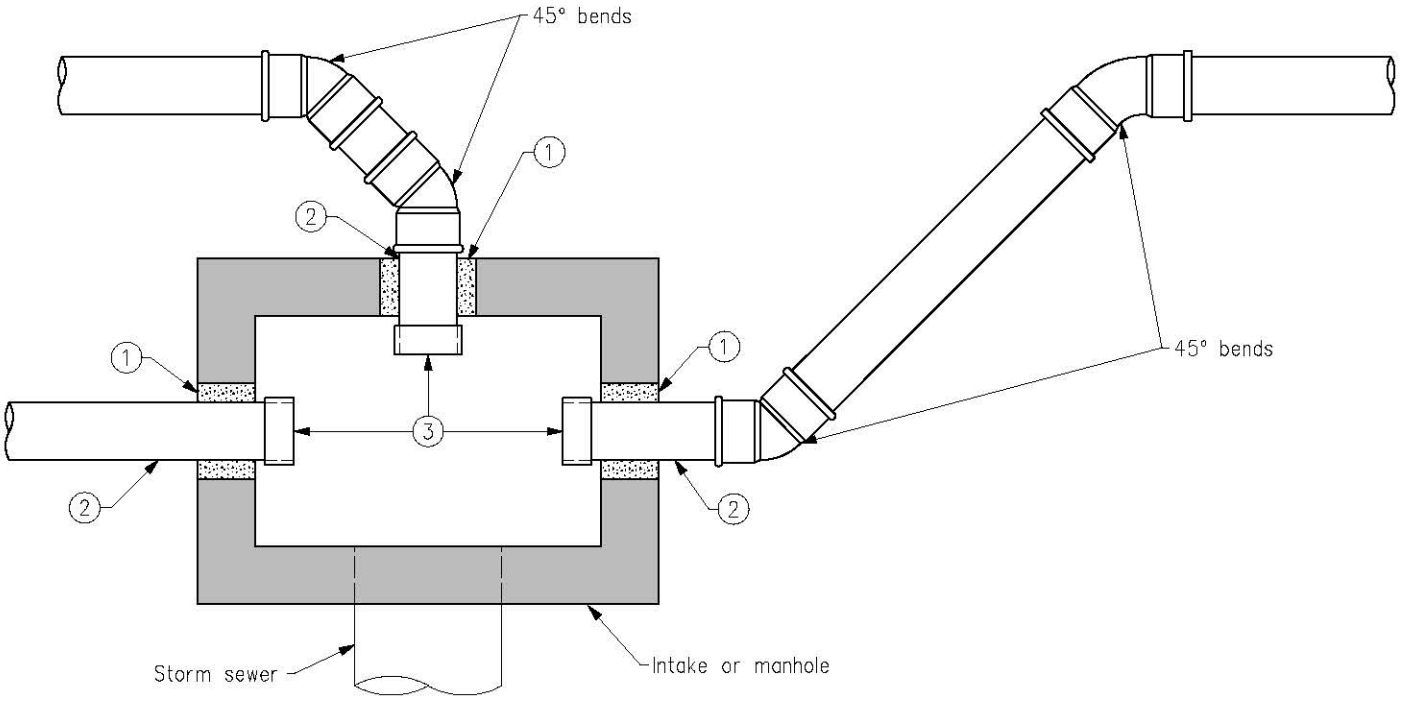
FIGURE: 4040.232

# SUBDRAIN CLEANOUTS

1. Fill annular space with non-shrink grout.
2. Outlets through intake walls to be CMP; corrugated, double-walled HDPE; or PVC.
3. Extend outlet pipe into structure as required to install removable rodent guard grate. Rodent guard grates complying with Iowa DOT I.M. 443.01 are required for pipes 6 inches and smaller.




PLAN VIEW

SUDAS

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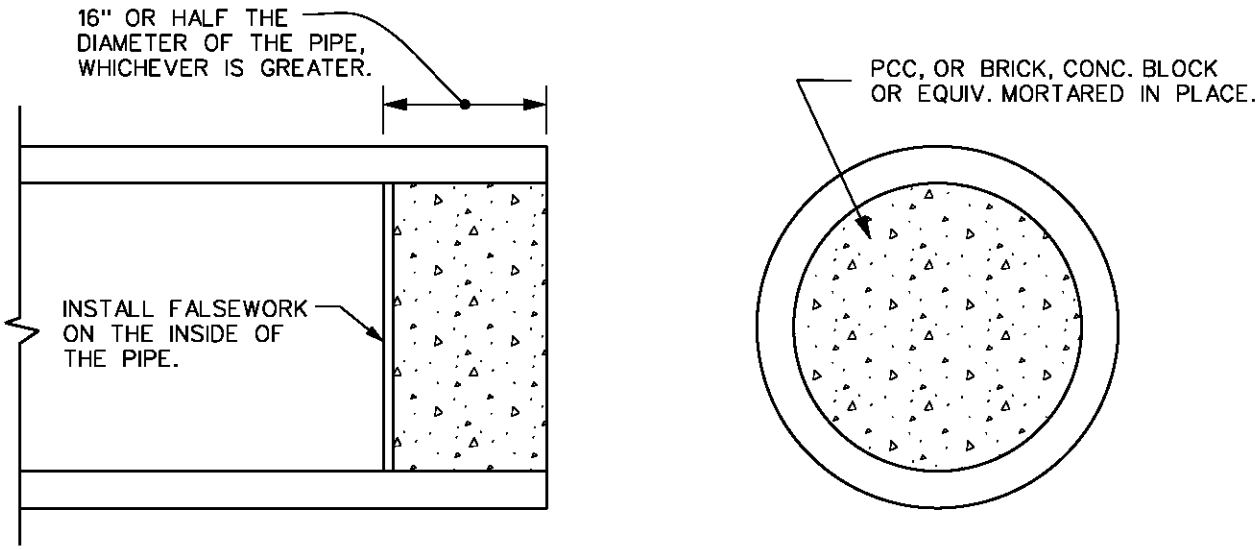
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 4040.233 | SHEET 1 OF 1 |

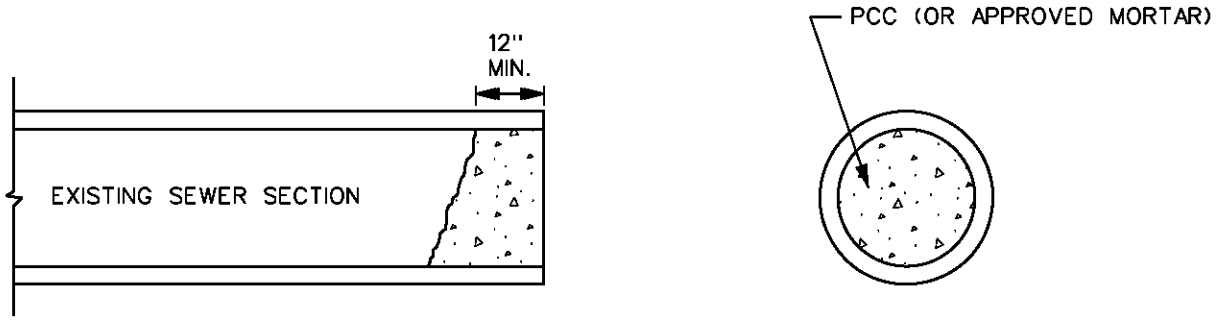
# SUBDRAIN OUTLETS

FIGURE: 4040.233 SHEET 1 OF 1




## STANDARD SEWER PLUG

FOR PLUGGING EXISTING SEWER (OVER 18" DIA.).




## STANDARD SEWER PLUG

FOR PLUGGING EXISTING SEWER (18" AND SMALLER).



| REV. | DATE | BY | | |
|---|---|---|---|---|
| 2 | 10/17/06 | | STANDARD SEWER PLUG FOR ABANDONMENT | FIGURE: 4010.2 |
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |

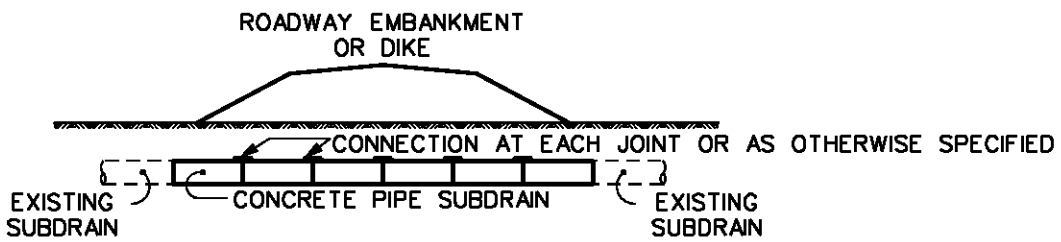
| REV. | DATE | BY |
|---|---|---|
| | | |

DATE: 01/25/01

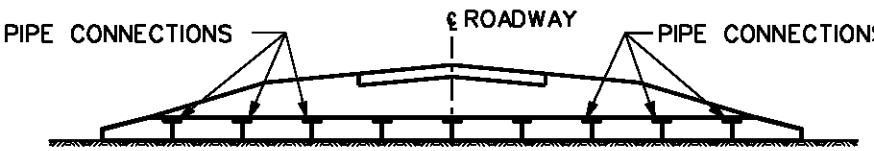
# PIPE CONNECTION DETAILS (CULVERT)

SHEET 1 OF 1

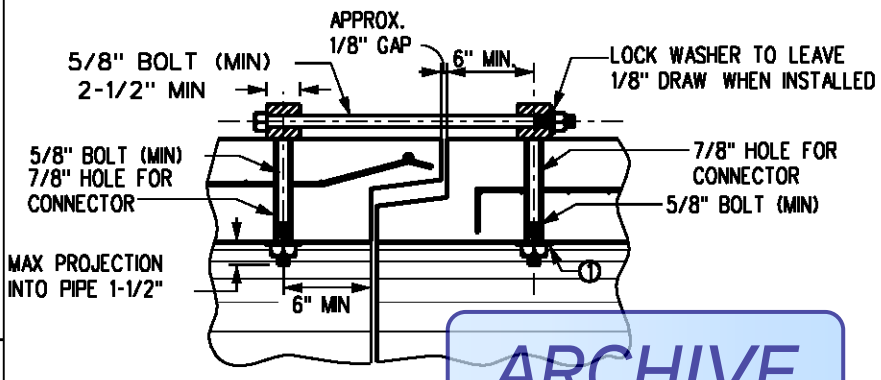
FIGURE: 4020.1B




TYPICAL INSTALLATION
WRAPPED PIPE JOINT
(SEALED JOINT NOT REQUIRED)

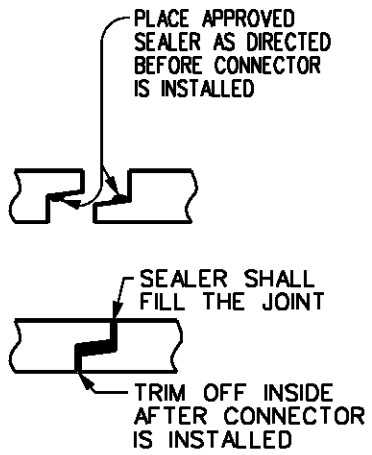



TYPICAL INSTALLATION
NEW CONSTRUCTION

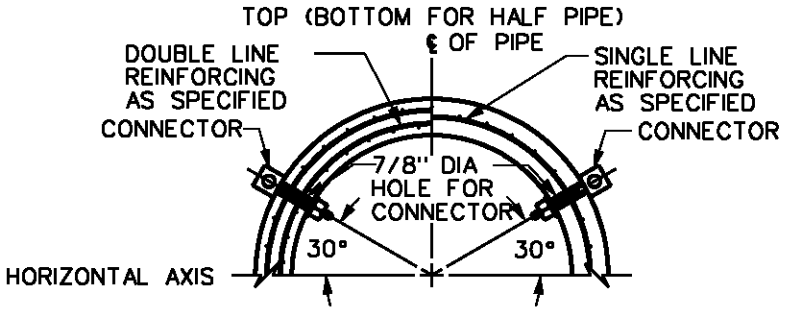



SECTION OF TYPICAL PIPE CONNECTOR





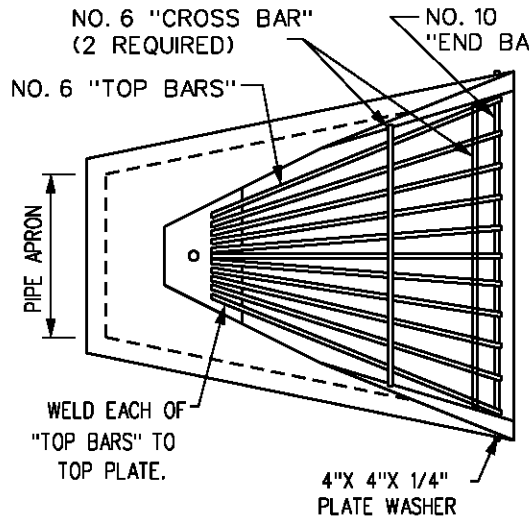

DETAILS OF SEALED JOINT
(TYPE 2 CONNECTION ONLY)




TYPICAL SECTION
PIPE CONNECTION

THE PIPE CONNECTION SHALL BE INSTALLED AS SHOWN WITH TWO (2) CONNECTORS NEAR THE TOP OF THE PIPE SECTION. ALL JOINTS SHALL BE SEALED UNLESS A WRAPPED PIPE JOINT IS SPECIFIED. THE SEAL SHALL BE OF A TYPE THAT MEETS THE REQUIREMENTS OF SECTION 4020, 3.04

① 1-3/4" DIAMETER X 9/64" THICK WASHER OR 3" X 3" X 1/4" SQUARE PLATE (SHAPED TO PIPE RADIUS).




TYPICAL PLAN

## GENERAL NOTES

IT IS INTENDED THAT THE DESIGN FOR THE PIPE APRON GUARD DETAILED HEREON PROVIDE A TREATMENT FOR THE EXPOSED END OF A PIPE CULVERT, SUCH THAT AN OUT-OF-CONTROL VEHICLE COULD PASS OVER THE END OF THE CULVERT WITHOUT UNDUE LOSS OF CONTROL OR DAMAGE TO THE VEHICLE.

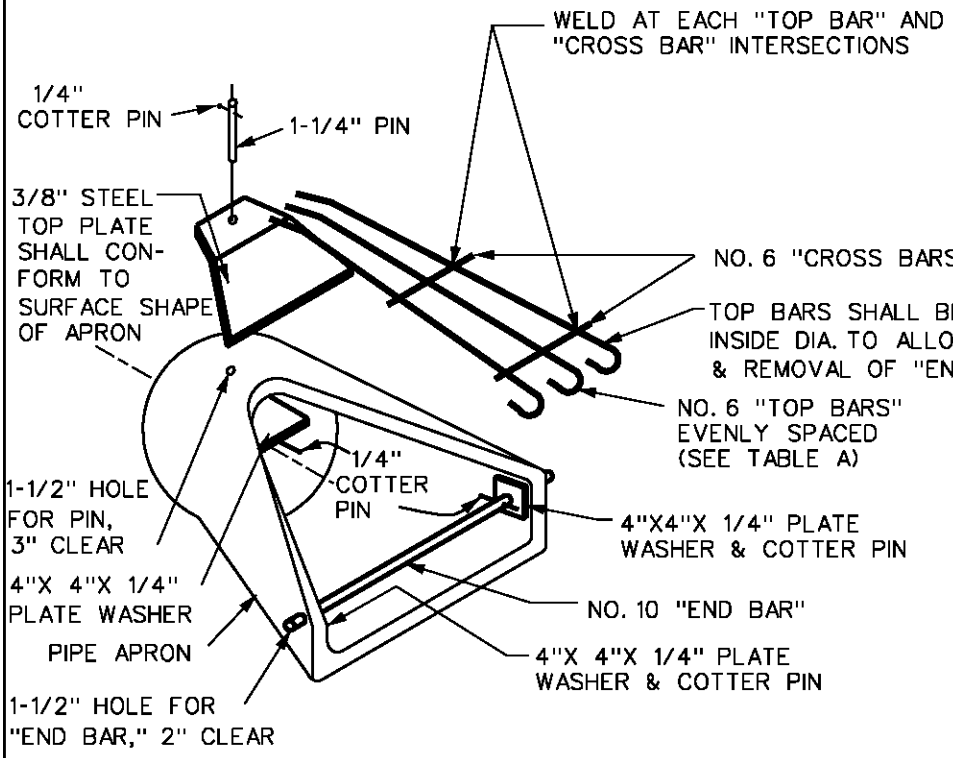
STEEL BARS USED IN CONSTRUCTION OF THE GUARD SHALL BE SMOOTH OR DEFORMED STEEL, ASTM A615, GRADE 40 OR MERCHANT QUALITY.

WELDING OF STEEL PARTS SHALL BE AS SHOWN AND SUBJECT TO THE APPROVAL OF THE ENGINEER. THE GUARD SHALL BE GIVEN TWO COATS OF PAINT, THE FIRST COAT BEING AN APPROVED PRIMER AND THE SECOND FOLIAGE GREEN. IN LIEU OF PAINTING AS SPECIFIED, THE COMPLETED APRON GUARD SHALL BE HOT-DIPPED GALVANIZED IN ACCORDANCE WITH ASTM A123.

ALTERNATE DETAILS FOR DESIGN OF APRON GUARD MAY BE SUBMITTED TO THE JURISDICTIONAL ENGINEER FOR APPROVAL.

## SPECIAL NOTE

WHEN DETAIL PROJECT PLANS REQUIRE PIPE APRON GUARDS OF SIZES OTHER THAN THOSE SHOWN HEREON, THE DESIGN FOR SUCH APRON GUARDS SHALL BE SIMILAR TO THOSE INDICATED, CONFORMING TO MINIMUM BAR SPACING AND GENERAL REQUIREMENTS SHOWN.

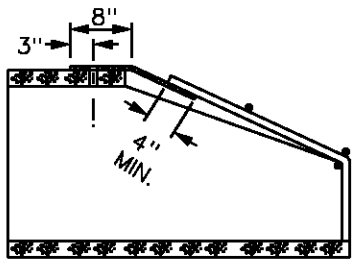



### TABLE A

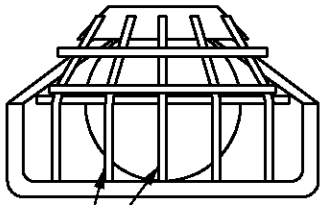
NO. 6 TOP BARS

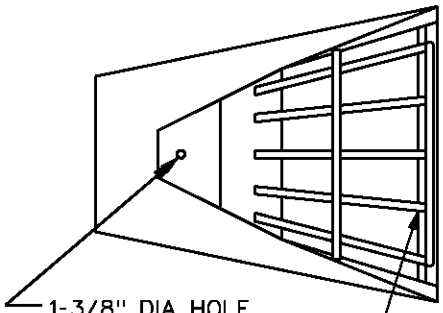
| | |
|---|---|
| 15" PIPE APRON | 6 EA. |
| 18" PIPE APRON | 7 EA. |
| 24" PIPE APRON | 8 EA. |
| 30" PIPE APRON | 10 EA. |
| 36" PIPE APRON | 12 EA. |

INSTALLATION VIEW




SECTION




PLAN



| REV. | DATE | BY |
|---|---|---|
| 1 | 10/19/04 | |

DATE: 01-01-98

FLARED END SECTION APRON GUARD

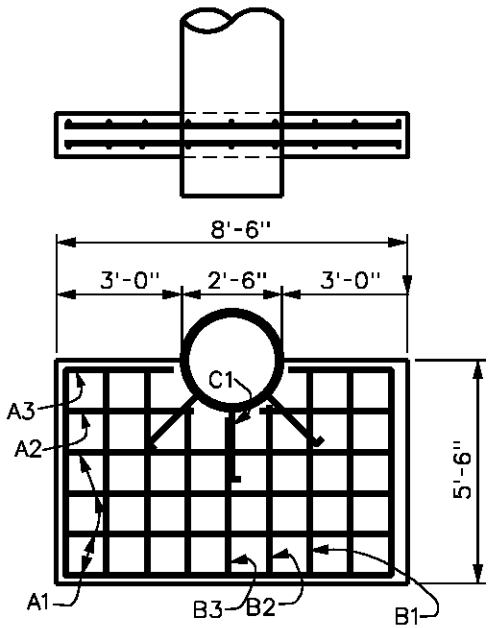
FIGURE: 4020.3

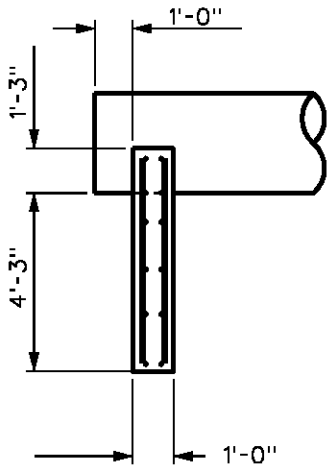
SHEET 1 OF 1

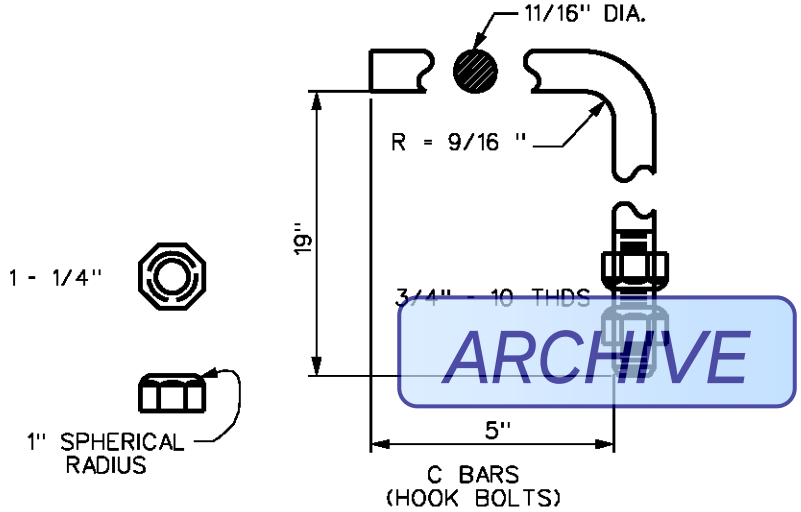
| REV. | DATE | BY |
|---|---|---|
| 1 | 01/25/99 | |

DATE: 01-01-98

# CURTAIN WALL DETAILS FOR 30" DIAMETER CULVERT






| REINFORCING STEEL | | |
|---|---|---|
| LOCATION | BAR | LENGTH |
| HORIZ. BF & FF | 4A1 | 8'-0" |
| HORIZ. BF & FF | 4A2 | 3'-0" |
| HORIZ. BF & FF | 4A3 | 2'-6" |
| VERT. BF & FF | 4B1 | 5'-0" |
| VERT. BF & FF | 4B2 | 4'-0" |
| VERT. BF & FF | 4B3 | 3'-6" |

NOTE:

STEEL SPACING AT 1'0" CENTERS.

HOOK BOLTS AND NUTS SHALL BE GALVANIZED.

CLEAR DISTANCE FROM FACE OF CONCRETE TO NEAR STEEL SHALL BE 3".

FIGURE: 4020.4A

SHEET 1 OF 1

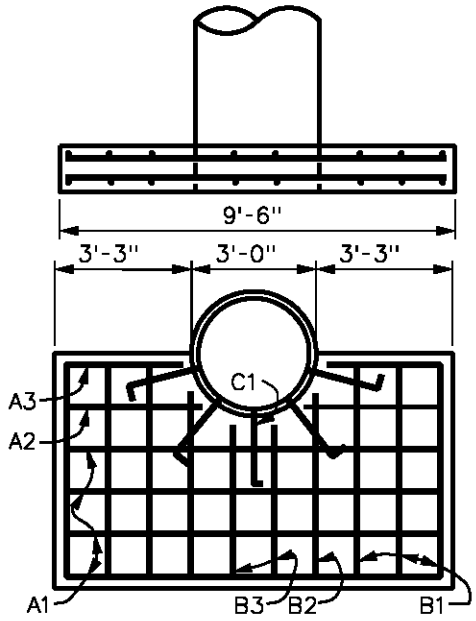
| REV. | DATE | BY |
|---|---|---|
| 1 | 01/25/99 | |

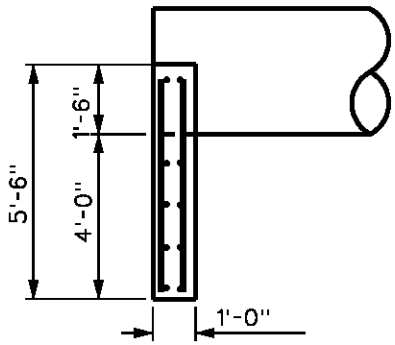
DATE: 01-01-98

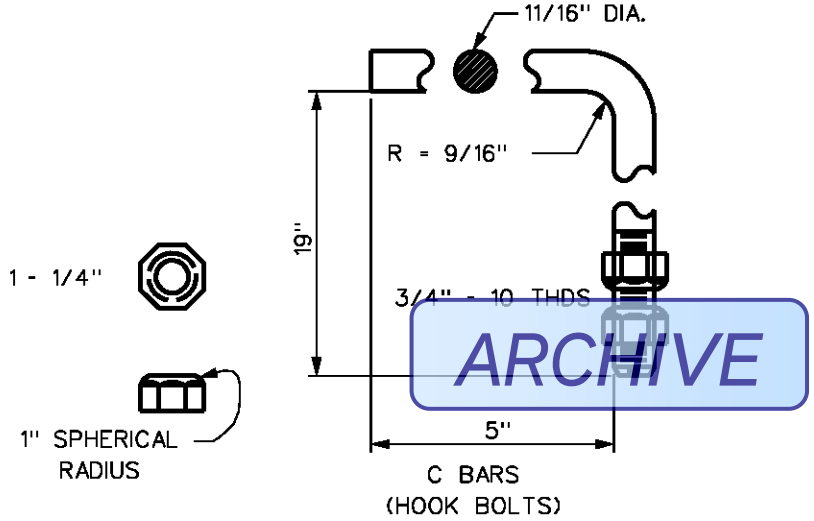
# CURTAIN WALL DETAILS FOR 36" CULVERT

FIGURE: 4020.4B

SHEET 1 OF 1



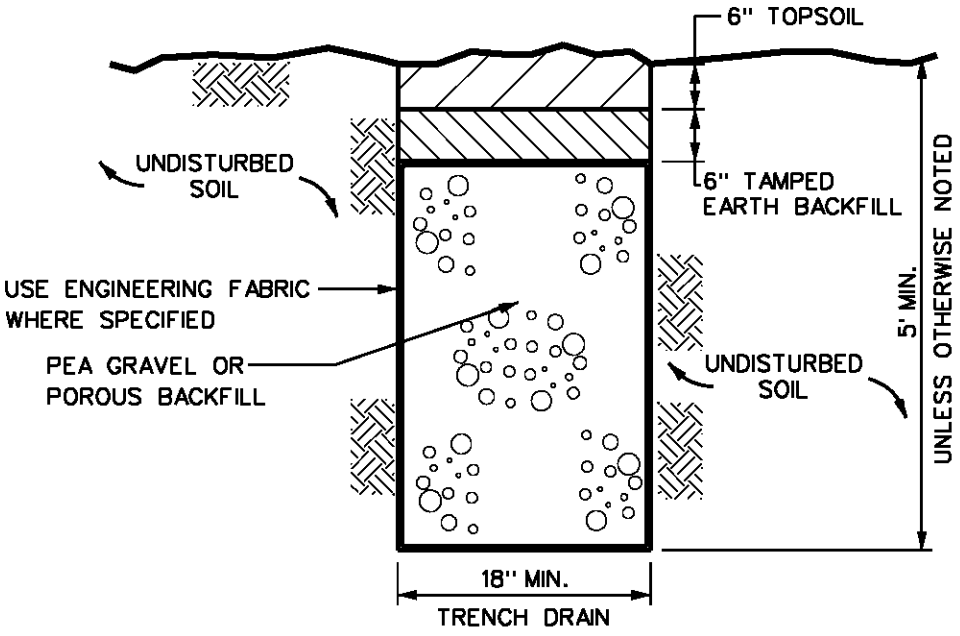






| REINFORCING STEEL | | |
|---|---|---|
| LOCATION | BAR | LENGTH |
| HORIZ. BF & FF | 4A1 | 9'-0" |
| HORIZ. BF & FF | 4A2 | 3'-3" |
| HORIZ. BF & FF | 4A3 | 2'-9" |
| VERT. BF & FF | 4B1 | 5'-0" |
| VERT. BF & FF | 4B2 | 4'-3" |
| VERT. BF & FF | 4B3 | 3'-6" |

NOTE:

STEEL SPACING AT 1'0" CENTERS.
HOOK BOLTS AND NUTS SHALL BE GALVANIZED.
CLEAR DISTANCE FROM FACE OF CONCRETE TO NEAR STEEL SHALL BE 3".



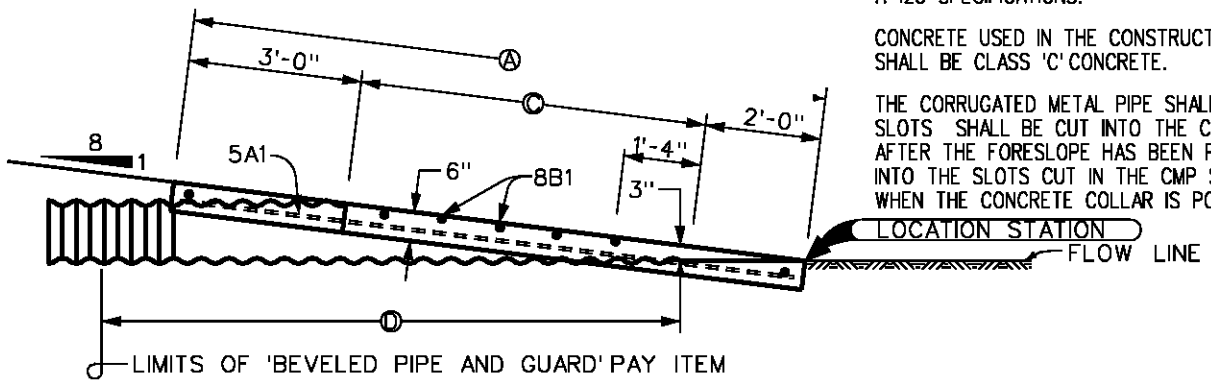



| REV. | DATE | BY | TRENCH DRAIN | FIGURE: 4020.7 |
|---|---|---|---|---|
| 1 | 01/25/01 | | | |
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |

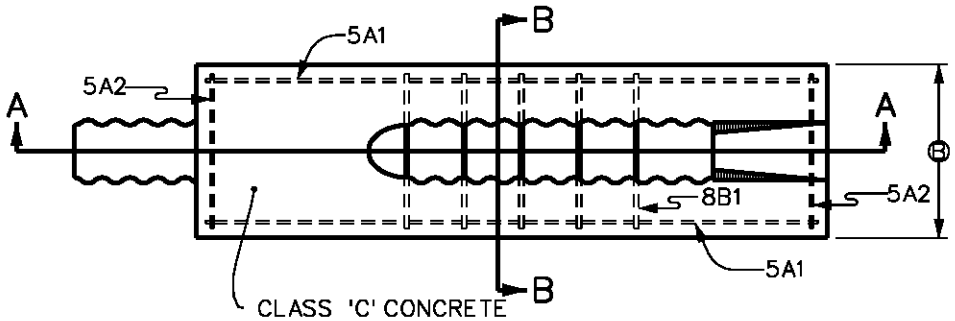
REINFORCING STEEL USED IN CONSTRUCTION OF "BEVELED PIPE AND GUARD" SHALL BE DEFORMED BARS MEETING THE REQUIREMENTS OF ARTICLE 4151.03. ALL STEEL BARS SHALL BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A 123 SPECIFICATIONS.

CONCRETE USED IN THE CONSTRUCTION OF BEVELED PIPE AND GUARD SHALL BE CLASS 'C' CONCRETE.

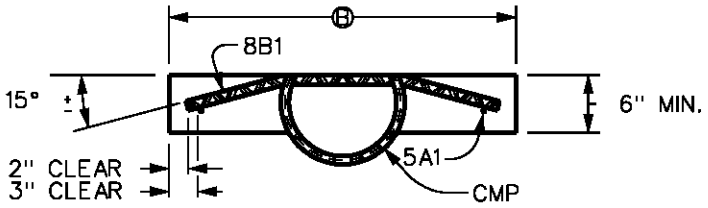
THE CORRUGATED METAL PIPE SHALL BE CUT TO FIT THE 8:1 FORESLOPE. SLOTS SHALL BE CUT INTO THE CMP FOR PLACEMENT OF THE NO. 8 BARS. AFTER THE FORESLOPE HAS BEEN PLACED, THE NO. 8 BARS SHALL BE FITTED INTO THE SLOTS CUT IN THE CMP SO THEY WILL BE IN PROPER POSITION WHEN THE CONCRETE COLLAR IS POURED.




SECTION A-A




PLAN VIEW




SECTION B-B

| TABLE OF DIMENSIONS | | | | |
|---|---|---|---|---|
| PIPE SIZE | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 12" | 11'-0" | 3'-0" | 6'-0" | 10'-0" |
| 15" | 13'-2" | 3'-3" | 8'-2" | 12'-0" |
| 18" | 15'-4" | 3'-6" | 10'-4" | 14'-10" |



| REINFORCING BAR LIST | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PIPE SIZE | BAR | LOCATION | SHAPE | NO. | LENGTH | LIN. FT. | WEIGHT | TOTAL WEIGHT | SPACING |
| 12" | 5A1 | BASE | | 2 | 10'-8" | 21.4 | 14.3 | 55.8 | SEE DETAIL |
| | 5A2 | BASE | | 2 | 2'-8" | 5.4 | 3.6 | | SEE DETAIL |
| | 8B1 | BASE | | 5 | 2'-10" | 14.2 | 37.9 | | 12" |
| 15" | 5A1 | BASE | | 2 | 12'-10" | 25.7 | 17.2 | 78.8 | SEE DETAIL |
| | 5A2 | BASE | | 2 | 2'-11" | 5.9 | 3.9 | | SEE DETAIL |
| | 8B1 | BASE | | 7 | 3'-1" | 21.6 | 57.7 | | 12" |
| 18" | 5A1 | BASE | | 2 | 15'-0" | 30.0 | 20.0 | 104.4 | SEE DETAIL |
| | 5A2 | BASE | | 2 | 3'-2" | 6.4 | 4.3 | | SEE DETAIL |
| | 8B1 | BASE | | 9 | 3'-4" | 30.0 | 80.1 | | 12" |

REV. | DATE | BY

DATE: 01-01-98

DETAILS OF BEVELED PIPE AND GUARD

SHEET 1 OF 1

FIGURE: 4020.8

URBAN STANDARD SPECIFICATIONS for PUBLIC IMPROVEMENT MANUAL

URBAN STANDARD SPECIFICATIONS for PUBLIC IMPROVEMENT MANUAL

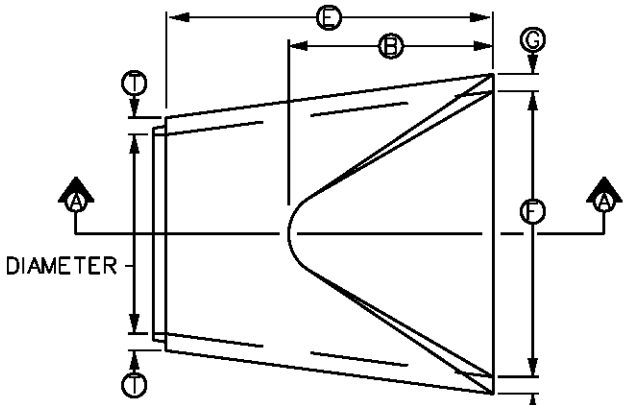
REV. | DATE | BY

DATE: 01/25/01

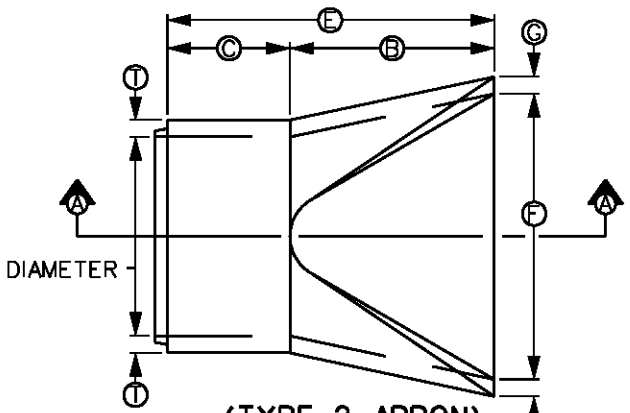
# CONCRETE PIPE APRON

FIGURE: 4020.9

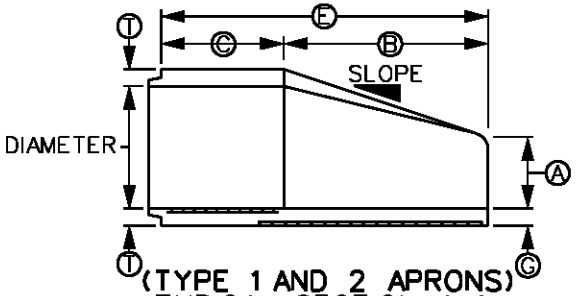
SHEET 1 OF 2



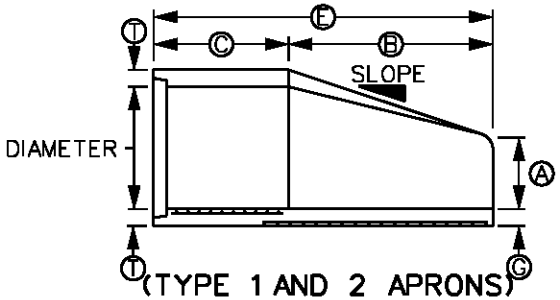

(TYPE 1 APRON)
TYPICAL PLAN VIEW



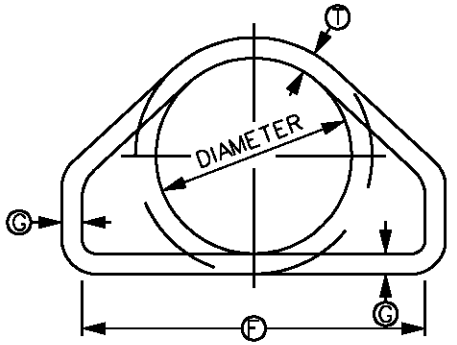

(TYPE 2 APRON)
TYPICAL PLAN VIEW




(TYPE 1 AND 2 APRONS)
TYPICAL SECTION A-A
TONGUE END DETAIL ①




(TYPE 1 AND 2 APRONS)
TYPICAL SECTION A-A
GROOVE END DETAIL ①




(TYPE 1 AND TYPE 2 APRONS)
TYPICAL END VIEW

TABLE OF TYPE 1 APRON DIMENSIONS

| DIAM. | SLOPE | A | B | MINIMUM C | MINIMUM E | F | G | T |
|---|---|---|---|---|---|---|---|---|
| 12" | 2.4:1 | 4" | 2'-0" | 4'-7/8" | 6'-7/8" | 2'-0" | 2" | 2" |
| 15" | 2.4:1 | 6" | 2'-3" | 3'-10" | 6'-1" | 2'-6" | 2 1/4" | 2 1/4" |
| 18" | 2.3:1 | 9" | 2'-3" | 3'-10" | 6'-1" | 3'-0" | 2 1/2" | 2 1/2" |
| 24" | 2.5:1 | 9 1/2" | 3'-7 1/2" | 2'-6" | 6'-1 1/2" | 4'-0" | 3" | 3" |
| 30" | 2.5:1 | 12" | 4'-6" | 1'-7 3/4" | 6'-1 3/4" | 5'-0" | 3 1/2" | 3 1/2" |
| 36" | 2.5:1 | 15" | 5'-3" | 2'-9" | 8'-0" | 6'-0" | 4" | 4" |
| 42" | 2.5:1 | 21" | 5'-3" | 2'-9" | 8'-0" | 6'-6" | 4 1/2" | 4 1/2" |
| 48" | 2.5:1 | 24" | 6'-0" | 2'-0" | 8'-0" | 7'-0" | 5" | 5" |
| 54" | 1.8:1 | 27" | 5'-0" | 3'-0" | 8'-0" | 7'-6" | 5 1/2" | 5 1/2" |
| 60" | 1.6:1 | 29 1/2" | 5'-0" | 3'-0" | 8'-0" | 8'-0" | 5 1/2" | 6" |
| 66" | 1.7:1 | 30" | 6'-0" | 2'-3" | 8'-3" | 8'-0" | 5 1/2" | 6" |
| 72" | 1.6:1 | 30" | 6'-6" | 1'-9" | 8'-3" | 9'-0" | 6" | 7" |
| 78" | 1.8:1 | 36" | 7'-6" | 1'-9" | 9'-3" | 9'-6" | 6 1/2" | 7 1/2" |
| 84" | 1.3:1 | 29 1/2" | 6'-9" | 2'-6 1/2" | 9'-3 1/2" | 10'-0" | 6 1/2" | 8" |

TABLE OF TYPE 2 APRON DIMENSIONS

| DIAM. | SLOPE | A | B | MINIMUM C | MINIMUM E | F | G | T |
|---|---|---|---|---|---|---|---|---|
| 12" | 2.4:1 | 4" | 2'-0" | 4'-7/8" | 6'-7/8" | 2'-0" | 2" | 2" |
| 15" | 2.4:1 | 6" | 2'-3" | 3'-10" | 6'-1" | 2'-6" | 2 1/4" | 2 1/4" |
| 18" | 2.3:1 | 9" | 2'-3" | 3'-10" | 6'-1" | 3'-0" | 2 1/2" | 2 1/2" |
| 24" | 2.5:1 | 9 1/2" | 3'-7 1/2" | 2'-6" | 6'-1 1/2" | 4'-0" | 3" | 3" |
| 30" | 2.5:1 | 12" | 4'-6" | 1'-7 3/4" | 6'-1 3/4" | 5'-0" | 3 1/2" | 3 1/2" |
| 36" | 2.5:1 | 15" | 5'-3" | 2'-9" | 8'-0" | 6'-0" | 4" | 4" |
| 42" | 2.5:1 | 21" | 5'-3" | 2'-9" | 8'-0" | 6'-6" | 4 1/2" | 4 1/2" |
| 48" | 2.5:1 | 24" | 6'-0" | 2'-0" | 8'-0" | 7'-0" | 5" | 5" |
| 54" | 1.9:1 | 24 1/2" | 5'-5" | 2'-7" | 8'-0" | 7'-6" | 5 1/2" | 5 1/2" |
| 60" | 1.4:1 | 24 1/2" | 5'-0" | 3'-0" | 8'-0" | 8'-0" | 5 1/2" | 6" |
| 66" | 1.7:1 | 30" | 6'-0" | 2'-3" | 8'-3" | 8'-0" | 5 1/2" | 6" |
| 72" | 1.4:1 | 24" | 6'-6" | 1'-9" | 8'-3" | 9'-0" | 6" | 7" |
| 78" | 1.8:1 | 36" | 7'-6" | 1'-9" | 9'-3" | 9'-6" | 6 1/2" | 7 1/2" |
| 84" | 1.5:1 | 23 1/2" | 7'-6 1/2" | 1'-9" | 9'-3 1/2" | 10'-0" | 6 1/2" | 8" |



① TONGUE END USED ON INLET END SECTION. GROOVE END USED ON OUTLET END SECTION. DIMENSIONS FOR TONGUE AND GROOVE CONNECTIONS SHALL BE SAME AS FOR REINFORCED CONCRETE PIPE, SECTION 4020, 2.01A.

SEE GENERAL NOTES ON SHEET 2.

## GENERAL NOTES:

DETAILS ON THIS SHEET INDICATE TYPICAL REQUIREMENTS AND GENERAL INSTALLATION REQUIREMENTS OF CONCRETE APRONS. DESIGN OF THE BARREL PORTION OF APRONS SHALL CONFORM TO, OR EXCEED, THE REQUIREMENTS OF SECTION 4020, 2.01A. REINFORCEMENT OF THE FLARED PORTION OF APRON SHALL BE AS INDICATED OR AS OTHERWISE APPROVED BY THE JURISDICTIONAL ENGINEER.

DIMENSION 'E' SHOWN IS MINIMUM AND SHALL BE CONSIDERED THE DESIGN LENGTH. ANY DIFFERENCE BETWEEN THE ACTUAL LENGTH OF CONCRETE APRON INSTALLED AND THE LENGTH INDICATED HERON SHALL BE APPROPRIATELY ADJUSTED FOR IN THE LENGTH OF CONCRETE PIPE CULVERT FURNISHED.

TIE BOLTS AND BOLT HOLES ARE NECESSARY ONLY WHEN SPECIFICALLY REQUIRED IN DETAIL PROJECT PLANS.

MANUFACTURE IN ACCORDANCE WITH APPLICABLE SECTIONS OF ASTM C76.

ALTERNATE DESIGNS FOR CONCRETE PIPE APRONS MAY BE SUBMITTED FOR APPROVAL. WELDED WIRE FABRIC SHALL MEET THE REQUIREMENTS OF A.S.T.M. A-185.

REFER TO PROJECT PLANS FOR ADDITIONAL DETAILS OF INDIVIDUAL CULVERT INSTALLATIONS.

PRICE BID FOR "CONCRETE PIPE APRONS', OF THE SIZE SPECIFIED SHALL BE CONSIDERED FULL COMPENSATION FOR FABRICATION AND INSTALLATION OF CONCRETE APRONS AS DETAILED HEREON.



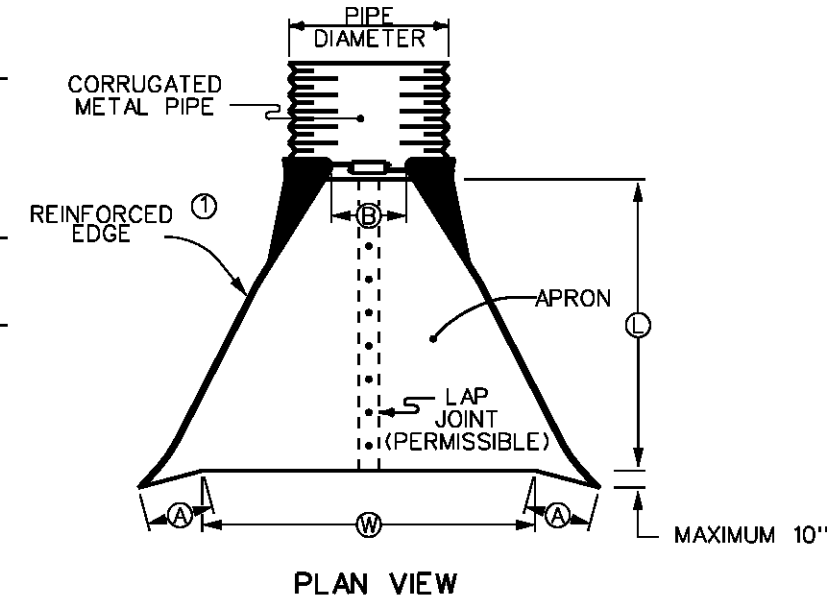
| REV. | DATE | BY | CONCRETE PIPE APRON | FIGURE: 4020.9 |
|---|---|---|---|---|
| DATE: 01/25/01 | | | | SHEET 2 OF 2 |

URBAN STANDARD SPECIFICATIONS for PUBLIC IMPROVEMENT MANUAL

| REV. | DATE | BY |
|---|---|---|
| 1 | 01/25/01 | |

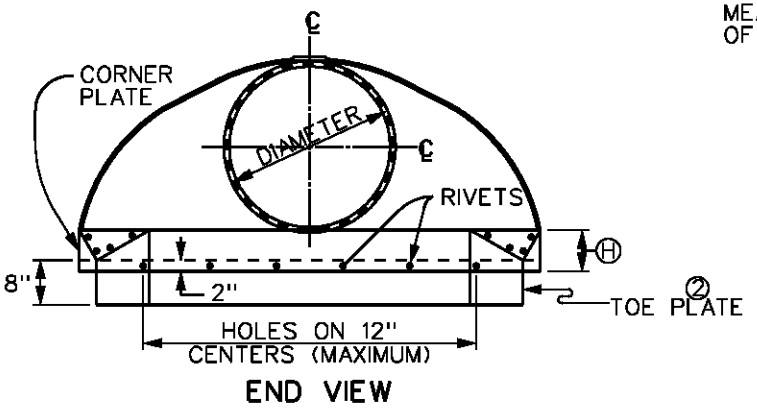
DATE: 01-01-98

# METAL PIPE APRONS AND BEVELED ENDS



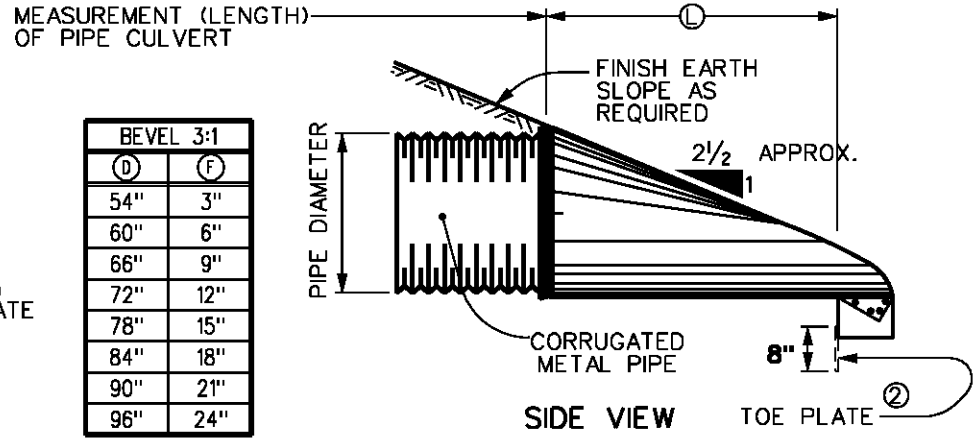

PLAN VIEW

| DIMENSIONS | | | | | |
|---|---|---|---|---|---|
| PIPE DIAM. | A (±1") | B MAX. | H (±1") | L (± 1½") | W (±2") |
| 15" | 6" | 8" | 6" | 26" | 30" |
| 18" | 7" | 9" | 6" | 31" | 36" |
| 21" | 8¼" | 11" | 6" | 36" | 42" |
| 24" | 9½" | 12" | 6" | 42" | 48" |
| 30" | 12" | 15" | 7½" | 52½" | 60" |
| 36" | 14" | 18" | 9" | 63" | 72" |
| 42" | 16" | 21" | 10½" | 73½" | 84" |
| 48" | 18" | 27" | 12" | 84" | 90" |
| 54" | 18" | 30" | 12" | 84" | 102" |
| 60" | 18" | 33" | 12" | 87" | 114" |
| 66" | 18" | 36" | 12" | 87" | 120" |
| 72" | 18" | 39" | 12" | 87" | 126" |
| 78" | 18" | 42" | 12" | 87" | 132" |
| 84" | 18" | 45" | 12" | 87" | 138" |
| 90" | 24" | 37" | 11" | 87" | 144" |
| 96" | 25" | 35" | 12" | 87" | 150" |

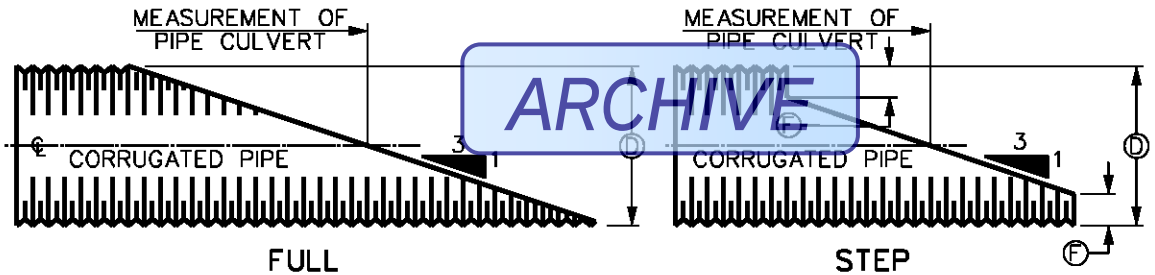



END VIEW

| BEVEL 3:1 | |
|---|---|
| D | F |
| 54" | 3" |
| 60" | 6" |
| 66" | 9" |
| 72" | 12" |
| 78" | 15" |
| 84" | 18" |
| 90" | 21" |
| 96" | 24" |




SIDE VIEW




FULL STEP

BEVELED ENDS FOR CORRUGATED METAL PIPE

NOTE:
WHEN SPECIFICALLY REQUIRED AS PART OF DETAIL PROJECT PLANS, ENDS OF PIPE CULVERT MAY BE PROVIDED WITH BEVELED ENDS AS SHOWN. EITHER FULL BEVEL OR STEP BEVEL MAY BE USED UNLESS ONE TYPE IS SPECIFIED. UNLESS SPECIFIED OTHERWISE, THE SLOPE OF THE BEVEL SHALL BE 3:1.

BEVELED ENDS WILL NOT BE PAID FOR SEPERATELY BUT, WHEN REQUIRED, SHALL BE CONSIDERED INCIDENTAL TO THE PRICE BID OF THE CULVERT.



SEE GENERAL NOTES ON SHEET 2.



FIGURE: 4020.10

GENERAL NOTES:

METAL PIPE APRONS AND HARDWARE SHALL BE CONSTRUCTED OF GALVANIZED STEEL IN CONFORMANCE WITH SECTION 4020, 2.02. AND AS INDICATED HEREON. REFER TO PROJECT PLANS FOR ADDITIONAL DETAILS OF INDIVIDUAL CULVERT INSTALLATIONS. ALTERNATE DESIGN DETAILS MAY BE SUBMITTED TO THE JURISDICTIONAL ENGINEER FOR APPROVAL.

APRONS MAY BE ATTACHED TO CULVERT PIPE AS FOLLOWS:

A. IF NORMAL CULVERT IS OF CIRCUMFERENTIAL CORRUGATION TYPE, USE AN APPROVED BOLT OR CLAMP TO FASTEN APRON DIRECTLY TO CULVERT.

B. IF NORMAL CULVERT IS OF HELICAL CORRUGATION TYPE:

   1. USE AN APPROVED SIZING RING SECURELY FASTENED TO THE INSIDE DIAMETER OF APRON TO CONNECT TO THE CULVERT PIPE USING SPECIAL DIMPLE BAND CONNECTOR.

   2. DIMPLE BANDS ARE NOT ALLOWED WHEN A POSITIVE JOINT IS SPECIFIED.

ANY DAMAGE TO SPELTER COAT RESULTING FROM INSTALLATION OF CULVERT SHALL BE REPAIRED AS DIRECTED BY THE ENGINEER'

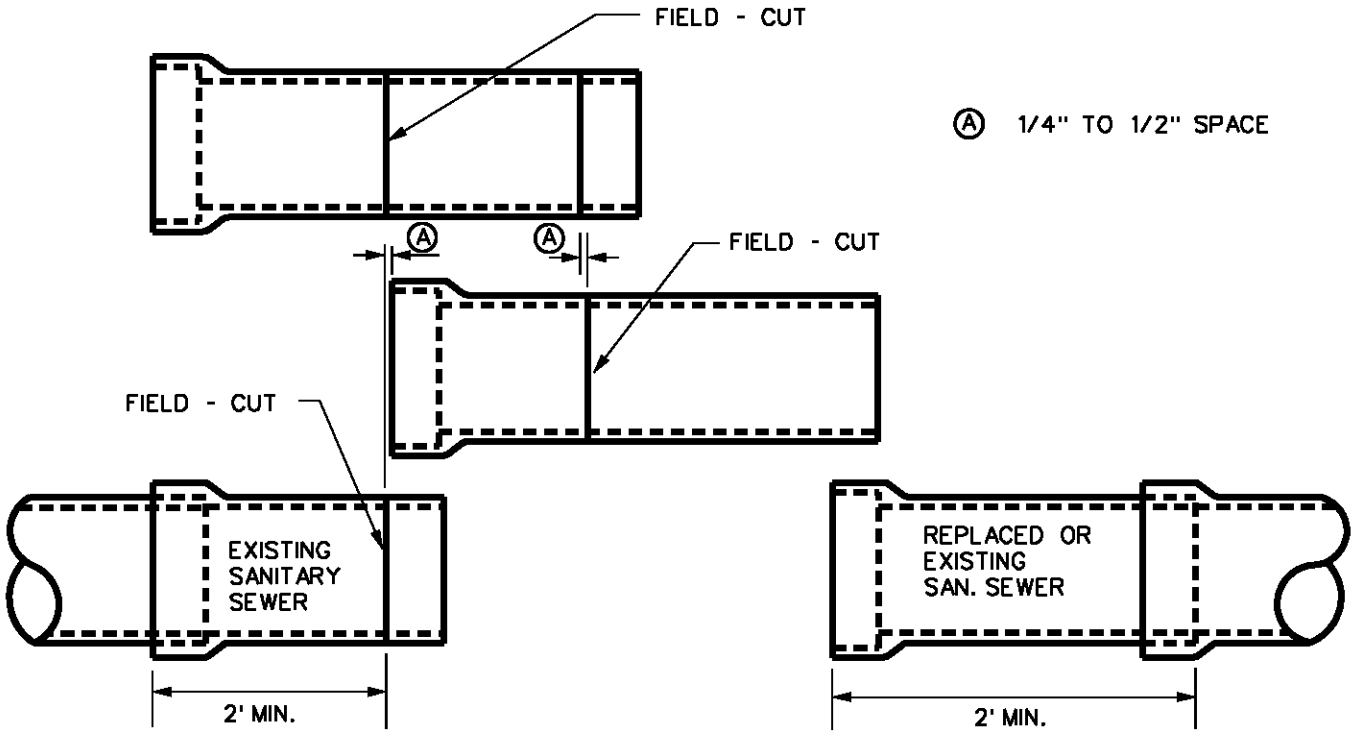
PRICE BID FOR "METAL PIPE APRONS" SHALL BE CONSIDERED FULL COMPENSATION FOR FABRICATION AND INSTALLATION OF THE METAL APRON AS DETAILED HEREON.

① ON SIZES 60" AND LARGER, THE REINFORCED EDGE SHOULD BE SUPPLEMENTED WITH A GALVANIZED STIFFENER ANGLE ATTACHED WITH BOLTS.

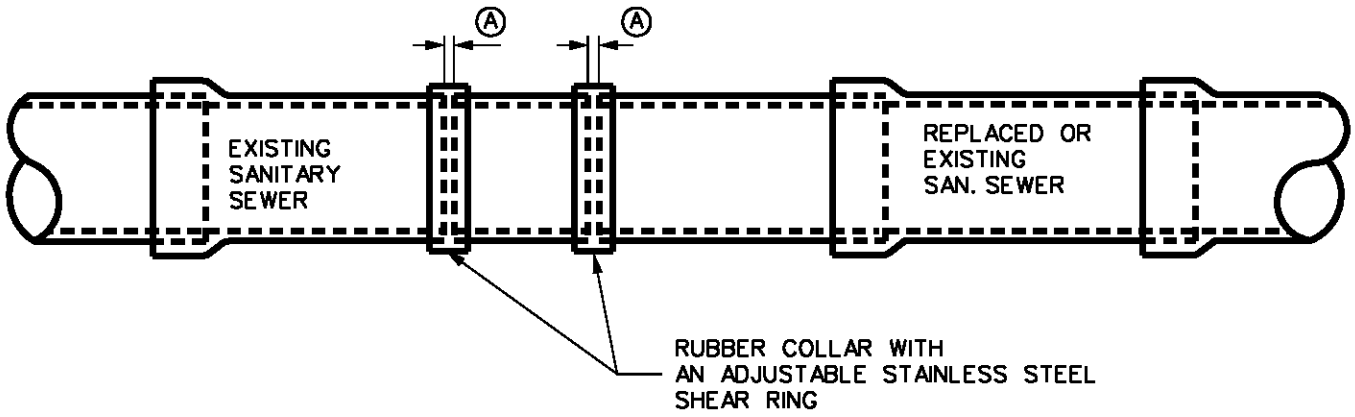
② GALVANIZED TOE PLATE ( SAME GAGE METAL AS APRON ) SHALL BE INSTALLED ON ALL APRONS 24" DIAMETER AND LARGER.



| REV. | DATE | BY | METAL PIPE APRONS AND BEVELED ENDS | FIGURE: 4020.10 |
|---|---|---|---|---|
| 1 | 01/25/01 | | | |
| DATE: 01-01-98 | | | | SHEET 2 OF 2 |




PIPE CUTTING DETAIL



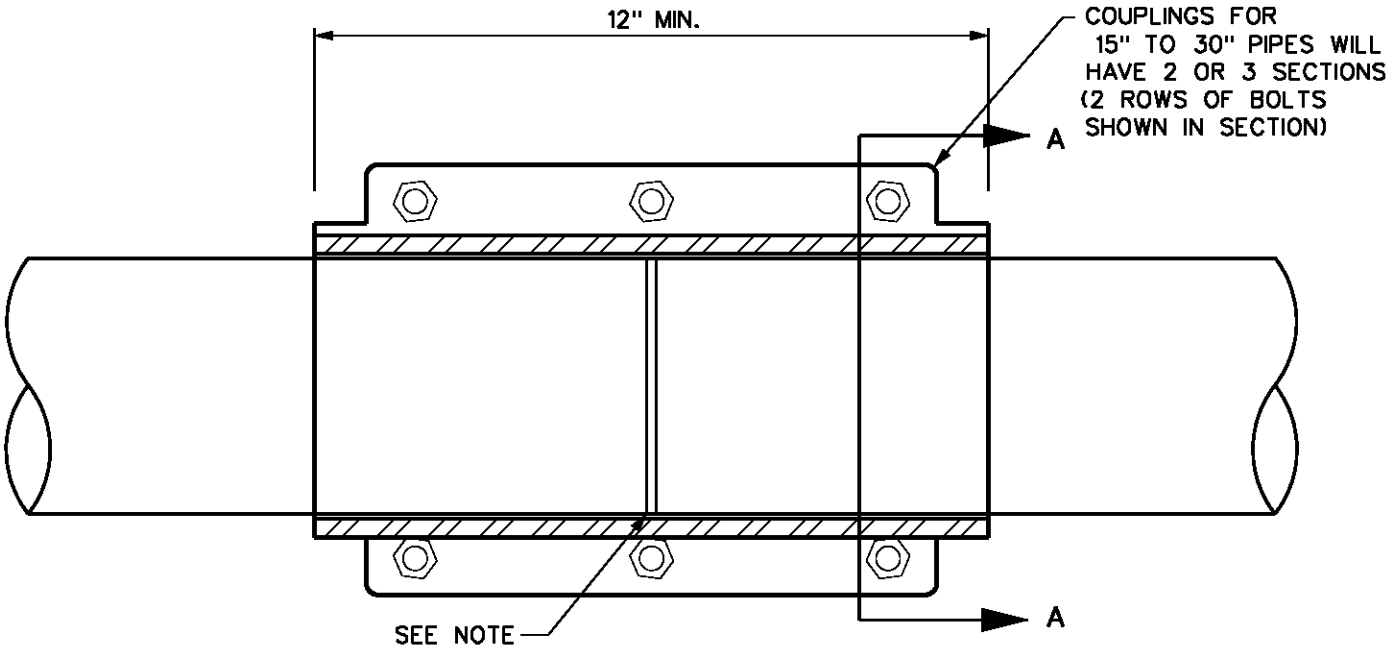

SEWER ASSEMBLY DETAIL

NOTE:

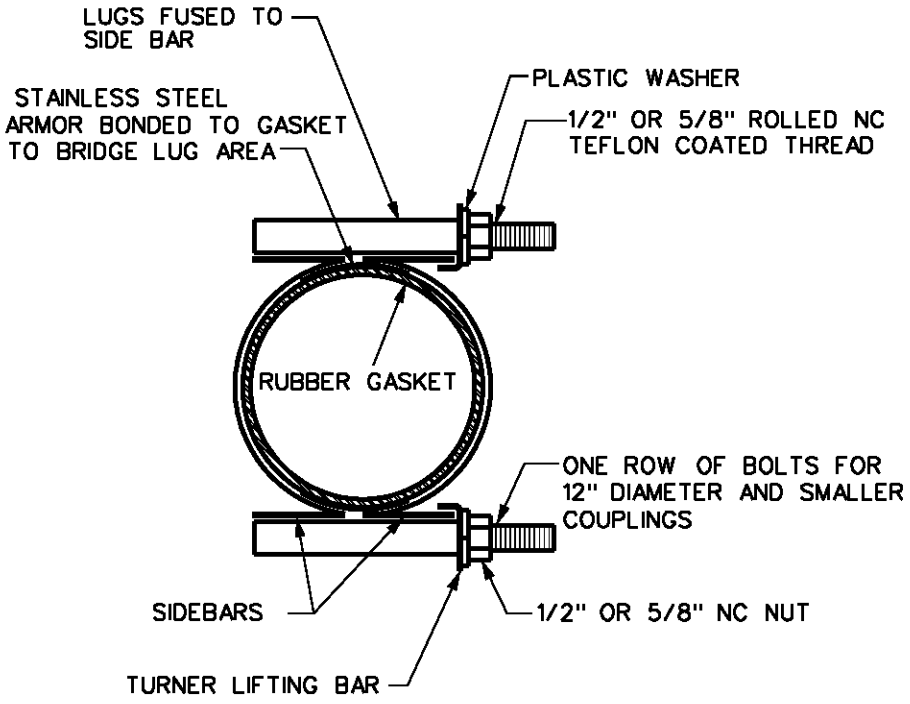
1. ALL PIPE SURFACES ON WHICH REPAIR COUPLINGS ARE TO BE INSTALLED SHALL BE CLEAN.
2. AFTER COMPLETING ASSEMBLY OF THE REPAIR COUPLINGS, ALL VOIDS UNDER THE EXPOSED SEWER LINE SHALL BE COMPLETELY FILLED WITH CONTROLLED DENSITY FILL.
3. MATERIALS FOR REPLACEMENT PIPE: SEE SPECIFICATIONS.



| REV. | DATE | BY | REPLACING SECTIONS OF EXISTING VCP SANITARY SEWER | FIGURE: 4030.1 |
|---|---|---|---|---|
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |




CUTAWAY




SECTION A-A

NOTE: PIPE ENDS SHALL BE SAWED STRAIGHT AND PERPENDICULAR TO THE PIPE CENTERLINE. PIPES TO BE JOINED SHALL BE BUTTED END TO END WITH A GAP NO GREATER THAN 1" BETWEEN ENDS PRIOR TO PLACEMENT OF THE COUPLING . THE JURISDICTIONAL ENGINEER SHALL INSPECT AND ACCEPT THE BUTTED PIPE JOINT PRIOR TO PLACEMENT OF THE COUPLING. THE COUPLING SHALL BE A MANUFACTURED COUPLING. FOR MAIN LINE, THE COUPLING SHALL BE FURNISHED WITH SHEAR BANDS OR CONCRETE COLLAR.

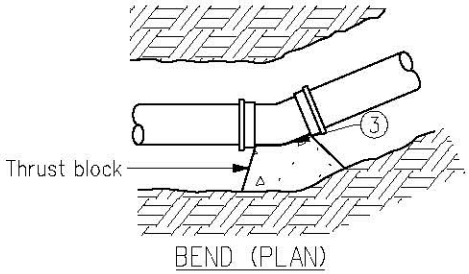


| REV. | DATE | BY | COUPLINGS FOR REPLACING SECTIONS OF SANITARY SEWER | FIGURE: 4030.2 |
|---|---|---|---|---|
| 1 | 01/29/03 | | | |
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |

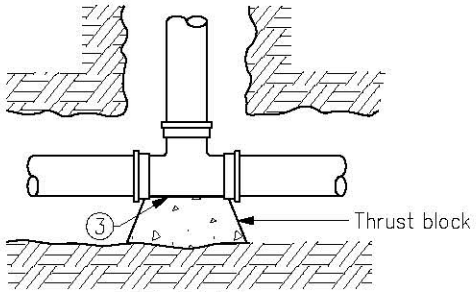
# Division 5 Figures
## Water Mains and Appurtenances

## Division 5 - Water Main and Appurtenances

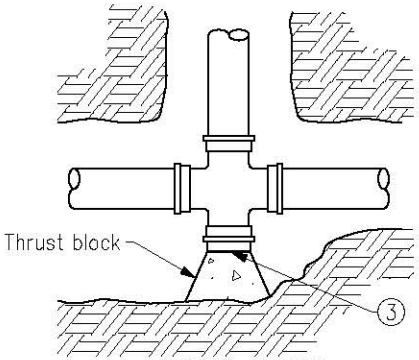
| Current # | Current SUDAS Name | Proposed SUDAS # | Proposed Iowa DOT # | Proposed Name |
|---|---|---|---|---|
| 5010.1A | P.C. Concrete Thrust Block (Detail A) | 5010.101 | WM-101 | PCC Thrust Blocks |
| 5010.1B | P.C. Concrete Thrust Block (Detail B) | | | |
| 5010.1C | P.C. Concrete Thrust Block (Detail C) | | | |
| 5010.1D | P.C. Concrete Thrust Block (Detail D) | | | |
| 5010.4 | Polyethylene Wrap | 5010.102 | WM-102 | Polyethylene Wrap |
| 5010.5 | Tracer Wire Detail | 5010.103 | WM-103 | Tracer Wire Detail |
| 5010.8 | Minimum Clearance Between Water Service and Structure | 5010.104 | WM-104 | Minimum Clearance Between Water Service and Structure |
| 5020.1 | Fire Hydrant Detail | 5020.201 | WM-201 | Fire Hydrant Assembly |
| 5020.2 | Permanent Flushing Device (Blowoff) | 5020.202 | WM-202 | Flushing Device (Blowoff) |
| 5010.2 | 1" Service Pipe Installation | Archive | None | |
| 5010.3 | 1-1/2" or 2" Service Pipe Installation | Archive | None | |
| 5010.6 | Stop Box Relocation | Archive | None | |
| 5010.7 | Lower Water Service | Archive | None | |
| 5010.9 | Relocate Water Service in Conflict with New Sewer | Archive | None | |
| 5010.10 | Meter Pit | Archive | None | |
| 5020.3 | Temporary Flushing Device (Blowoff) | Archive | None | |
| | | | | |



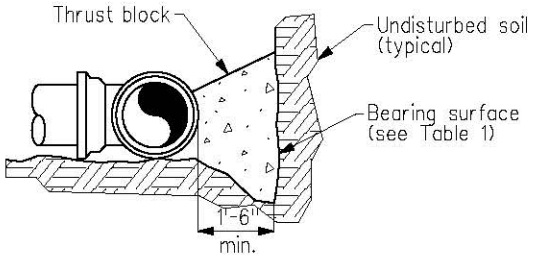

BEND (PLAN)



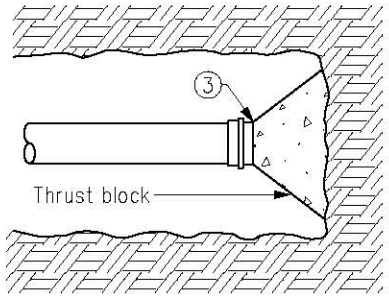

TEE (PLAN)



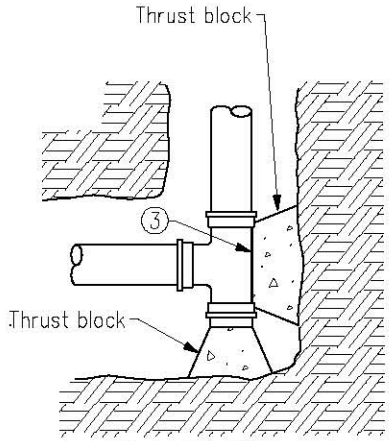

CROSS (PLAN)



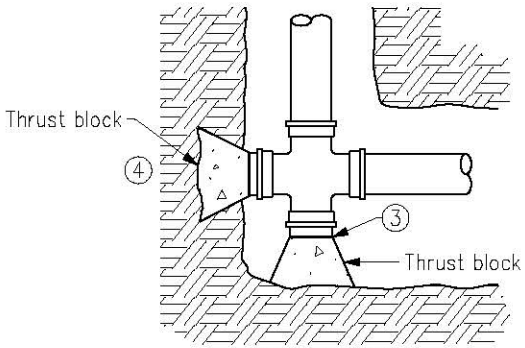

ELEVATION




DEAD END (PLAN)




TEE (PLAN)




CROSS (PLAN)

GENERAL NOTES:

Use alternate thrust block at dead ends only when permitted by the Engineer, or when specified in the contract documents.

1. Extend thrust blocks to undisturbed soil.
2. Form vertical surfaces of poured concrete thrust blocks except on bearing surface.
3. Encase all fittings in polyethylene wrap. Do not allow concrete to directly contact joints or fitting bolts.
4. Excavation into trench wall may be necessary.
5. Refer to Table 1 for minimum bearing surface area.

Table 1

| Size of Pipe (in) | Minimum Bearing Surface (SF) | | | | |
|---|---|---|---|---|---|
| | BENDS | | | | Tee or Dead End |
| | 11.25° | 22.5° | 45° | 90° | |
| 4 | 1.0 | 1.0 | 2.0 | 4.0 | 3.0 |
| 6 | 1.0 | 2.0 | 4.0 | 8.0 | 6.0 |
| 8 | 2.0 | 4.0 | 7.0 | 14.0 | 10.0 |
| 10 | 3.0 | 6.0 | 11.0 | 21.0 | 15.0 |
| 12 | 4.0 | 8.0 | 16.0 | 29.0 | 21.0 |
| 14 | 5.0 | 11.0 | 21.0 | 39.0 | 28.0 |
| 16 | 7.0 | 14.0 | 27.0 | 50.0 | 36.0 |
| 18 | 9.0 | 17.0 | 34.0 | 63.0 | 45.0 |
| 20 | 11.0 | 21.0 | 42.0 | 78.0 | 55.0 |
| 24 | 15.0 | 31.0 | 60.0 | 111.0 | 78.0 |
| 30 | 24.0 | 47.0 | 92.0 | 171.0 | 121.0 |
| 36 | 34.0 | 67.0 | 132.0 | 244.0 | 173.0 |
| | | | | | |

Note: Area based upon water pressure of 150 PSI and allowable soil pressure of 1000 PSF. Engineer may modify required size based upon site conditions.

SUDAS

| REVISION NO. |
|---|
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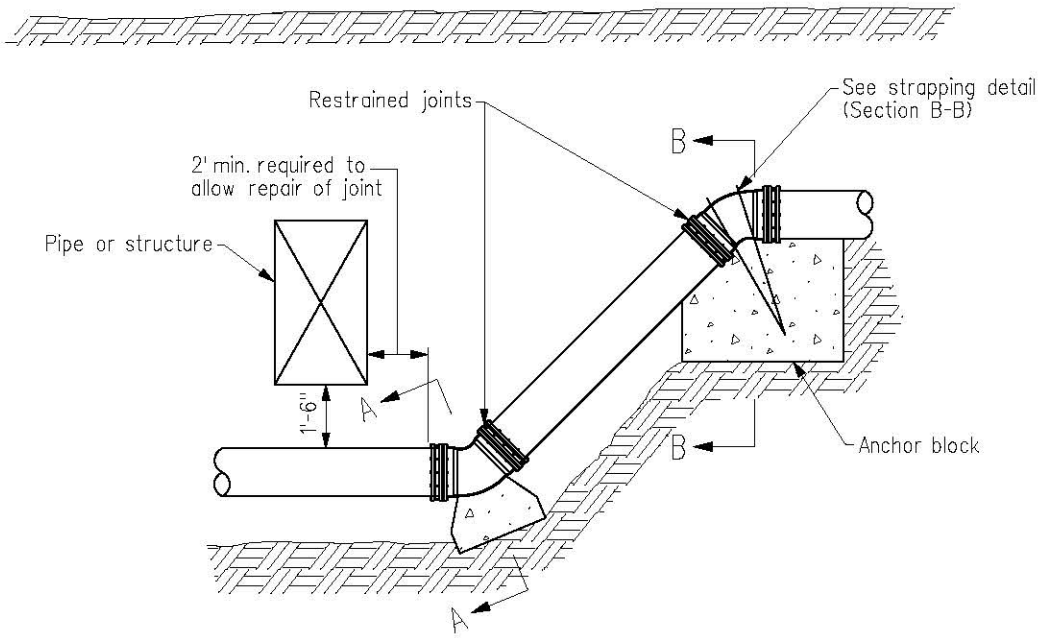
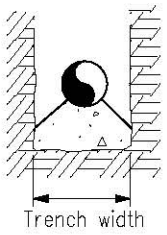
| 10/17/07 |
| SHEET 1 OF 2 |

FIGURE: 5010.1

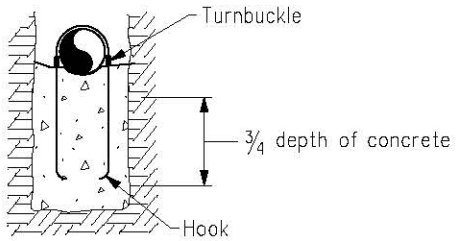
# PCC THRUST BLOCKS

FIGURE: 5010.1 SHEET 1 OF 2



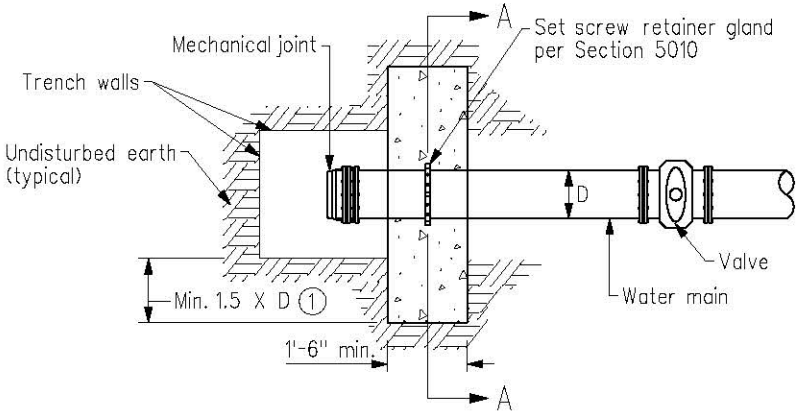



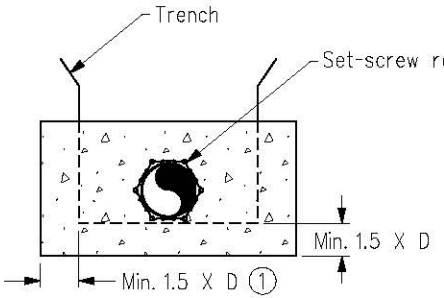

SECTION A-A




SECTION B-B

PIPE LOWERING




SECTION A-A

DEAD END (ALTERNATE)

SUDAS

| REVISION NO. |
|---|
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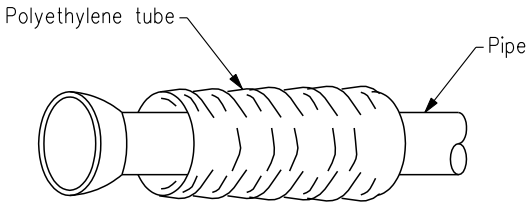
| REVISION DATE |
| 10/17/07 |
| SHEET 2 OF 2 |

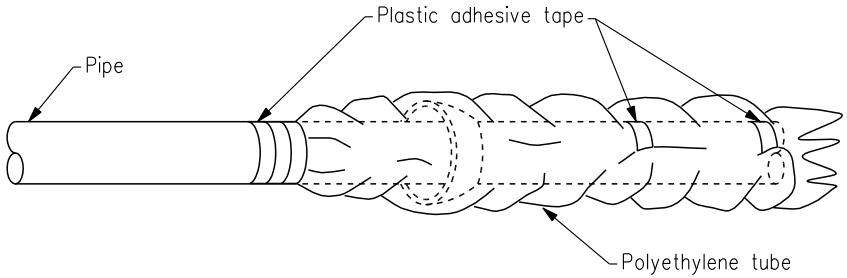
FIGURE: 5010.1

PCC THRUST BLOCKS

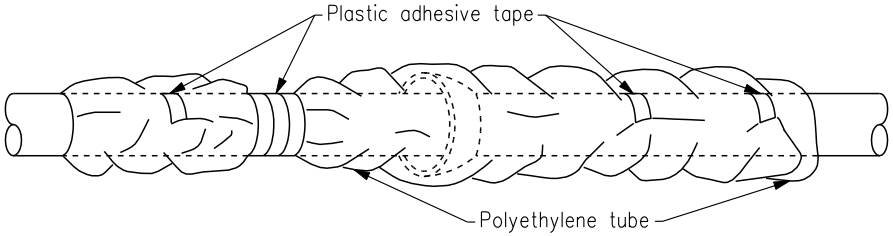
FIGURE: 5010.1 | SHEET 2 OF 2




STEP 1




STEP 2




STEP 3

1. Place tube of polyethylene material on pipe prior to lowering it into the trench.

2. Pull the tube over the length of pipe. Secure tube to pipe at joint. Pull tube past bell and fold material around the adjacent spigot and wrap with plastic adhesive tape to hold the plastic tube in place.

3. Overlap first tube with adjacent tube and secure with tape. Loosely cover the pipe with a polyethylene tube. Neatly draw up excess material around the pipe barrel, fold on top of, and secure with tape.

4. Wrap iron pipe fittings, including valves and hydrants, with polyethylene material. Extend the wrapping at least 1 ft. beyond the fitting joints onto the adjoining pipe and fasten to the pipe with tape. Use tape as needed o hold wrap in place. Either polyethylene sheets or slit tubing may be used.

FIGURE: 5010.2 | SHEET 1 OF 1

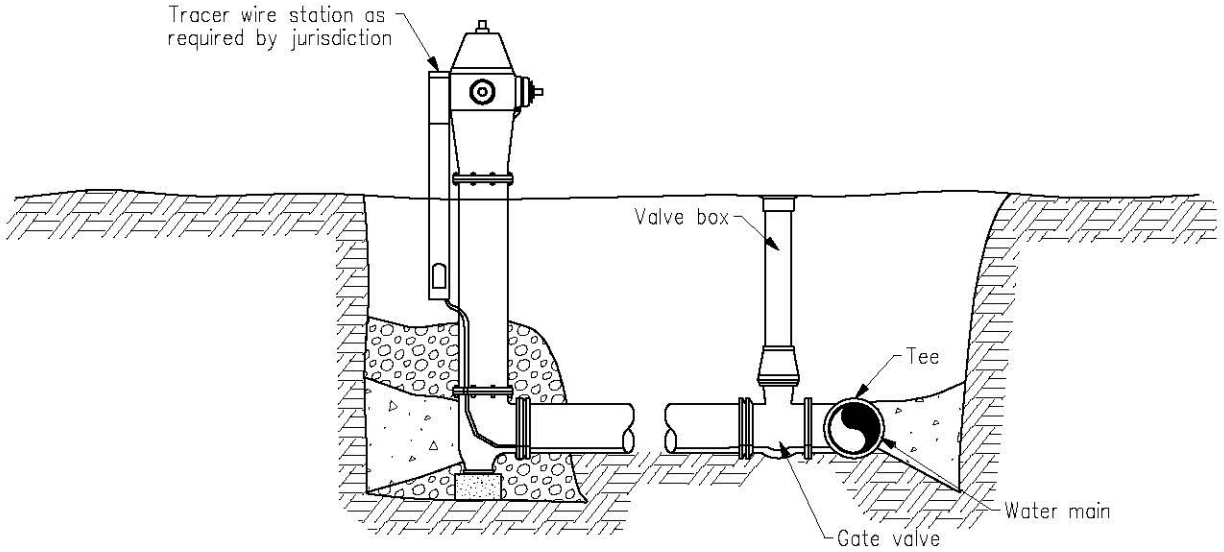
SUDAS

| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/17/07 |
| FIGURE: 5010.2 | SHEET 1 OF 1 |

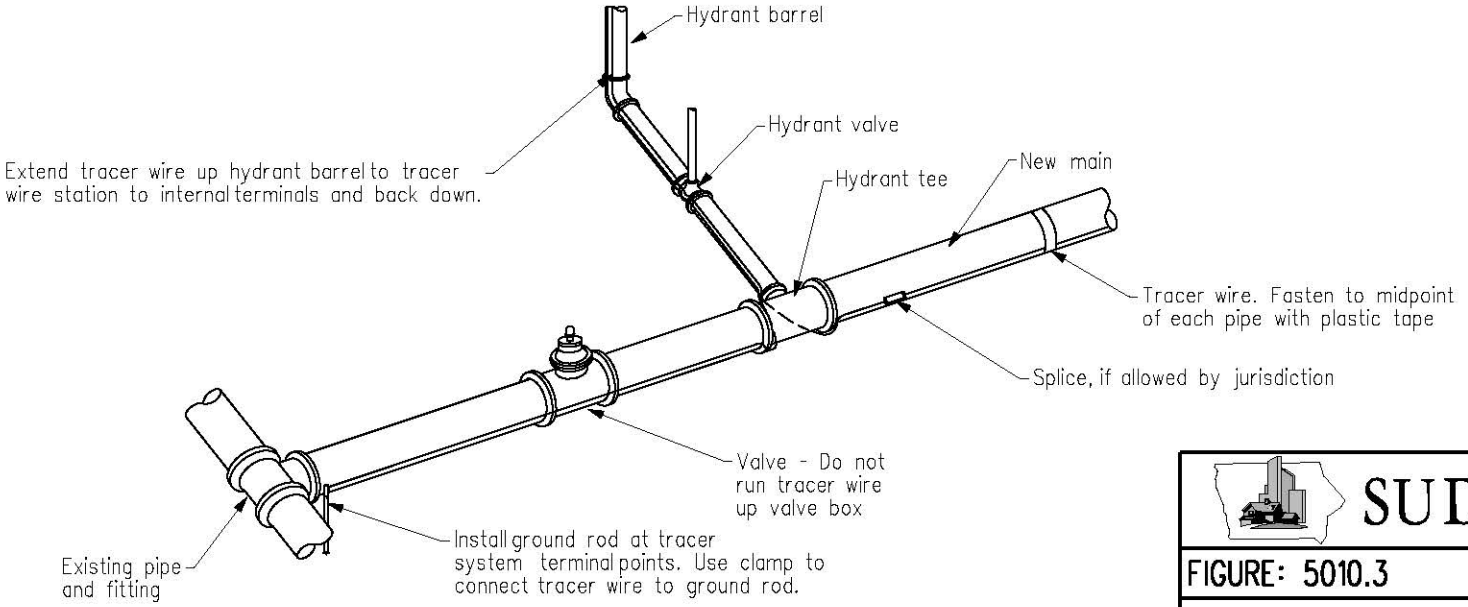
# POLYETHYLENE WRAP

GENERAL NOTES:

Exercise care to preserve the integrity of the insulation on the tracer wire.




TRACER WIRE STATION AT HYDRANT




TRACER WIRE DETAIL

FIGURE: 5010.3 SHEET 1 OF 1

SUDAS

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| 10/17/07 |
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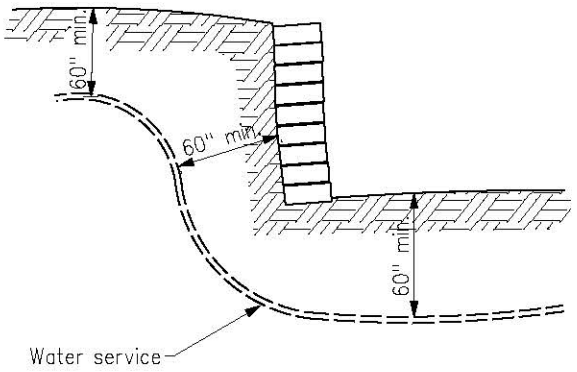
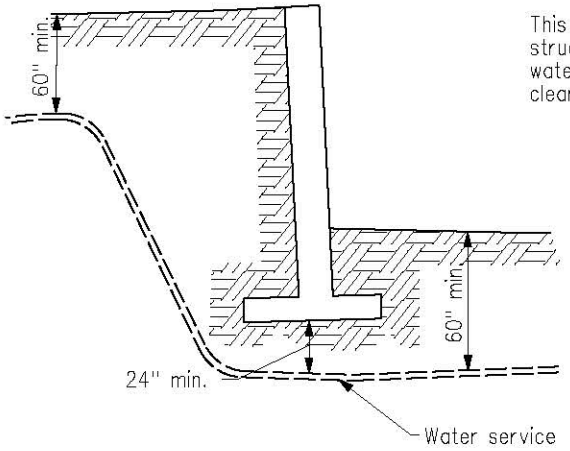
FIGURE: 5010.3

# TRACER WIRE DETAIL



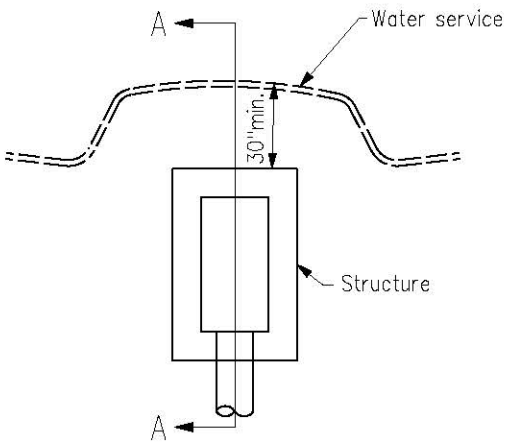

SECTION



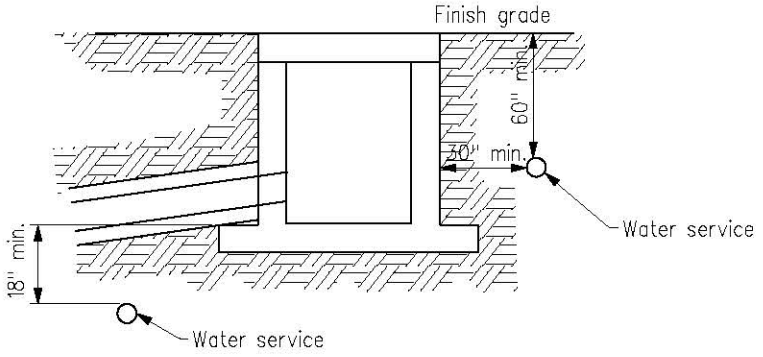

SECTION

GENERAL NOTES:

This figure details minimum required clearances between structure and water service lines. Adjust location of water services as directed by the Engineer to maintain the clearances shown.




PLAN VIEW



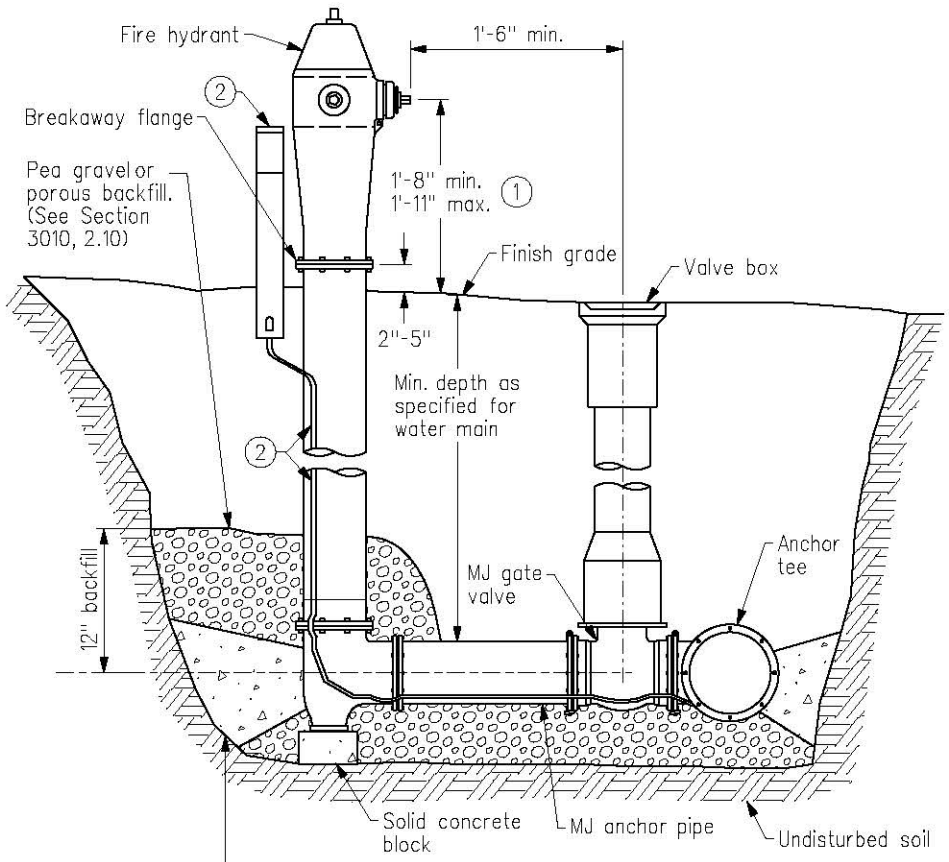

SECTION

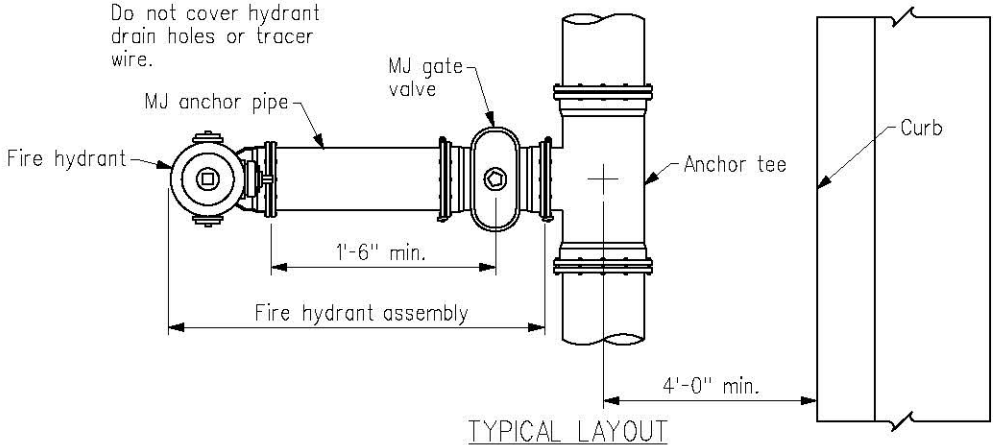
FIGURE: 5010.4 SHEET 1 OF 1

SUDAS

| | |
|---|---|
| REVISION NO. | --- |
| REVISION DATE | 10/17/07 |
| FIGURE: 5010.4 | SHEET 1 OF 1 |

# MINIMUM CLEARANCE BETWEEN WATER SERVICE AND STRUCTURE



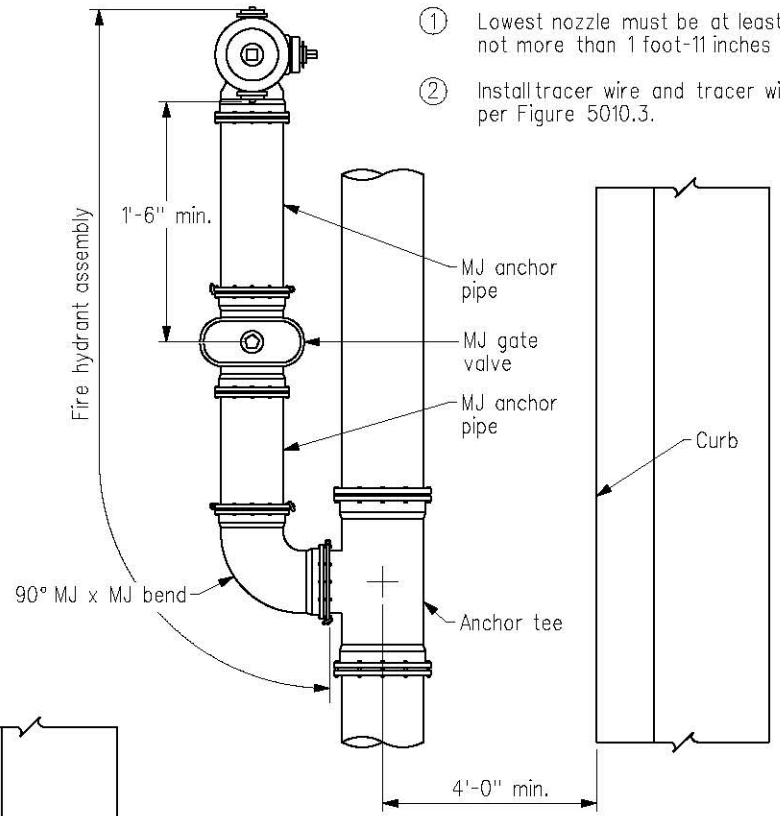

TYPICAL LAYOUT

GENERAL NOTES:

Utilize typical layout unless alternate layout is indicated in the contract documents or directed by the Engineer.

Use ductile iron pipe with restrained joints for hydrant assembly.

1. Lowest nozzle must be at least 1 foot-8 inches and not more than 1 foot-11 inches above finish grade.
2. Install tracer wire and tracer wire station per Figure 5010.3.




ALTERNATE LAYOUT

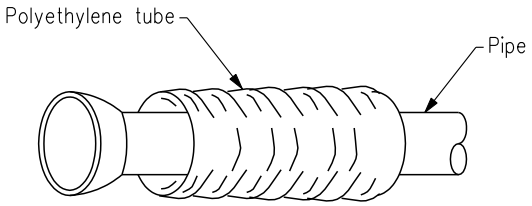
SUDAS

| | |
|---|---|
| REVISION NO. | --- |
| REVISION DATE | 10/16/07 |
| FIGURE: 5020.1 | SHEET 1 OF 1 |

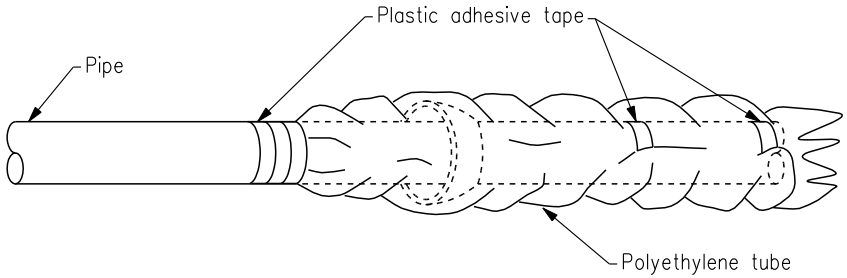
# FIRE HYDRANT ASSEMBLY

FIGURE: 5020J

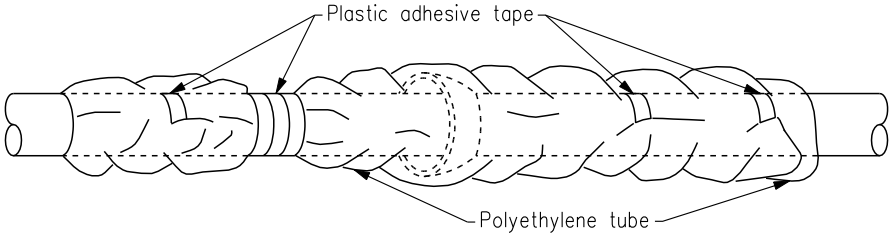
SHEET 1 OF 1




STEP 1




STEP 2




STEP 3

1. Place tube of polyethylene material on pipe prior to lowering it into the trench.

2. Pull the tube over the length of pipe. Secure tube to pipe at joint. Pull tube past bell and fold material around the adjacent spigot and wrap with plastic adhesive tape to hold the plastic tube in place.

3. Overlap first tube with adjacent tube and secure with tape. Loosely cover the pipe with a polyethylene tube. Neatly draw up excess material around the pipe barrel, fold on top of, and secure with tape.

4. Wrap iron pipe fittings, including valves and hydrants, with polyethylene material. Extend the wrapping at least 1 ft. beyond the fitting joints onto the adjoining pipe and fasten to the pipe with tape. Use tape as needed o hold wrap in place. Either polyethylene sheets or slit tubing may be used.

FIGURE: 5010.2 | SHEET 1 OF 1

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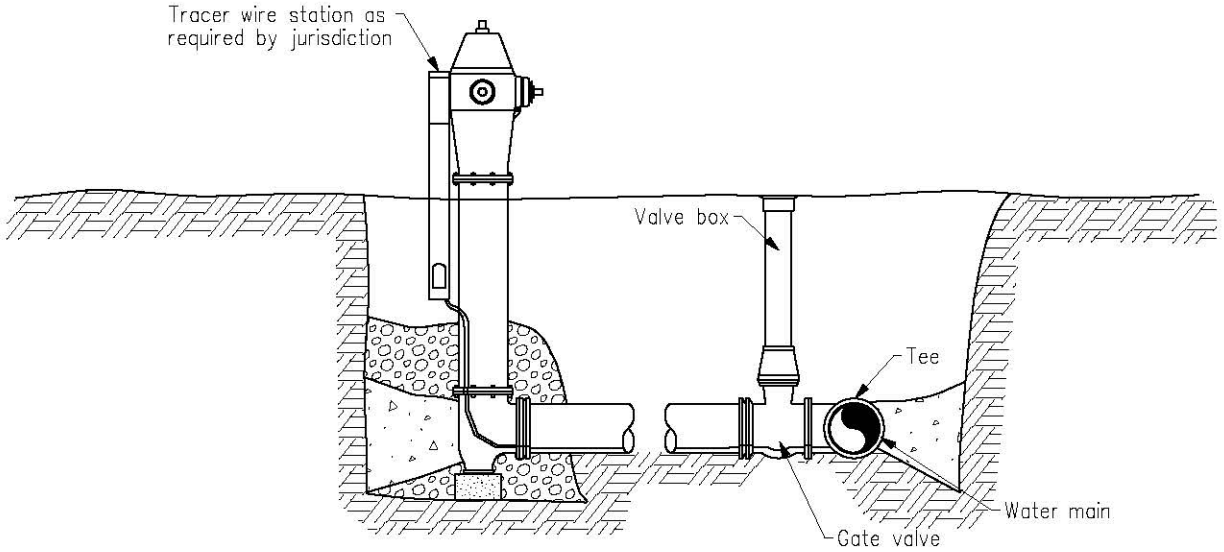
|---|---|
| REVISION DATE | 10/17/07 |
| FIGURE: 5010.2 | SHEET 1 OF 1 |

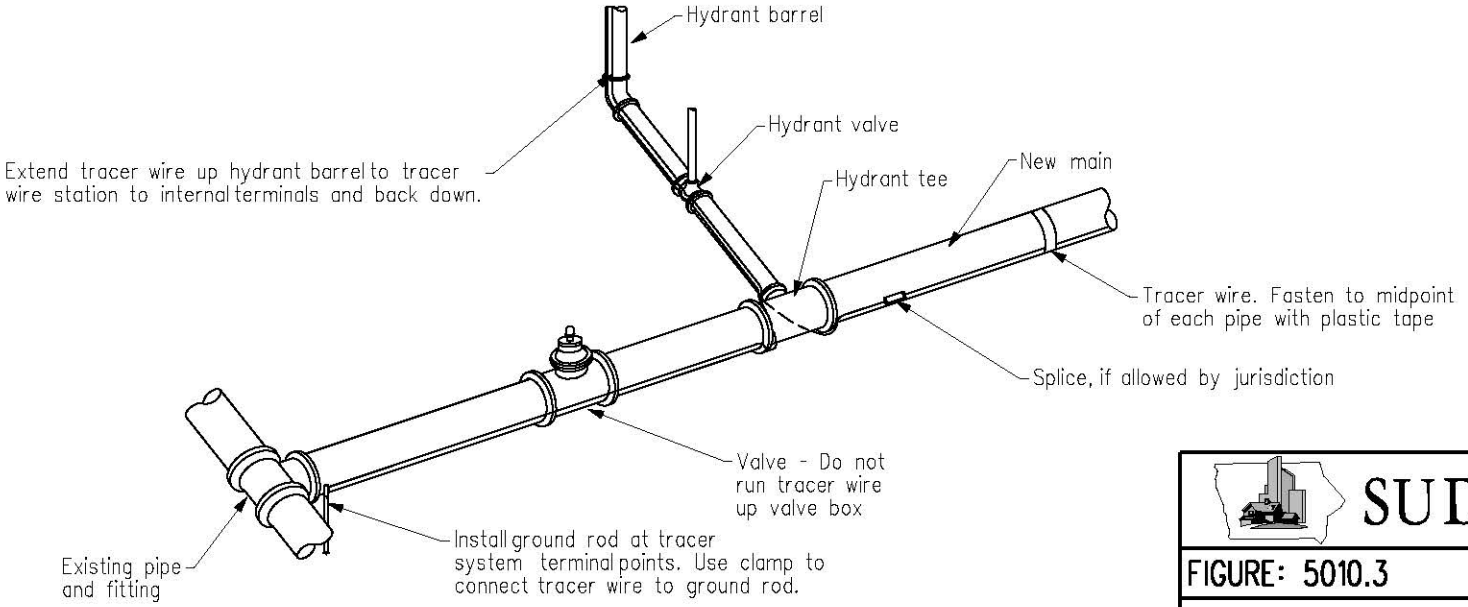
# POLYETHYLENE WRAP

GENERAL NOTES:

Exercise care to preserve the integrity of the insulation on the tracer wire.




TRACER WIRE STATION AT HYDRANT




TRACER WIRE DETAIL

FIGURE: 5010.3 SHEET 1 OF 1

SUDAS

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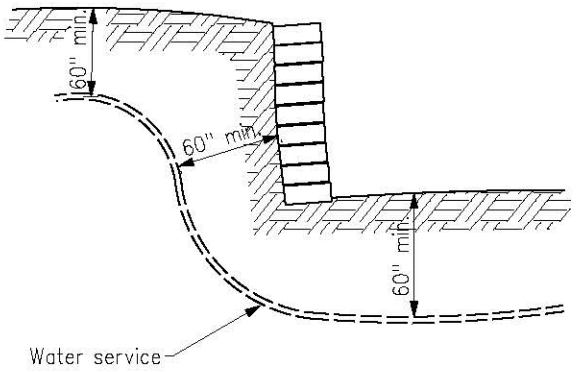
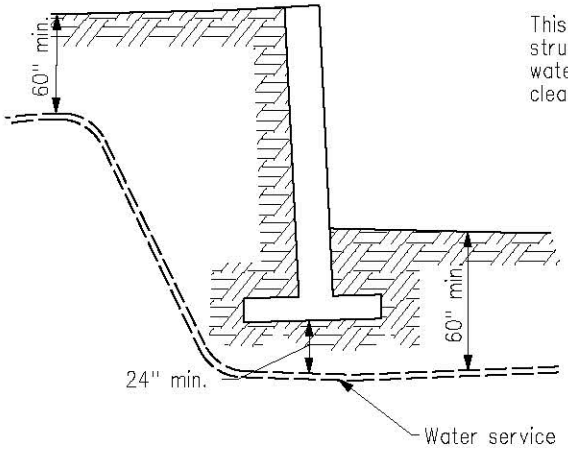
FIGURE: 5010.3

# TRACER WIRE DETAIL



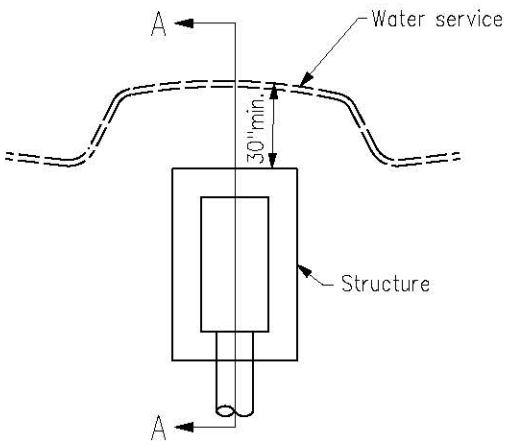

SECTION



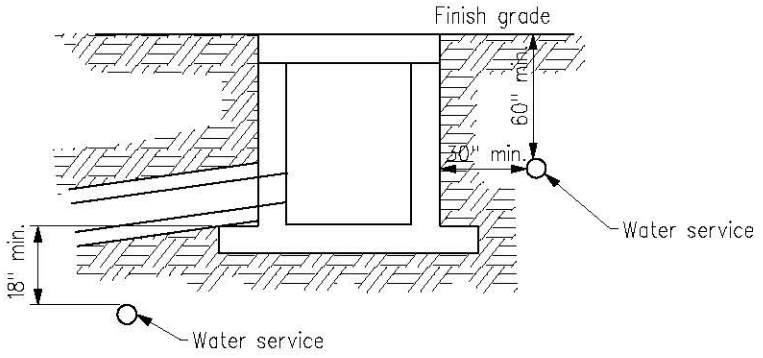

SECTION

GENERAL NOTES:

This figure details minimum required clearances between structure and water service lines. Adjust location of water services as directed by the Engineer to maintain the clearances shown.




PLAN VIEW



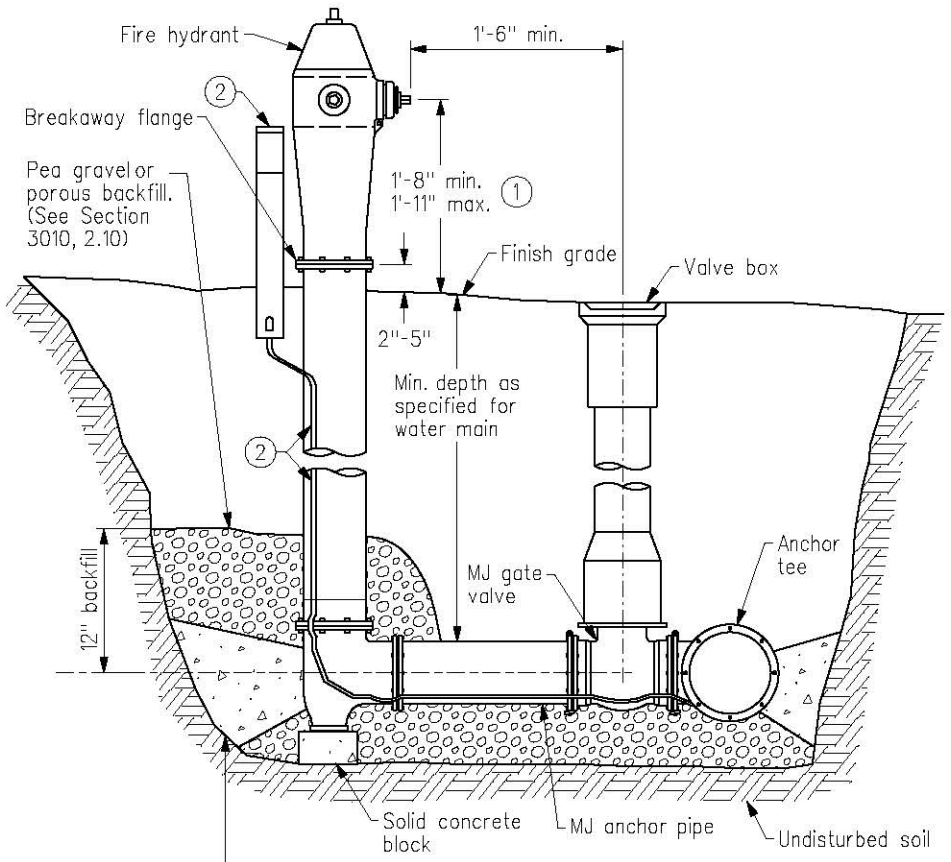

SECTION

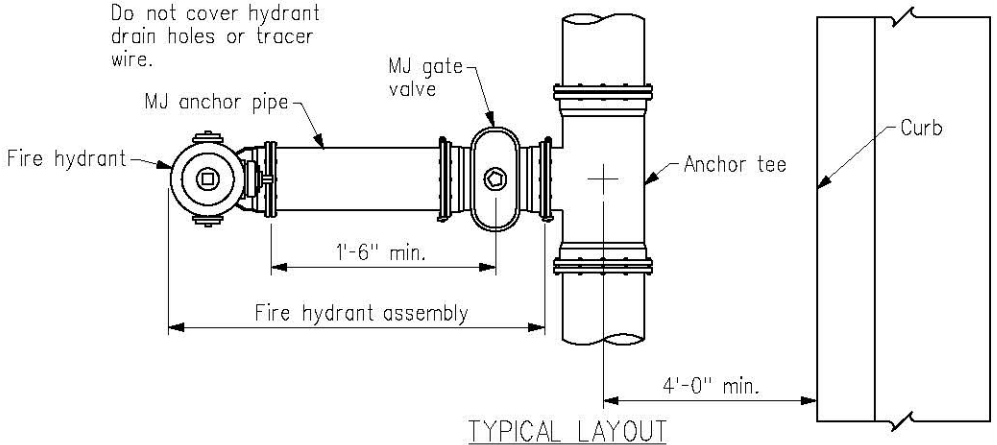
FIGURE: 5010.4 SHEET 1 OF 1

SUDAS

| | |
|---|---|
| REVISION NO. | --- |
| REVISION DATE | 10/17/07 |
| FIGURE: 5010.4 | SHEET 1 OF 1 |

# MINIMUM CLEARANCE BETWEEN WATER SERVICE AND STRUCTURE



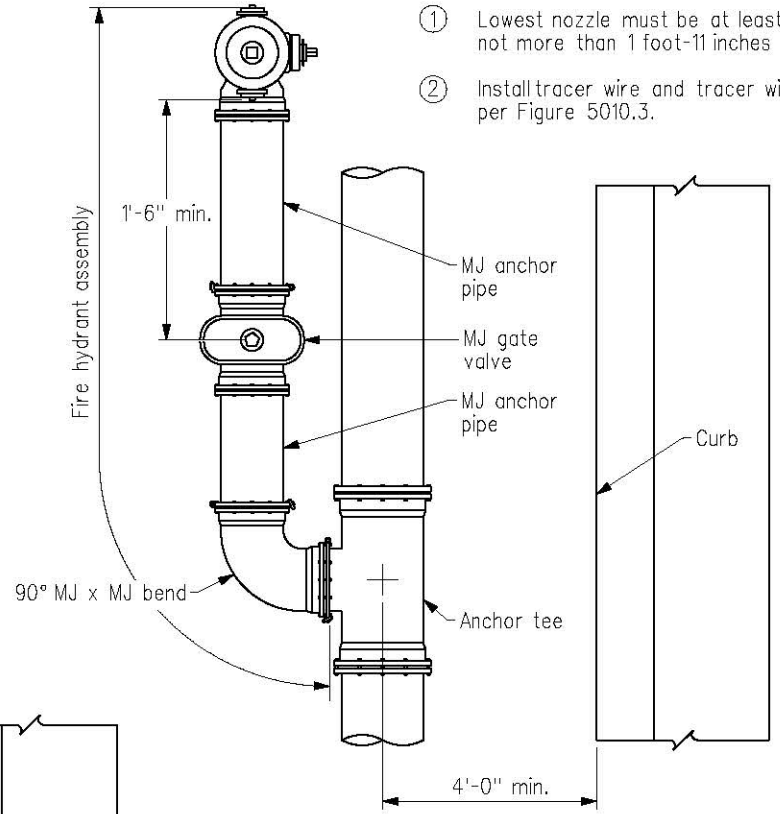

TYPICAL LAYOUT

GENERAL NOTES:

Utilize typical layout unless alternate layout is indicated in the contract documents or directed by the Engineer.

Use ductile iron pipe with restrained joints for hydrant assembly.

1. Lowest nozzle must be at least 1 foot-8 inches and not more than 1 foot-11 inches above finish grade.
2. Install tracer wire and tracer wire station per Figure 5010.3.




ALTERNATE LAYOUT

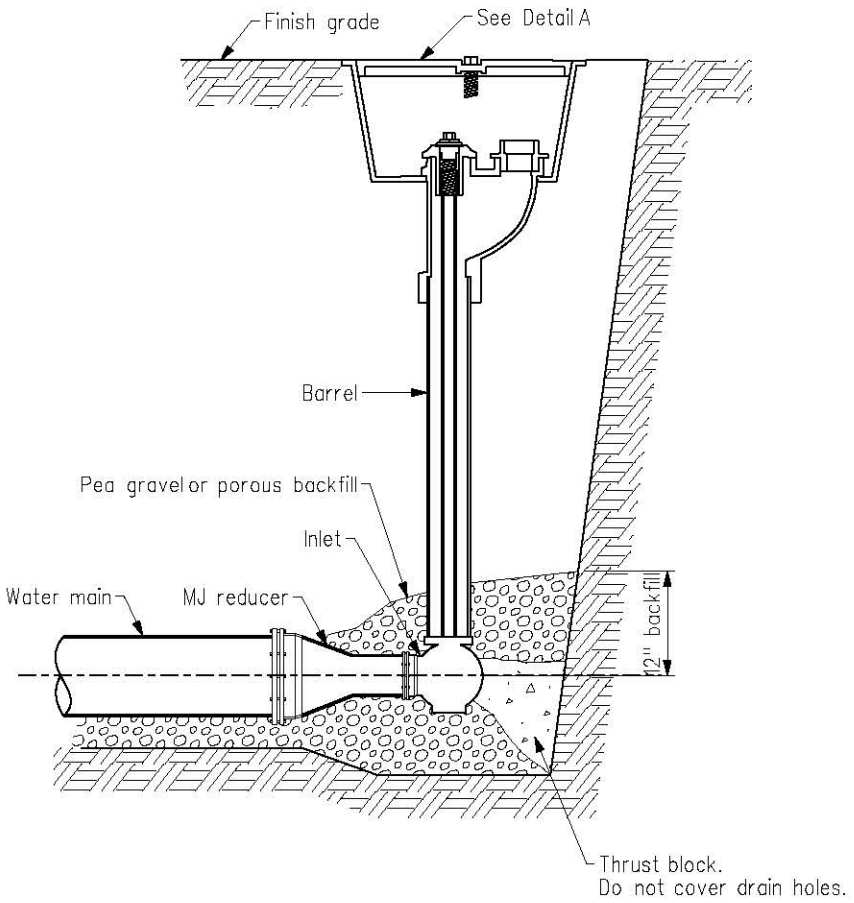
SUDAS

| | |
|---|---|
| REVISION NO. | --- |
| REVISION DATE | 10/16/07 |
| FIGURE: 5020.1 | SHEET 1 OF 1 |

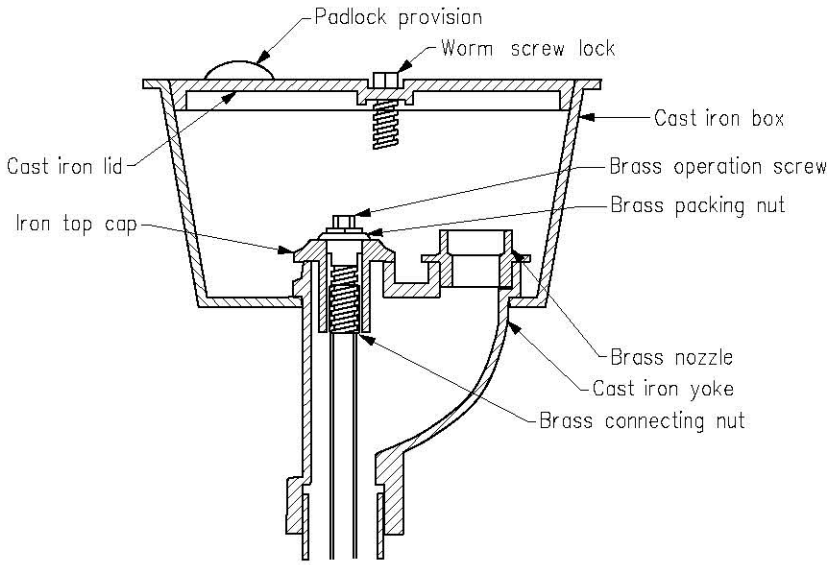
# FIRE HYDRANT ASSEMBLY

FIGURE: 5020J

SHEET 1 OF 1




NON-FREEZING FLUSHING DEVICE



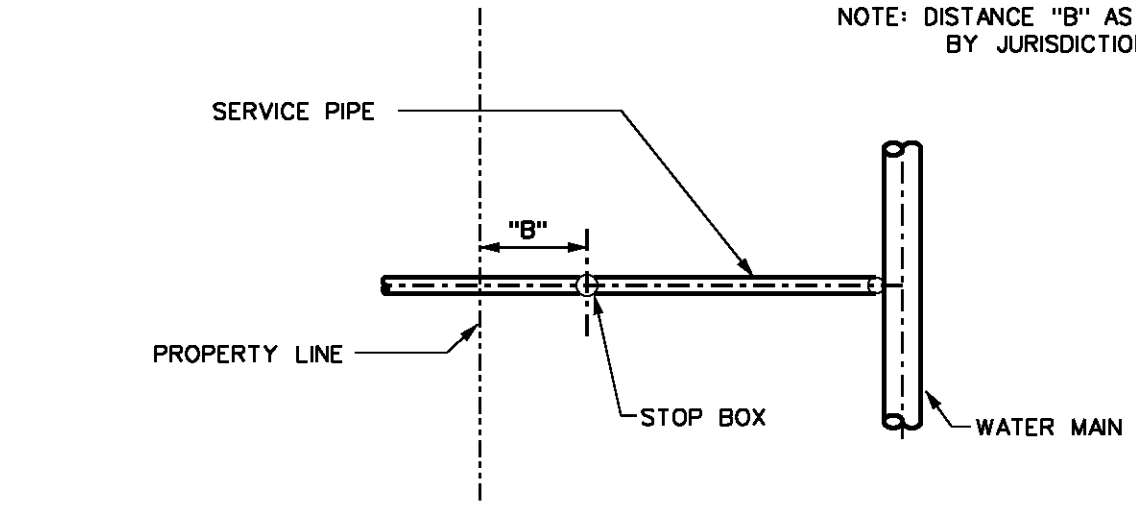

DETAIL A

FIGURE: 5020.2 SHEET 1 OF 1

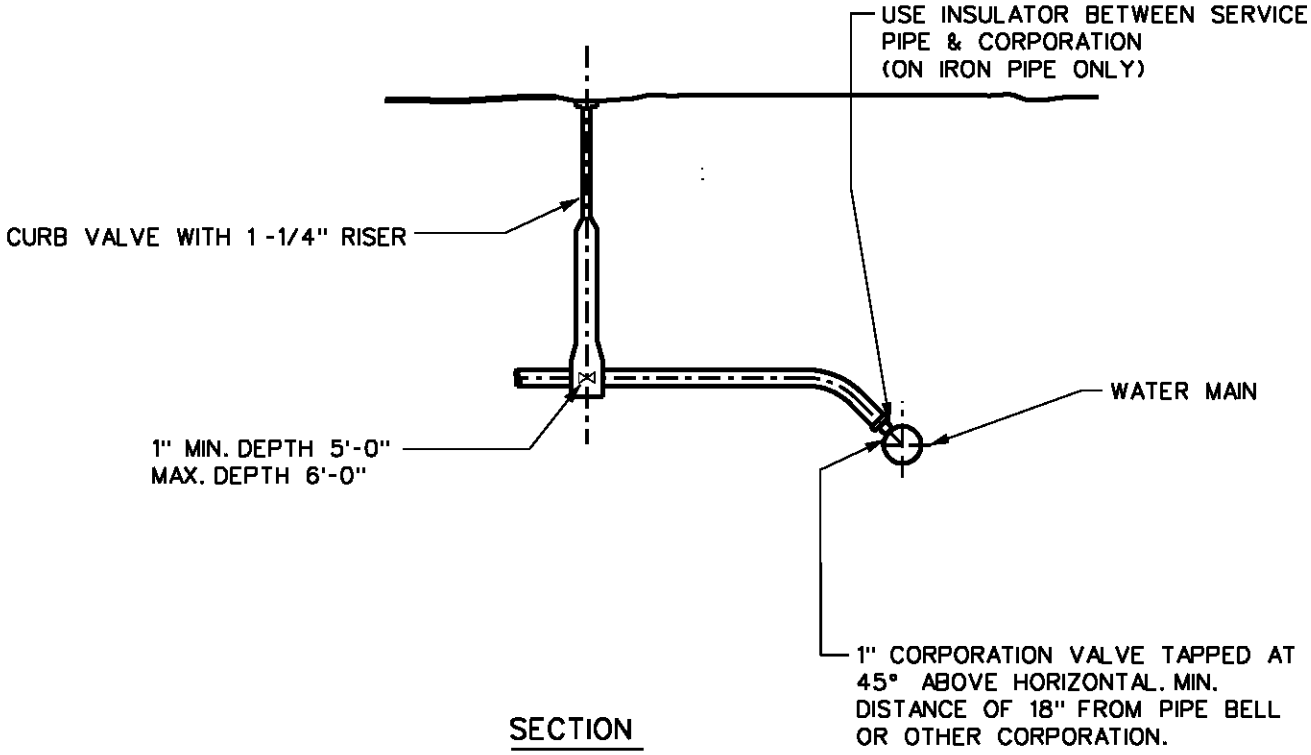
SUDAS

| | |
|---|---|
| | REVISION NO. - - |
| | REVISION DATE 10/16/07 |
| FIGURE: 5020.2 | SHEET 1 OF 1 |

# FLUSHING DEVICE (BLOWOFF)



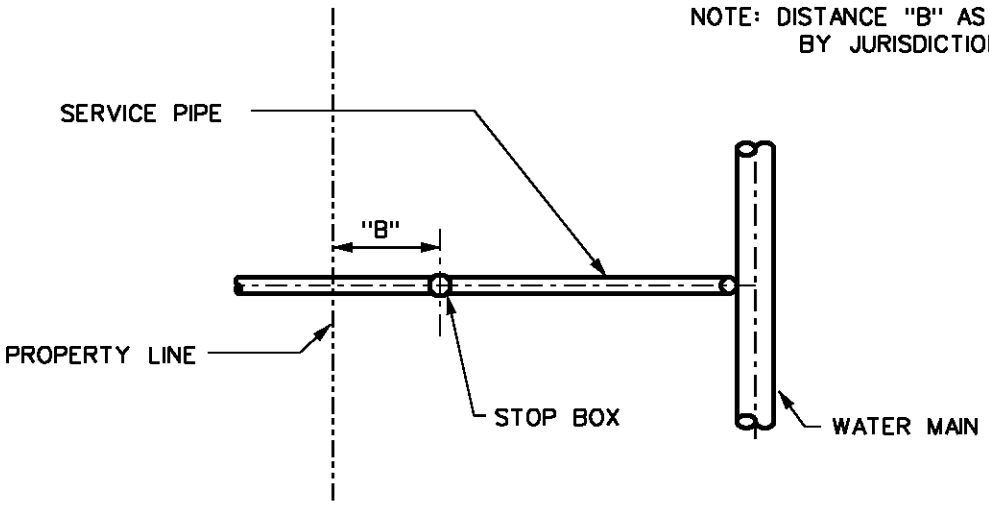

PLAN




SECTION

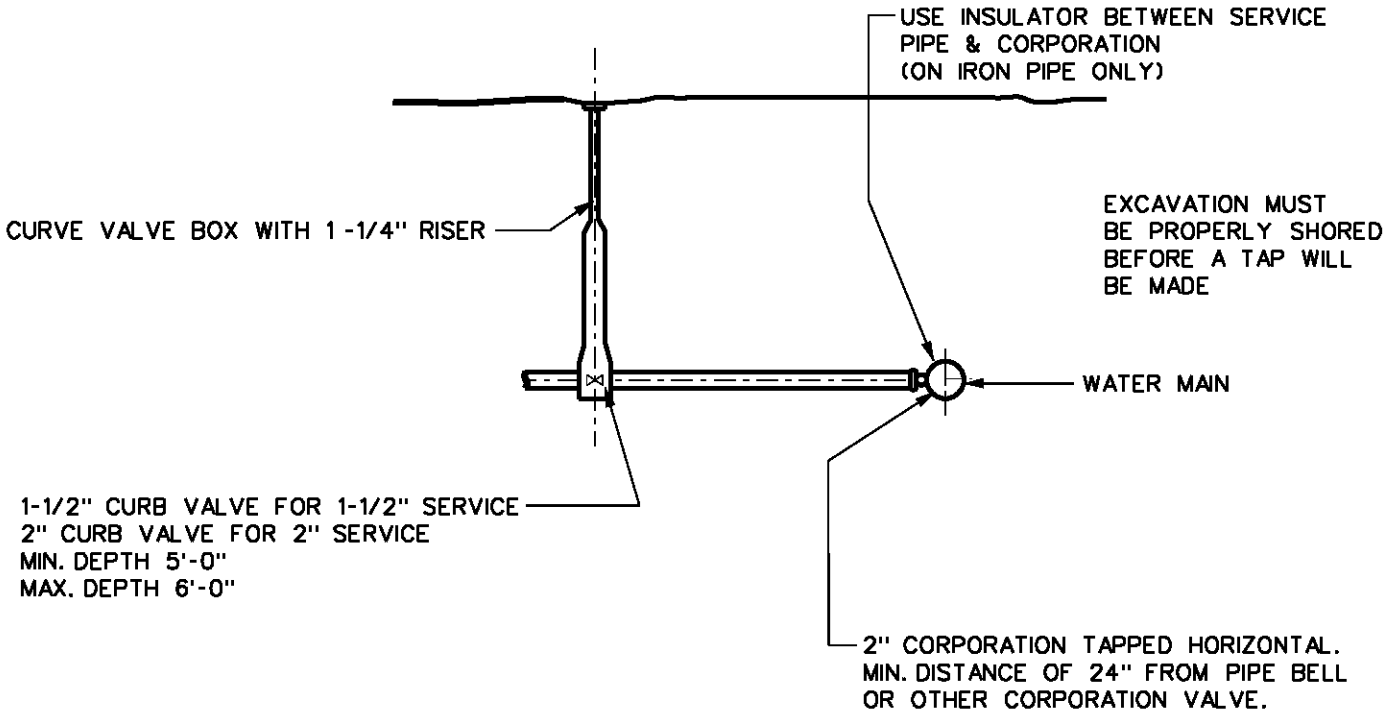


| REV. | DATE | BY | 1" SERVICE PIPE INSTALLATION | FIGURE: 5010.2 |
|---|---|---|---|---|
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |




PLAN

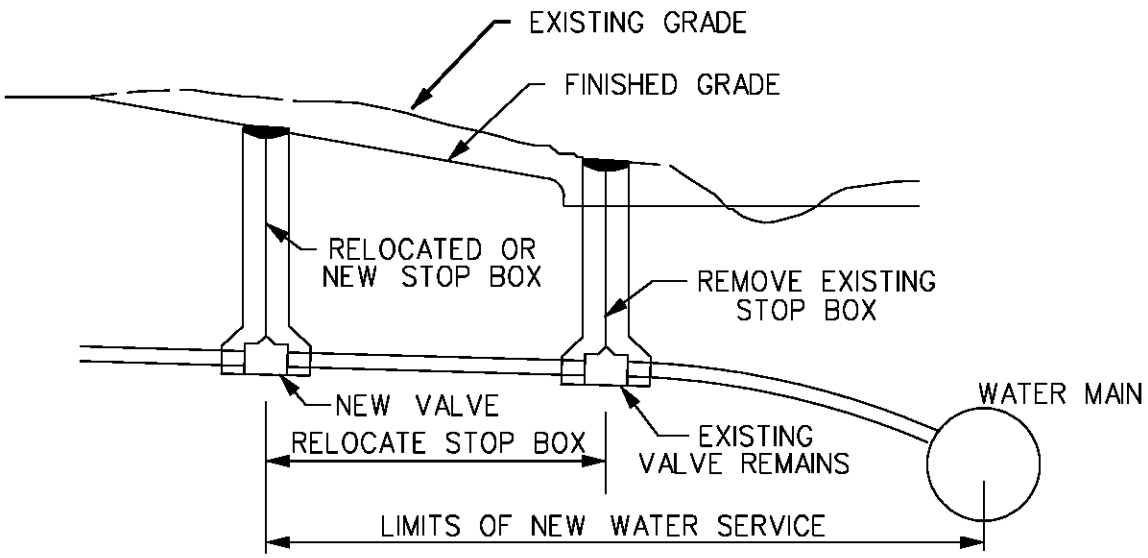
NOTE: CONTACT JURISDICTION FOR INFORMATION ON SERVICES LARGER THAN 2-INCH.




SECTION



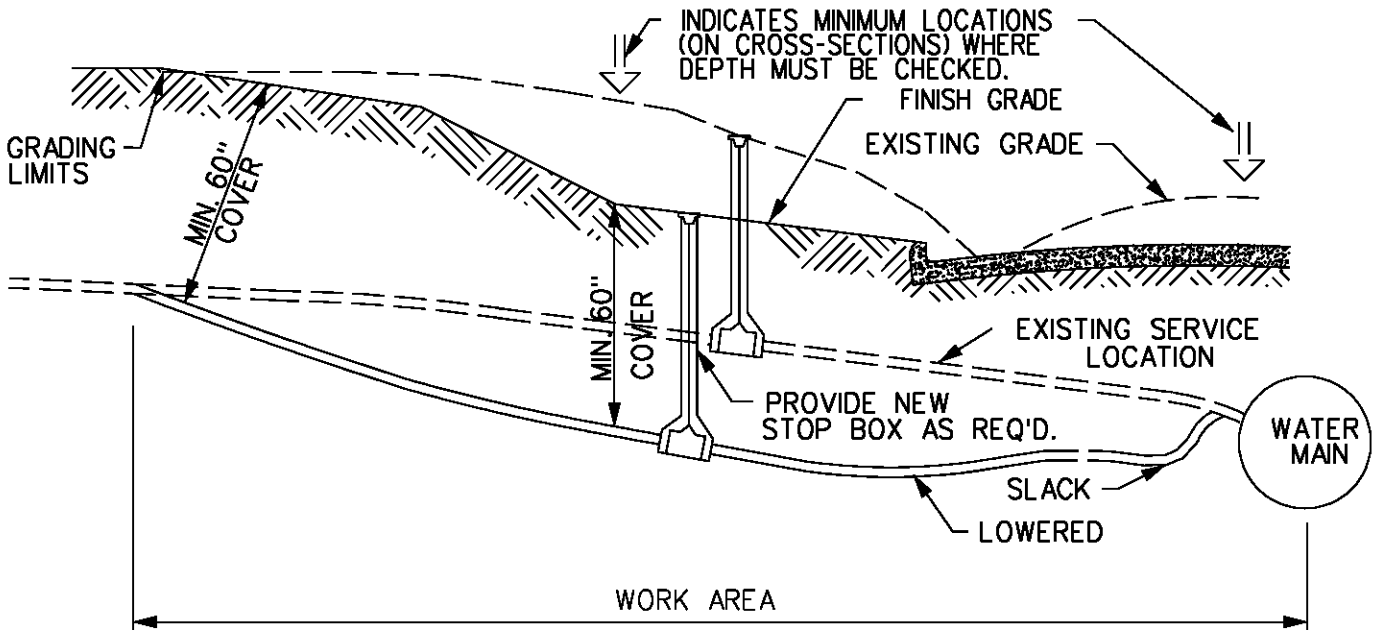
| REV. | DATE | BY | 1-1/2" OR 2" SERVICE PIPE INSTALLATION | FIGURE: 5010.3 |
|---|---|---|---|---|
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |




| WATER SERVICE STATUS | CONTRACTOR'S RESPONSIBILITY | COMPENSATION |
|---|---|---|
| 1. STOP BOX DOES NOT REQUIRE RELOCATION. | PROVIDE PROTECTION, IF DAMAGED. REPLACE OR REPAIR. ADJUST TO FINISH GRADE. | INCIDENTAL TO OTHER WORK |
| 2. STOP BOX REQUIRES RELOCATION. SERVICE COMPLIES WITH THE PLUMBING CODE. | RELOCATE STOP BOX. | BID ITEM-"RELOCATE STOP BOX" |
| 3. NEW STOP BOX REQUIRED IN CASE 2 ABOVE. | INSTALL NEW STOP BOX. | INCIDENTAL TO "RELOCATE STOP BOX" |
| 4. STOP BOX REQUIRES RELOCATION, BUT PLUMBING CODE INFORCE-MENT WILL NOT ALLOW SIMPLE RELOCATION. | CONSTRUCT NEW WATER SERVICE. STOP BOX AT SPECIFIED LOCATION. | BID ITEM -"NEW WATER SERVICE" |
| 5. EXISTING TAP 1/2 " IN CASE 4 ABOVE. | PROVIDE NEW TAP IF REQUIRED. | CHANGE ORDER, IF NOT A BID ITEM. |



| REV. | DATE | BY | | |
|---|---|---|---|---|
| 1 | 01/25/01 | | STOP BOX RELOCATION | FIGURE: 5010.6 |
| DATE: 05-25-00 | | | | SHEET 1 OF 1 |




NOTE: WHEN WATER SERVICES ARE LOWERED, THEY SHALL BE LOWERED OR RELOCATED TO AVOID CONFLICT WITH PROPOSED SEWERS, WALLS AND OTHER STRUCTURES.

| WATER SERVICE STATUS | CONTRACTOR'S RESPONSIBILITY | COMPENSATION |
|---|---|---|
| 1. CHECK DEPTH-SERVICE HAS MINMUM 60" OF EARTH COVER TO FINISH GRADE. | BACKFILL AND COMPACT INSPECTION EXCAVATION. | BID ITEM "CHECK DEPTH OF WATER SERVICE" |
| 2. CHECK DEPTH-SERVICE HAS LESS THAN 60" OF EARTH TO FINISH GRADE AND SERVICE COMPLIES WITH PLUMBING CODE. | LOWER SERVICE. | BID ITEM "LOWER WATER SERVICE" |
| 3. CHECK DEPTH-SERVICE HAS LESS THAN 60" OF EARTH COVER TO FINISH GRADE BUT PLUMBING CODE ENFORCEMENT WILL NOT ALLOW EXISTING PIPE TO BE LOWERED OR REUSED. | LOWER SERVICE WITH NEW COPPER PIPE. | BID ITEM "LOWER WATER SERVICE WITH NEW COPPER" |
| 4. NEW STOP BOX REQUIRED IN CASE 2 OR 3 ABOVE | INSTALL NEW STOP BOX | INCIDENTAL TO APPLICABLE BID ITEM IN CASE 2 OR 3 |
| 5. EXISTING TAP DOES NOT COMPLY WITH PLUMBING CODE IN CASE 3 ABOVE. | PROVIDE NEW TAP IF REQUIRED. | CHANGE ORDER, IF NOT BID ITEM. |



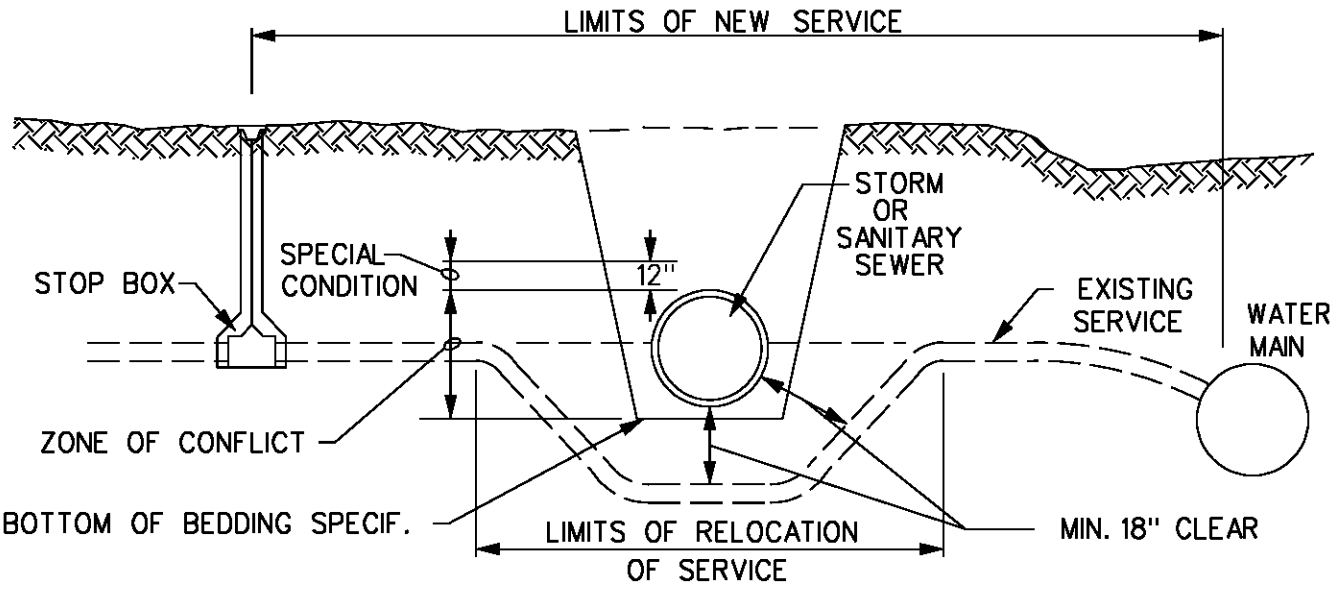
| REV. | DATE | BY |
|---|---|---|
| 1 | 01/25/01 | |

DATE: 05-25-00

LOWER WATER SERVICE

FIGURE: 5010.7

SHEET 1 OF 1




ZONE OF CONFLICT DEFINED-AREA FROM THE BOTTOM OF THE SPECIFIED BEDDING TO THE TOP OF PIPE.

| WATER SERVCE STATUS | CONTRACTOR'S RESPONSIBILITY | COMPENSATION |
|---|---|---|
| 1. SERVICE LOCATED OUTSIDE ZONE OF CONFLICT | PROVIDE PROTECTION. IF DAMAGED, REPAIR IN COMPLIANCE WITH THE PLUMBING CODE. | INCIDENTAL TO OTHER WORK |
| 2. SERVICE LOCATED IN ZONE OF CONFLICT, COMPLIES WITH THE PLUMBING CODE, AND IS NOT SPECIFIED TO BE LOWERED. | RELOCATE BELOW SEWER AS DETAILED ABOVE. | BID ITEM-"RELOCATION OF WATER SERVICE" |
| * 3. SERVICE LOCATED IN ZONE OF CONFLICT, BUT PLUMBING CODE ENFORCEMENT WILL NOT ALLOW SIMPLE RELOCATION THEREOF. | CONSTRUCT NEW WATER SERVICE, PROVIDE MINIMUM CLEARANCE OF SEWER AS DETAILED ABOVE. | BID ITEM-"NEW WATER SERVICE" |
| 4. SPECIAL CONDITION - SERVICE IS WITHIN 12" OF TOP OF SEWER & ALSO HAS LESS THAN 60" OF EARTH COVER TO FINISH GRADE. | RELOCATE OR RECONSTRUCT AS SPECIFIED IN 2 AND 3 ABOVE WHICHEVER CASE APPLIES. | AS IN 2 OR 3 ABOVE WHICHEVER APPLIES. |
| 5. SERVICE IS IN CONFLICT WITH PROPOSED INTAKE, WALLS OR OTHER STRUCTURES. | RELOCATE AROUND STRUCTURE TO MIN. CLEARANCE. | AS IN 2 OR 3 ABOVE WHICHEVER APPLIES. |
| 6. SERVICE REQUIRED TO BE LOWERED AS WELL AS RELOCATED. | LOWER SERVICE-PROVIDE MINIMUM CLEARANCE TO SEWER PIPE AS ABOVE. | BID ITEM-"LOWER WATER SERVICE" OR "LOWER WATER SERVICE WITH NEW COPPER" WHICHEVER APPLIES. |
| 7. EXISTING TAP DOES NOT COMPLY WITH PLUMBING CODE IN CASE 3 ABOVE. | PROVIDE NEW TAP IF REQUIRED. | CHANGE ORDER IF NOT BID ITEM. |

* CONDITIONS - EXISTING LINE IS LEAD LINE, LESS THAN 3/4" DIA. OR GALVANIZED LINE.



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|---|---|---|
| 1 | 01/25/01 | |

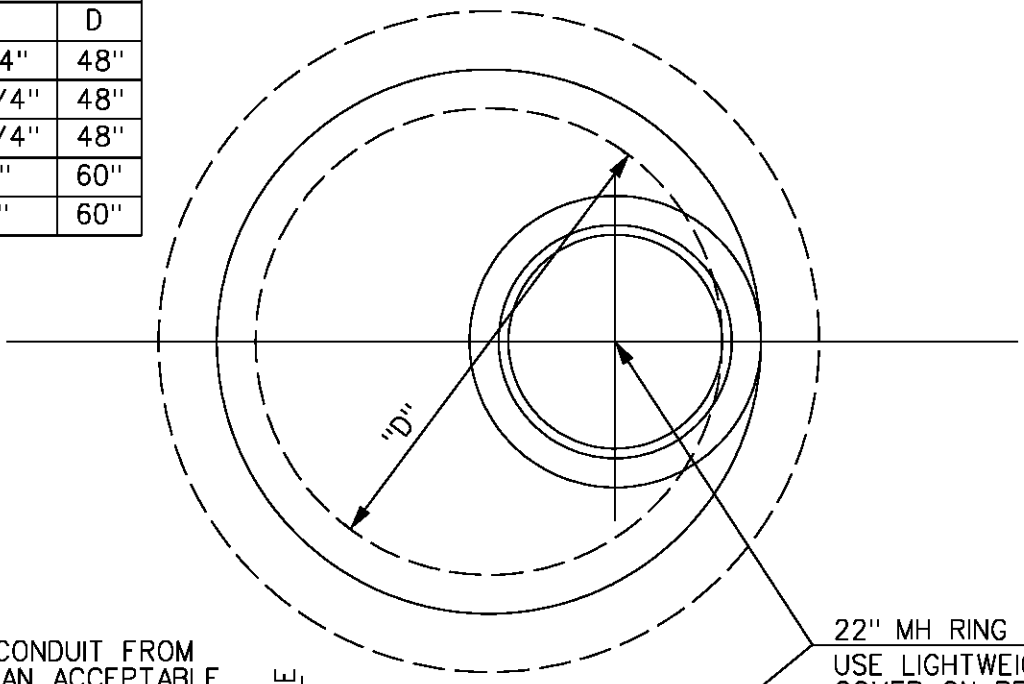
DATE: 05-25-00

RELOCATE WATER SERVICE IN CONFLICT WITH NEW SEWER

FIGURE: 5010.9

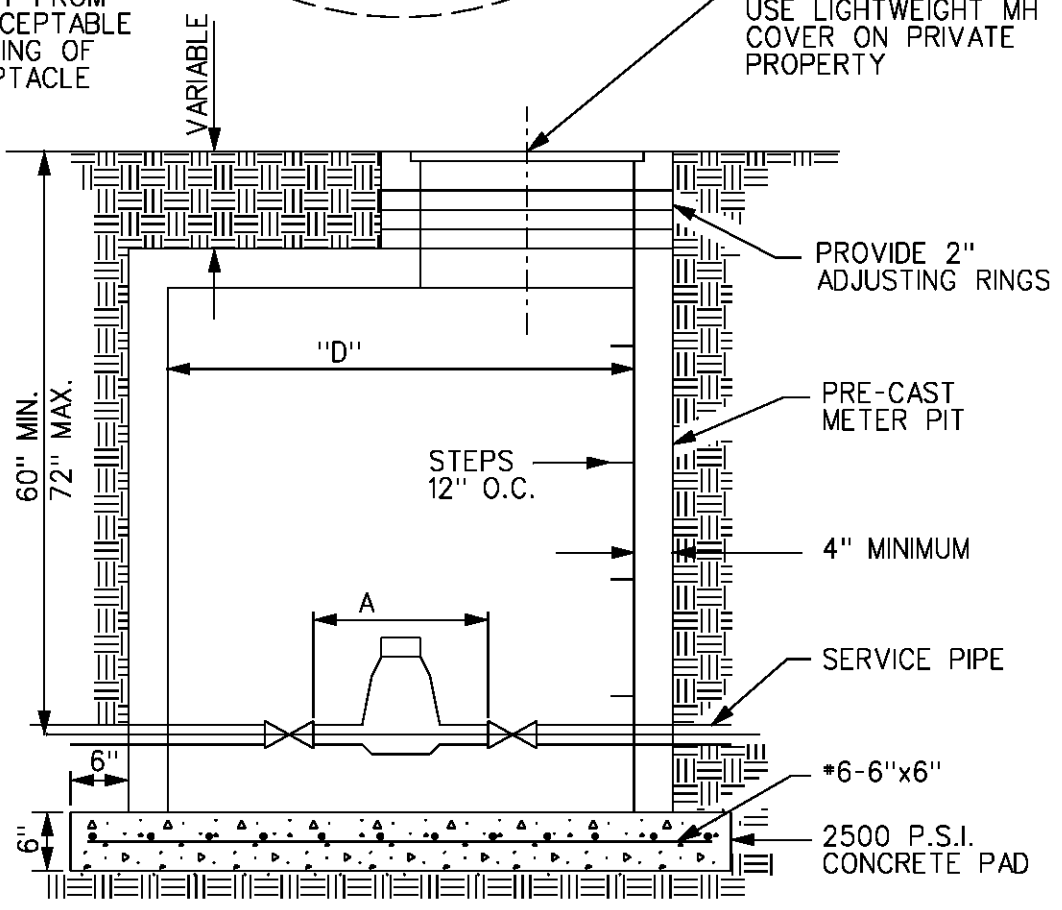
SHEET 1 OF 1

| SIZE OF METER | DIMENSIONS | |
|---|---|---|
| | A | D |
| 5/8" | 11 3/4" | 48" |
| 3/4" | 13 3/4" | 48" |
| 1" | 15 3/4" | 48" |
| 1 1/2" | 30" | 60" |
| 2" | 30" | 60" |




INSTALL 1/2 " CONDUIT FROM METER PIT TO AN ACCEPTABLE LOCATION FOR MOUNTING OF REMOTE METER RECEPTACLE

22" MH RING & COVER
USE LIGHTWEIGHT MH COVER ON PRIVATE PROPERTY






| REV. | DATE | BY | | |
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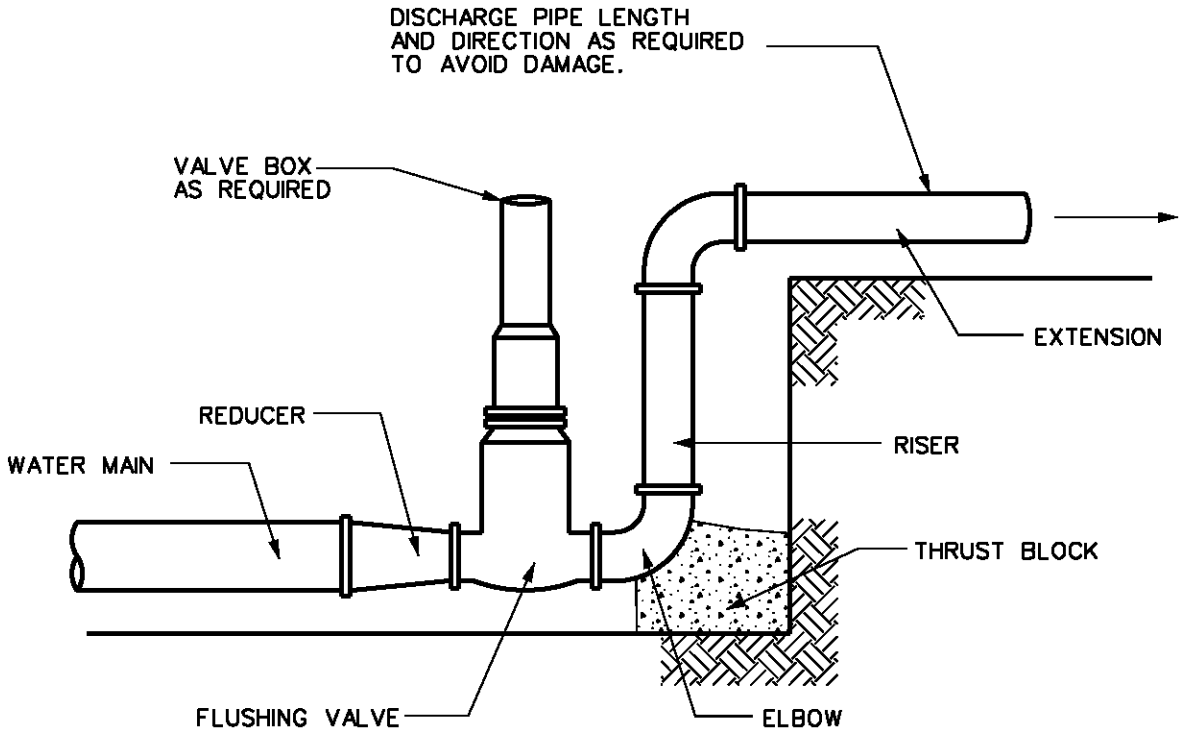
| 1 | 01/25/01 | | METER PIT | FIGURE: 5010.10 |
| DATE: 05-25-25 | | | | SHEET 1 OF 1 |




NOTES:

1. AFTER SUCCESSFUL MAIN TESTING AND DISINFECTION, REMOVE EXTENSION AND RISER. PLUG ELBOW.
2. TO EXTEND WATER MAIN, REMOVE REDUCER AND VALVE.

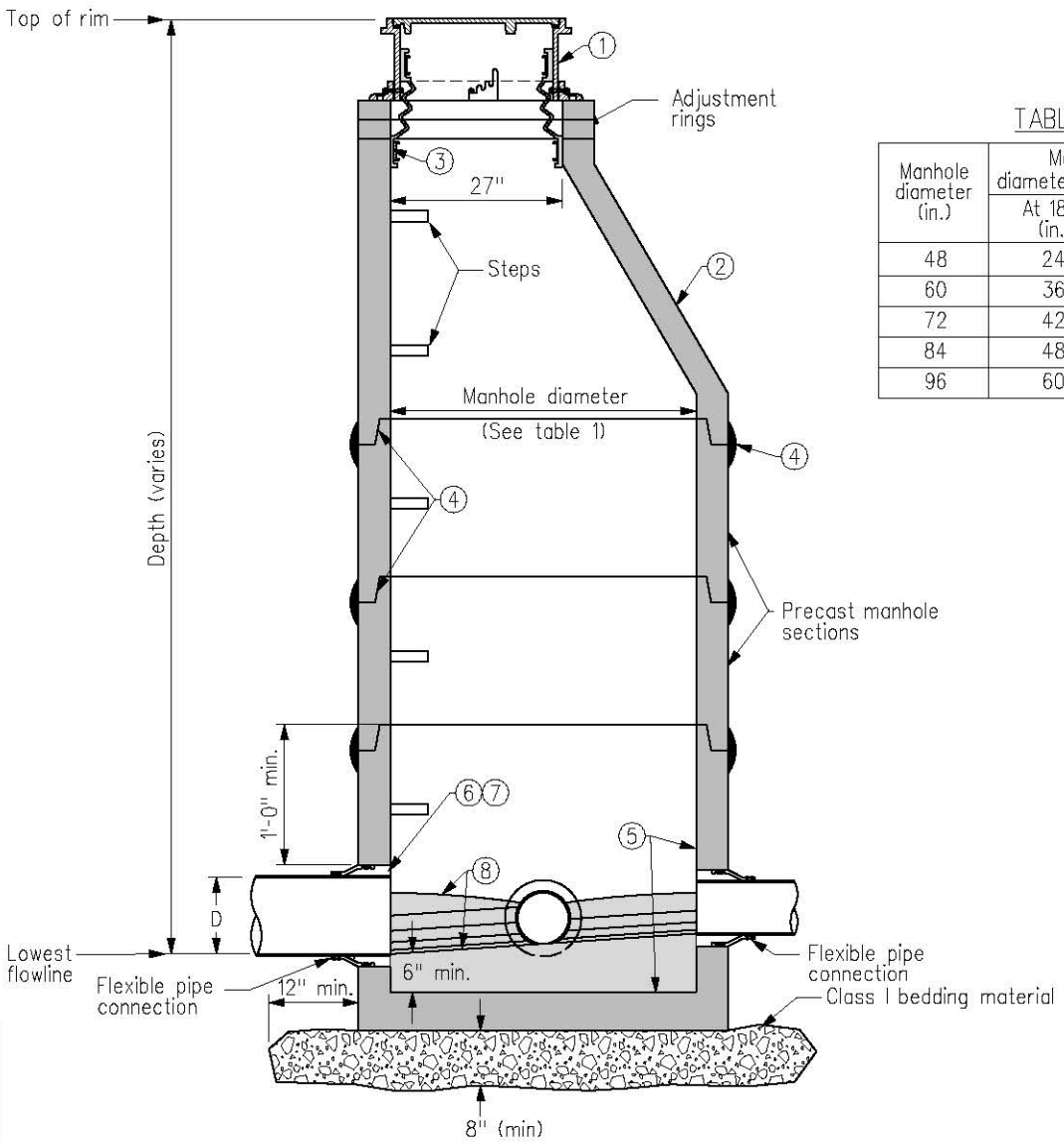


| REV. | DATE | BY | TEMPORARY FLUSHING DEVICE DETAIL (BLOWOFF) | FIGURE: 5020.3 |
|---|---|---|---|---|
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |

# Division 6 Figures
## Structures for Sanitary and Storm Sewers

## Division 6 - Structures for Sanitary and Storm Sewers

| Current # | Current SUDAS Name | Proposed SUDAS # | Iowa DOT # | Proposed Name |
|---|---|---|---|---|
| 6020.1 | Type "A" Manhole (Sanitary Sewer) | 6010.301 | SW-301 | Circular Sanitary Sewer Manhole |
| 6020.2 | Type "E" Manhole (Sanitary Sewer) | 6010.302 | SW-302 | Cast-in-place Flat-top Sanitary Sewer Manhole |
| 6020.3 | Type "F" Manhole (Sanitary Sewer) | 6010.303 | SW-303 | Rectangular Base/Circular Top Sanitary Sewer Manhole |
| 6020.4 | Type "I" Manhole (Sanitary Sewer) | 6010.304 | SW-304 | Sanitary Sewer Manhole Over Existing Sewer |
| 6020.5 | Type "J" Manhole (Sanitary Sewer) | 6010.305 | SW-305 | Tee-section Sanitary Sewer Manhole |
| New | Previously on Figure 6020.1 - Sheet 2 | 6010.306 | SW-306 | Chimney Seals for Sanitary Sewer Manholes |
| 6020.6A | Drop connection (Sanitary Sewer) Concrete Encased | 6010.307 | SW-307 | Drop Connection for Sanitary Sewer |
| 6020.6B | Drop connection (Sanitary Sewer) Flowable Mortar Encased | | | |
| 6020.12 | Type "M-A" Manhole (Storm Sewer) | 6010.401 | SW-401 | Circular Storm Sewer Manhole |
| 6020.13 | Type "M-B" Manhole (Storm Sewer) | 6010.402 | SW-402 | Rectangular Storm Sewer Manhole |
| 6020.14 | Type "M-C" Manhole (Storm Sewer) | 6010.403 | SW-403 | Deep-well Rectangular Storm Sewer Manhole |
| 6020.15 | Type "M-D" Manhole (Storm Sewer) | 6010.404 | SW-404 | Rectangular/Circular Storm Sewer Manhole |
| 6020.16 | Type "M-E" Manhole (Storm Sewer) | 6010.405 | SW-405 | Tee-section Storm Sewer Manhole |
| 6030.1 | Single, Type "M-A" Intake | 6010.501 | SW-501 | Single Grate Intake |
| 6030.2 | Single, Type "M-B" Intake | 6010.502 | SW-502 | Circular, Single Grate Intake |
| 6030.3 | Single, Type "M-C" Intake Combination | 6010.503 | SW-503 | Single Grate Intake with Manhole |
| 6030.4 | Special Type "M-C" Intake Combination | 6010.504 | SW-504 | Single Grate Intake with Flush-top Manhole |
| 6030.5 | Double Type "M-D" Intake | 6010.505 | SW-505 | Double Grate Intake |
| 6030.6 | Double, Type "M-E" Intake Combination | 6010.506 | SW-506 | Double Grate Intake with Manhole |
| 6030.7 | "Open Throat" Type M-F Intake | 6010.507 | SW-507 | Single Open-throat Intake, Small Box |
| 6030.7A | "Open Throat" Type M-F (Modified) Intake (Similar to Iowa DOT RA-40) | 6010.508 | SW-508 | Single Open-throat Intake, Large Box |
| 6030.10 | "Double Open Throat" Type M-I Intake | 6010.509 | SW-509 | Double Open-throat Intake, Small Box |
| 6030.10A | "Double Open Throat" Type M-I (Modified) Intake (Similar to Iowa DOT RA-43) | 6010.510 | SW-510 | Double Open-throat Intake, Large Box |
| 6030.9 | Area, Type "M-H" Intake | 6010.511 | SW-511 | Rectangular Area Intake |
| 6030.11 | Type "RCP Area" Intake | 6010.512 | SW-512 | Circular Area Intake |
| 6030.8 | Area Type "M-G" Intake (Ditch Section) | 6010.513 | SW-513 | Open-Sided Area Intake |
| 6030.16 | Grate Intake Boxout | 6010.514 | SW-514 | Grate Intake Boxouts |
| 6020.7 | Type "A" Ring and Cover (Sanitary Sewer) | 6010.601 | SW-601 | Castings for Sanitary Sewer Manholes |
| 6020.8 | Type "B" Ring and Cover (Sanitary Sewer) | | | |
| 6020.9 | Type "C" Ring and Cover (Sanitary Sewer) | | | |
| 6020.10 | Type "D" Ring and Cover (Sanitary Sewer) | | | |
| 6020.17 | Type "E" Ring and Cover (Storm Sewer Only) | 6010.602 | SW-602 | Castings for Storm Sewer Manholes |
| 6020.18 | Type "F" Ring and Cover (Storm Sewer Only) | | | |
| 6020.19 | Type "G" Ring and Cover (Storm Sewer Only) | | | |
| 6030.13 | Type "Q" Grate Detail (Storm Sewer) | 6010.603 | SW-603 | Castings for Grate-Type Intakes |
| 6030.14 | Type "R" Grate Detail (Storm Sewer) | 6010.604 | SW-604 | Castings for Area Intakes |
| 6030.15 | Type 3 and Type 4 Intake Grate | | | |
| 6020.11 | Manhole Cover Gasket (Sanitary Sewer) | Archive | None | |
| 6020.20 | Manhole Location Station | Archive | None | |
| 6020.21 | Connection to Existing Sanitary Sewer Manhole | Archive | None | |
| 6030.12 | Median Intake | Archive | RA-61 | Ditch or Median Intake |
| | | | | |




TYPICAL SECTION

TABLE 1 (9)

| Manhole diameter (in.) | Maximum pipe diameter, (D), for 2 pipes | |
|---|---|---|
| | At 180° (in.) | At 90° (in.) |
| 48 | 24 | 18 |
| 60 | 36 | 24 |
| 72 | 42 | 30 |
| 84 | 48 | 36 |
| 96 | 60 | 42 |

(1) Casting. When specified, attach casting to manhole with four, 1/2 inch diameter bolts.

(2) Precast eccentric cone (shown) or flat top.

(3) Install internal or external chimney seal (internal shown).

(4) O-ring or profile joint gasket. Apply bituminous joint compound or butyl sealant wrap to outside of each joint.

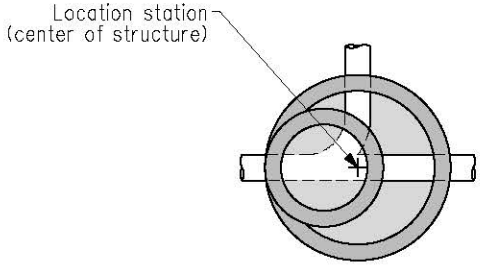
(5) Base integral with manhole structure.

(6) Install pipe flush with inside of manhole wall.

(7) Keep void between pipe and manhole section free of debris and concrete.

(8) Invert: slope toward channel 1/2 inch per foot.

(9) For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings. Provide additional reinforcement as necessary.




PLAN VIEW

SUDAS

| REVISION NO. |
|---|
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| REVISION DATE |
| 10/21/08 |
| SHEET 1 OF 1 |

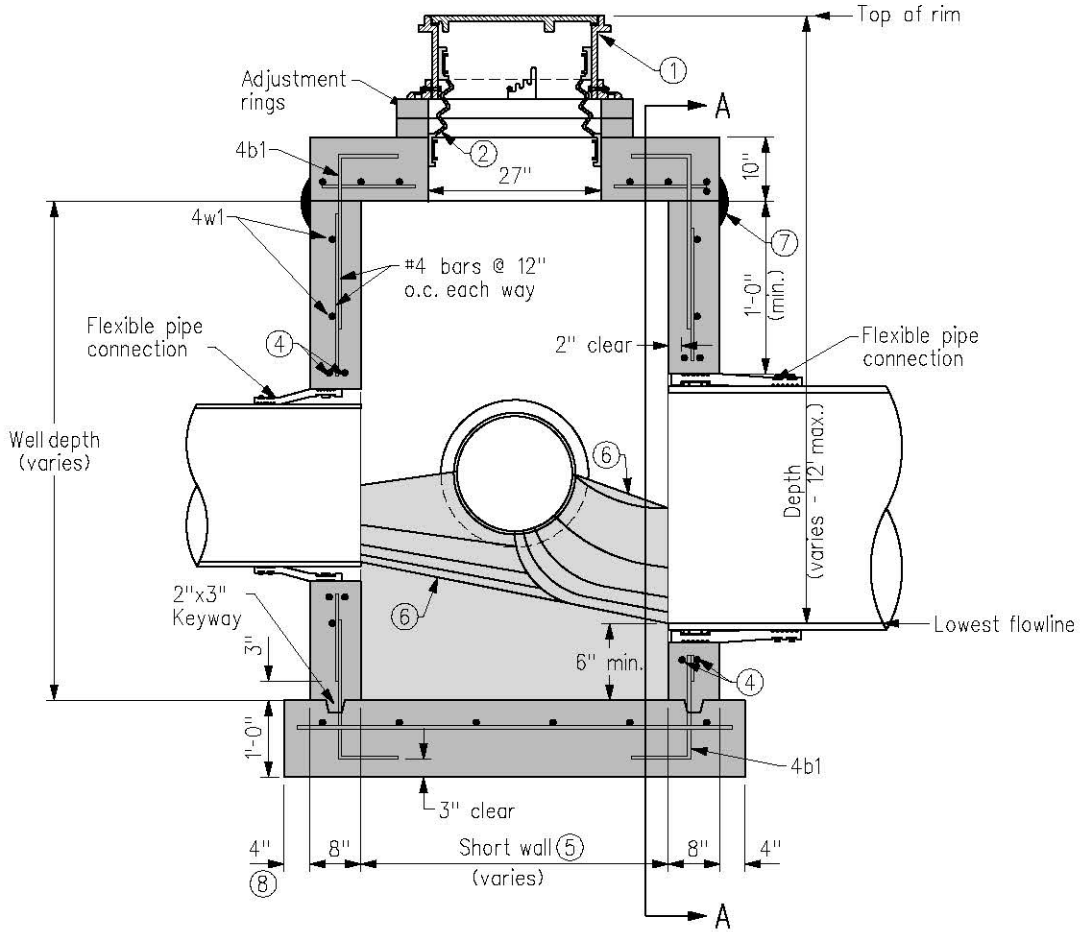
FIGURE: 6010.301

# CIRCULAR SANITARY SEWER MANHOLE

FIGURE: 6010.301 | SHEET 1 OF 1

TABLE 1

| REINFORCING BAR LIST ③ | | | | | |
|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Length | Spacing |
| 4b1 | 4 | Top/base | ⌋ | 36" bent | 12" |
| 4b2 | 4 | Base | —— | Long wall plus 1'-8" | 12" |
| 4b3 | 4 | Base | —— | Short wall plus 1'-8" | 12" |
| 4t1 | 4 | Top | —— | Long wall plus 12" | 6" |
| 4t2 | 4 | Top | —— | Short wall plus 12" | 6" |
| 4w1 | 4 | Wall | ⌐¬ | Short wall plus 3'-8" | 12" |
| 4w2 | 4 | Wall | —— | Well depth minus 6" | 12" |
| 4w3 | 4 | Wall | —— | Long wall plus 12" | 12" |




TYPICAL SECTION

① Casting. When specified, attach casting to manhole with four, ½ inch diameter bolts.

② Install internal chimney seal.

③ The number of reinforcing bars required varies with structure size. Bar counts are not shown.

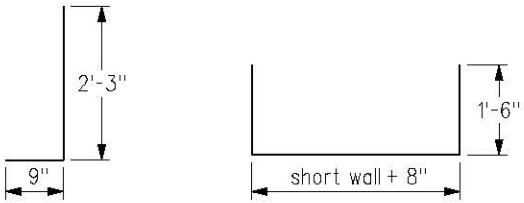
④ Two, #4 hoops, field bend (typical at each pipe opening).

⑤ Dimensions vary with opening diameter provided for pipe. Opening diameter varies based upon pipe diameter, pipe material, and pipe connector. Minimum inside dimension is 48 inches. Maximum inside dimension is 110 inches. Perpendicular walls may have different widths based upon pipe configuration.

⑥ Invert: slope towared channel ½ inch per foot.

⑦ Apply bituminous joint compound or butyl sealant wrap to the outside of each joint.

⑧ Cast-in-place base (shown). If base is cast intergral with manhole structure, the footprint of the base is not required to extend beyond the outside walls of the structure.




BENT BAR DETAILS

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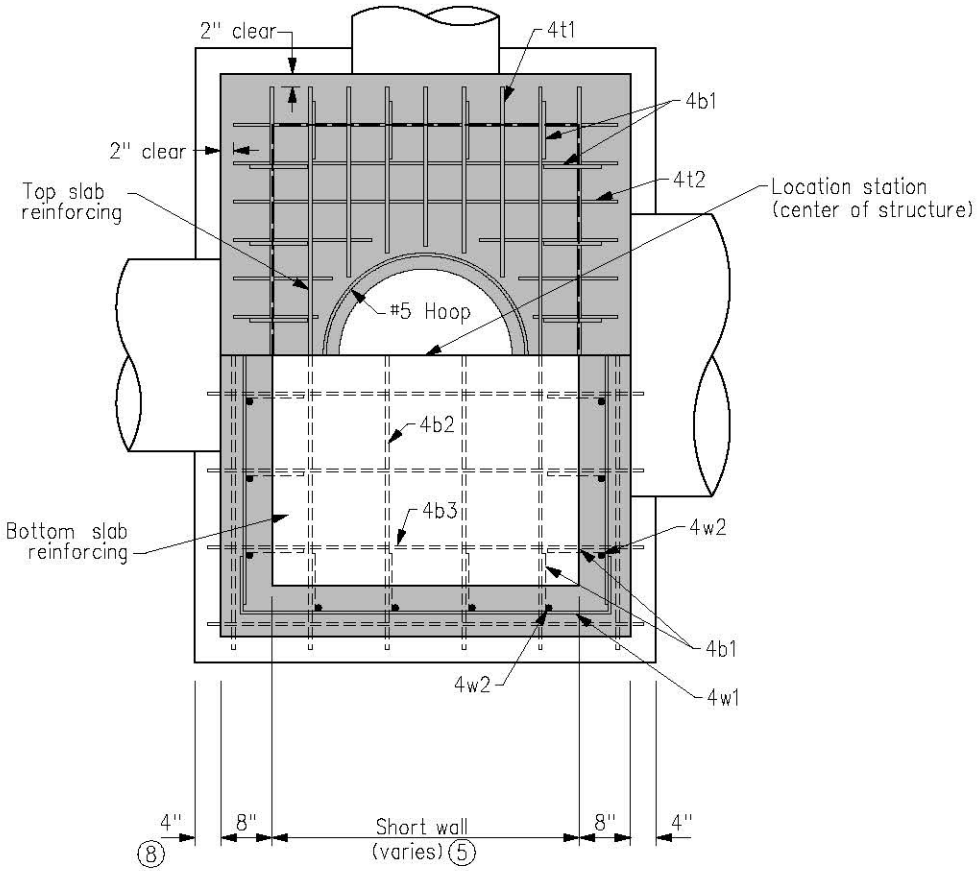
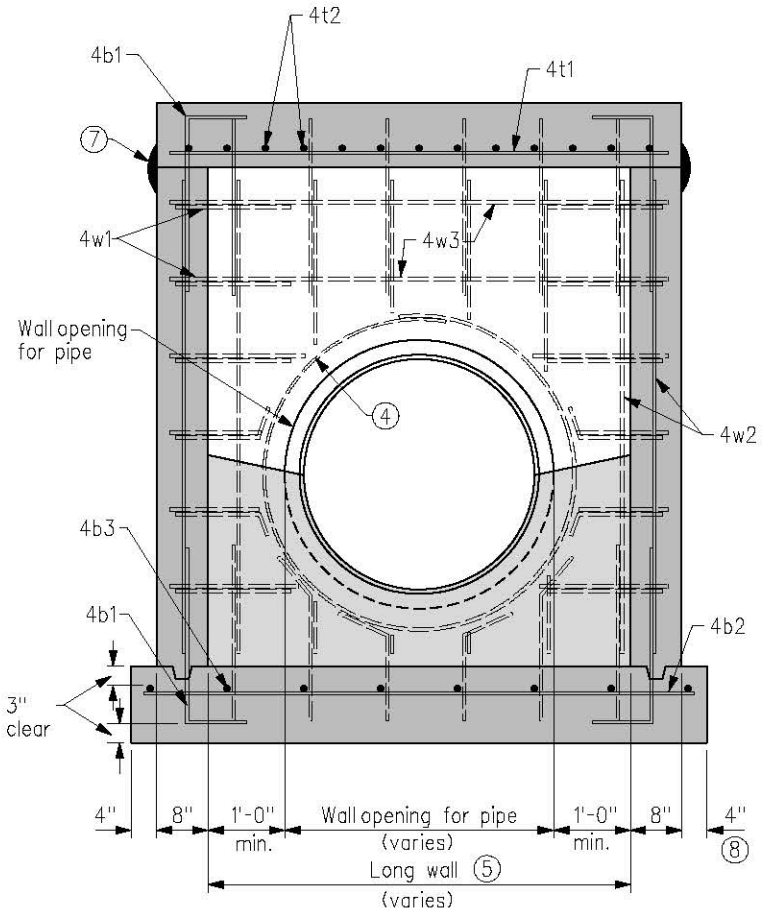
FIGURE: 6010.302

# CAST-IN-PLACE FLAT-TOP SANITARY SEWER MANHOLE

FIGURE: 6010.302 SHEET 1 OF 2




PLAN VIEW




SECTION A-A

SUDAS

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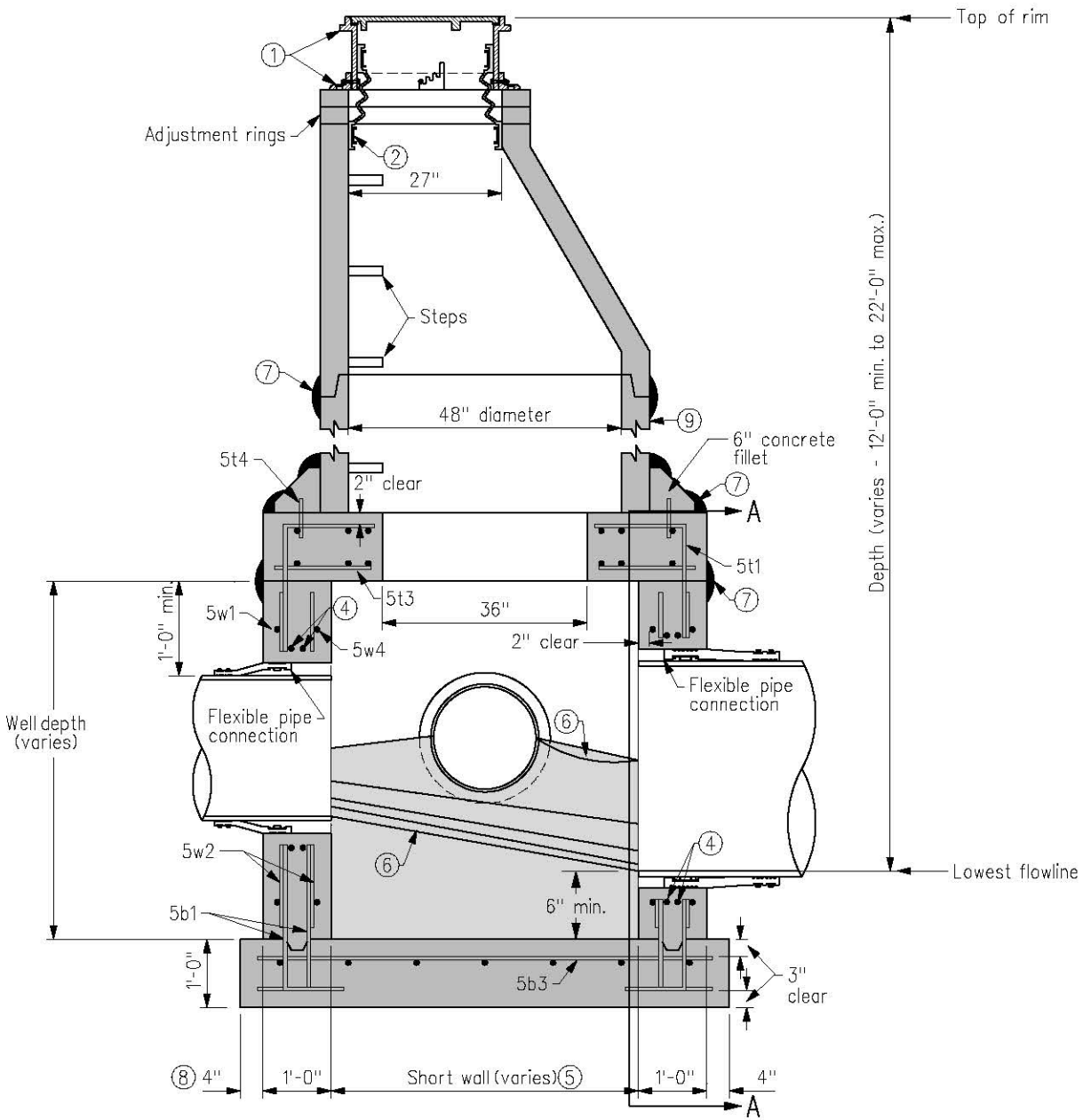
FIGURE: 6010.302

SHEET 2 OF 2

# CAST-IN-PLACE FLAT-TOP SANITARY SEWER MANHOLE




TYPICAL SECTION

1. Casting. When specified, provide four, ½ inch diameter anchor bolts to connect casting to manhole.
2. Provide internal or external chimney seal (internal shown).
3. The number of reinforcing bars required varies with structure size. Bar counts are not shown.
4. Two #5 hoops (field bend).
5. Inside dimension varies with opening diameter provided for pipe. Opening diameter varies based upon pipe material and pipe connector. Minimum inside dimension is 48 inches. Maximum inside dimension is 124 inches. Perpendicular walls may have different widths based upon pipe configuration.
6. Invert: slope toward channel ½ inch per foot.
7. Apply bituminous joint compound or butyl sealant wrap to the outside of each section joint. Provide O-ring or profile gasket between precast sections.
8. Cast-in-place base (shown). If base is cast intergral with manhole structure, the footprint of the base is not required to extend beyond outside wall of the structure.
9. Standard precast manhole sections with eccentric cone. Provide bottom section with square bearing edge.

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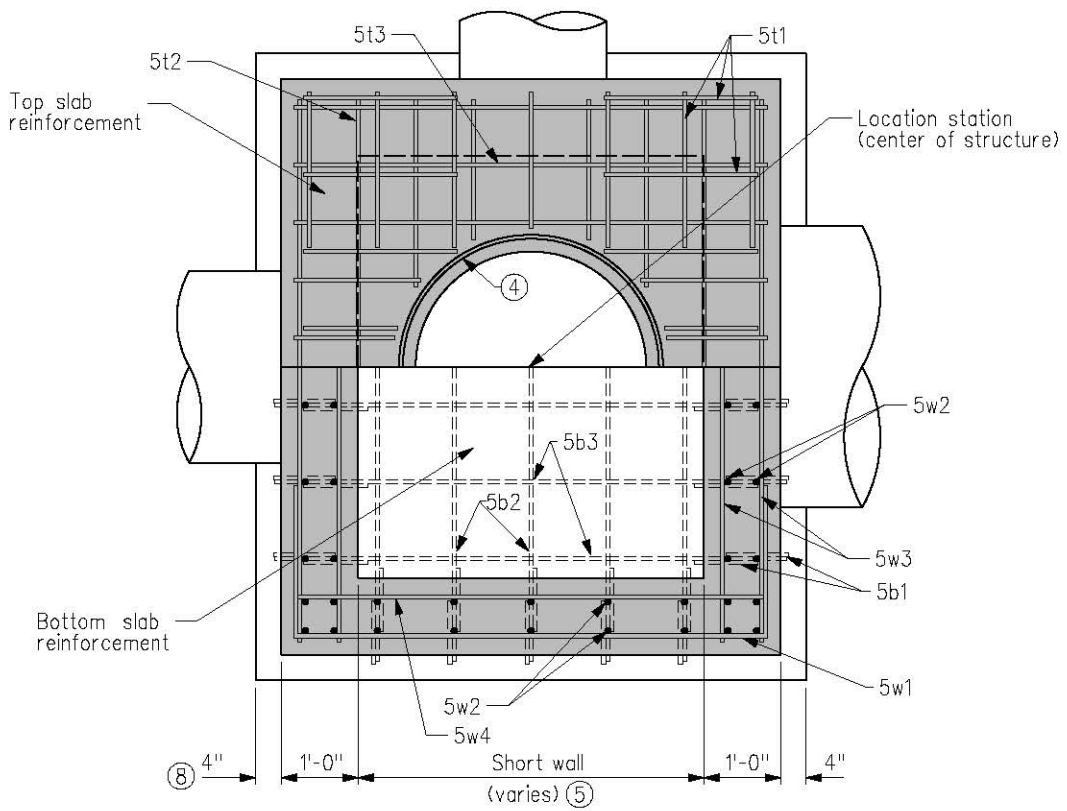
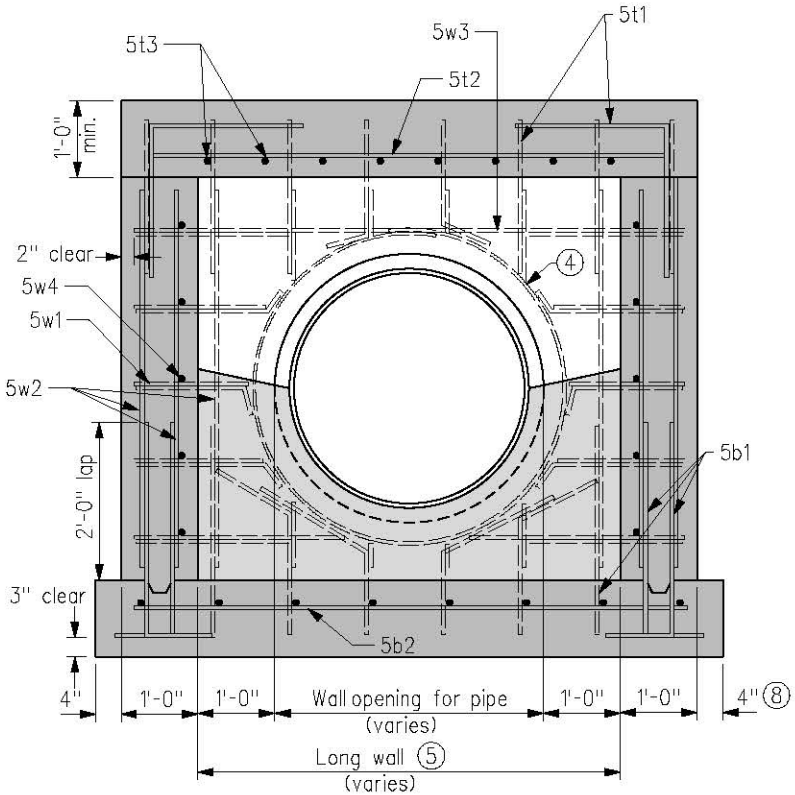
| FIGURE: 6010.303 | SHEET 1 OF 2 |

# RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE



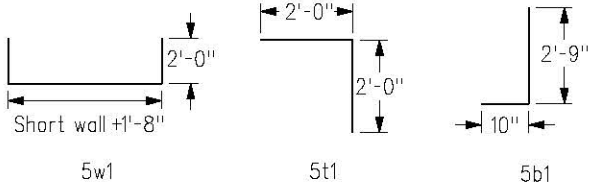

PLAN VIEW




SECTION A-A

TABLE 1

| REINFORCING BAR LIST ③ | | | | | |
|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Length | Spacing |
| 5t1 | 5 | Top | L | 4'-0" | 12" |
| 5t2 | 5 | Top | —— | Long wall plus 1'-8" | 9" |
| 5t3 | 5 | Top | —— | Short wall plus 1'-8" | 9" |
| 5t4 | 4 | Top | —— | 8" | 12" Ⓒ |
| 5b1 | 5 | Base | L | 3'-7" | 12" Ⓐ Ⓑ |
| 5b2 | 5 | Base | —— | Long wall plus 2'-4" | 12" |
| 5b3 | 5 | Base | —— | Short wall plus 2'-4" | 12" |
| 5w1 | 5 | Short wall | ⌐¬ | Short wall plus 5'-8" | 12" Ⓐ |
| 5w2 | 5 | Walls | —— | Well depth minus 4" | 12" Ⓐ |
| 5w3 | 5 | Short wall | —— | Long wall plus 1'-8" | 12" |
| 5w4 | 5 | Long wall | —— | Short wall plus 1'-7" | 12" |




BENT BAR DETAILS

Ⓐ Install two rows in each wall.
Ⓑ Bottom of L will face opposite wall.
Ⓒ Around perimeter of circular base section.

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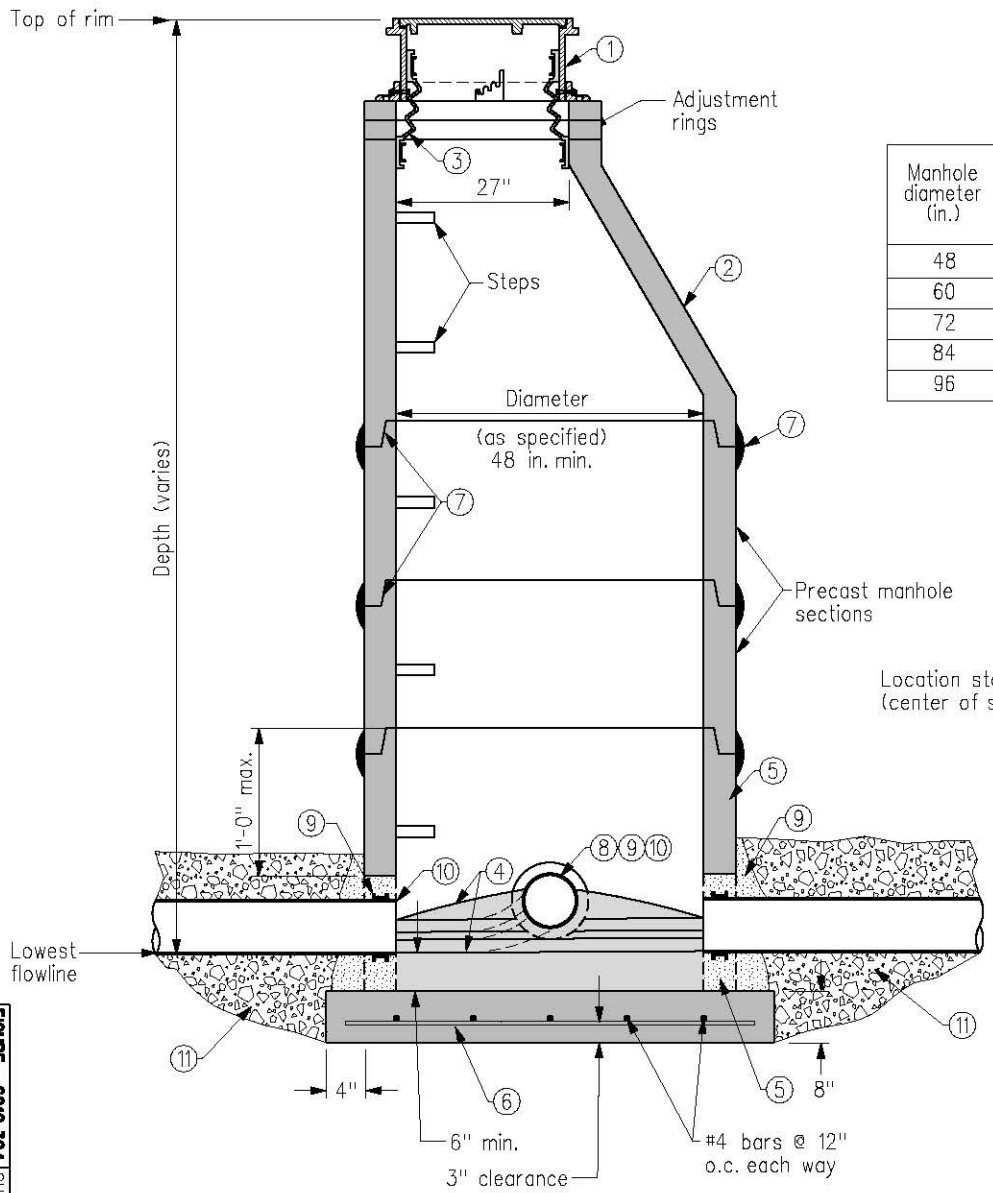
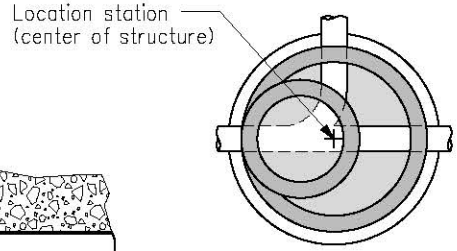
FIGURE: 6010.303

# RECTANGULAR BASE/ CIRCULAR TOP SANITARY SEWER MANHOLE

FIGURE: 6010.303 SHEET 2 OF 2




TYPICAL SECTION




PLAN VIEW

TABLE 1 (12)

| Manhole diameter (in.) | Maximum pipe diameter, (D), for 2 pipes | |
|---|---|---|
| | At 180° (in.) | At 90° (in.) |
| 48 | 24 | 18 |
| 60 | 36 | 24 |
| 72 | 42 | 30 |
| 84 | 48 | 36 |
| 96 | 60 | 42 |

(1) Casting. When specified, attach casting to manhole with four, 1/2 inch diameter bolts.

(2) Precast eccentric cone (shown) or flat top.

(3) Install internal or external chimney seal (internal shown).

(4) Invert: slope toward channel 1/2 inch per foot.

(5) Precast bottom section with square edge bearing.

(6) Cast-in-place concrete base.

(7) O-ring or profile joint gasket. Apply bituminous joint compound or butyl sealant wrap to outside of each joint.

(8) For new pipes, provide cored opening with flexible pipe connection.

(9) For existing pipes, provide arched opening with a maximum size 6 inches larger than outside diameter of pipe. Install water stop around existing pipe. Fill void between pipe and opening with non-shrink grout.

(10) Trim pipe flush with inside of manhole wall.

(11) Place Class I bedding material under and around pipe.

(12) For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings. Provide additional reinforcement as necessary.

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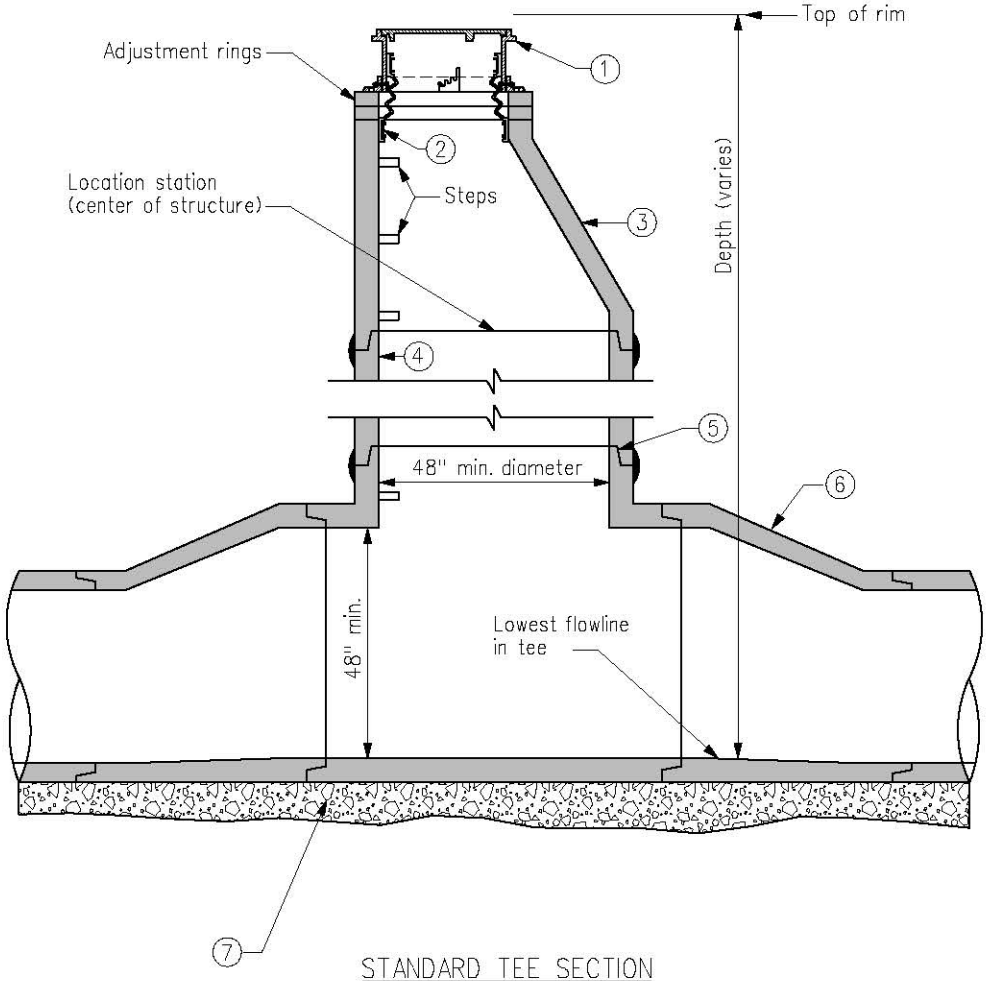
FIGURE: 6010.304

# SANITARY SEWER MANHOLE OVER EXISTING SEWER

FIGURE: 6010.304 SHEET 1 OF 1




STANDARD TEE SECTION

This detail is for use with reinforced concrete sewer pipe only. Do not use with other pipe materials.

1. Casting. When specified, attach casting to manhole with four, 1/2 inch diameter bolts.
2. Install internal or external chimney seal (internal shown).
3. Precast eccentric cone (shown) or flat top.
4. Install standard precast manhole barrel sections as required.
5. O-ring or profile joint gasket. Apply bituminous joint compound or butyl sealant wrap to the exterior of all manhole joints.
6. For sewer pipes less than 48 inch diameter, install eccentric reducers/increasers with a standard tee section or utilize a composite tee.
7. For standard tee section, provide Class I bedding material as required for concrete pipe. For composite tee, provide a minimum of 8 inches of Class I bedding over undisturbed soil.

FIGURE: 6010.305 SHEET 1 OF 2

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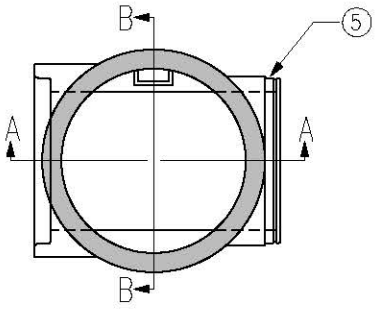
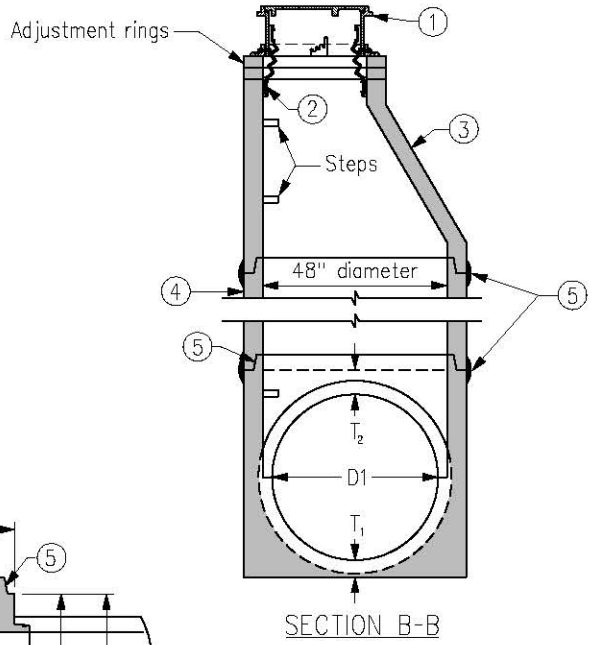
FIGURE: 6010.305

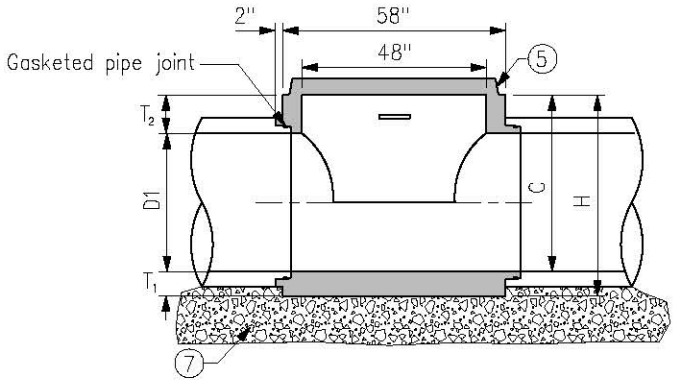
# TEE-SECTION SANITARY SEWER MANHOLE




PLAN VIEW




SECTION B-B




SECTION A-A

TABLE 1

| COMPOSITE TEE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Size | D1 | H | $T_1$ | $T_2$ | C | Weight |
| 48" on 12" | 12" | 50" | 8 ½" | 29 ½" | 41 ½" | 5600 lbs. |
| 48" on 15" | 15" | 50" | 7" | 28" | 43" | 5400 lbs. |
| 48" on 18" | 18" | 50" | 5 ½" | 26 ½" | 44 ½" | 5200 lbs. |
| 48" on 21" | 21" | 48" | 9 ½" | 17 ½" | 38 ½" | 5800 lbs. |
| 48" on 24" | 24" | 48" | 8" | 16" | 40" | 5600 lbs. |
| 48" on 27" | 27" | 48" | 9 ½" | 11 ½" | 38 ½" | 5900 lbs. |
| 48" on 30" | 30" | 48" | 8" | 10" | 40" | 5300 lbs. |
| 48" on 33" | 33" | 54" | 9 ½" | 11 ½" | 44 ½" | 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).

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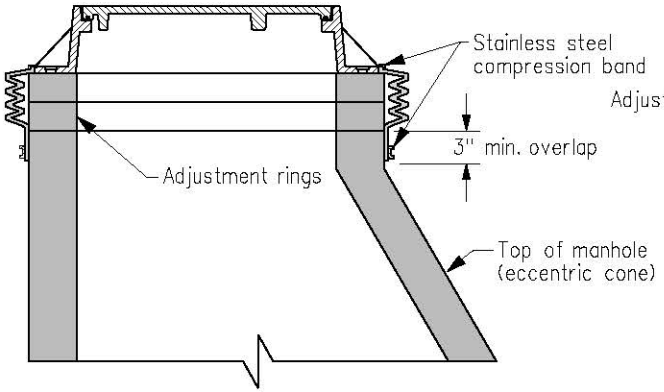
FIGURE: 6010.305

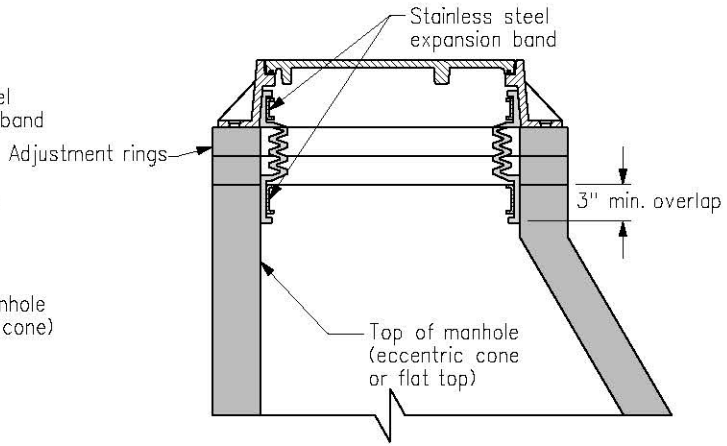
SHEET 2 OF 2

# TEE-SECTION SANITARY SEWER MANHOLE

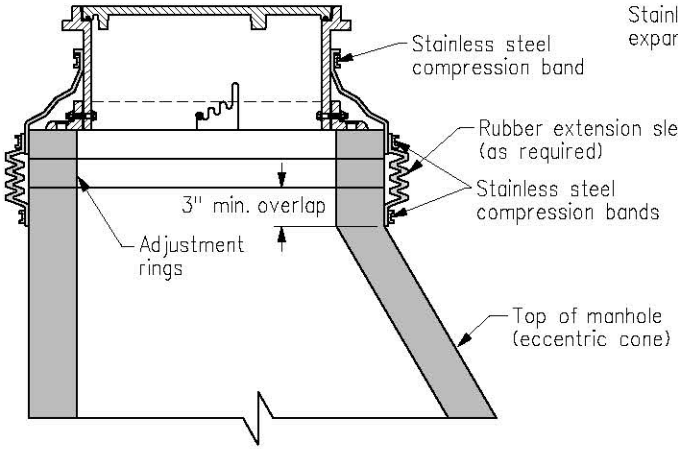
Attach chimney seal to the top of the manhole (riser or flat top). Extend chimney seal over adjustment rings and attach to manhole frame at a point above any joints or openings in the casting. Provide additional seals or rubber extensions as required to extend from top of manhole to frame.



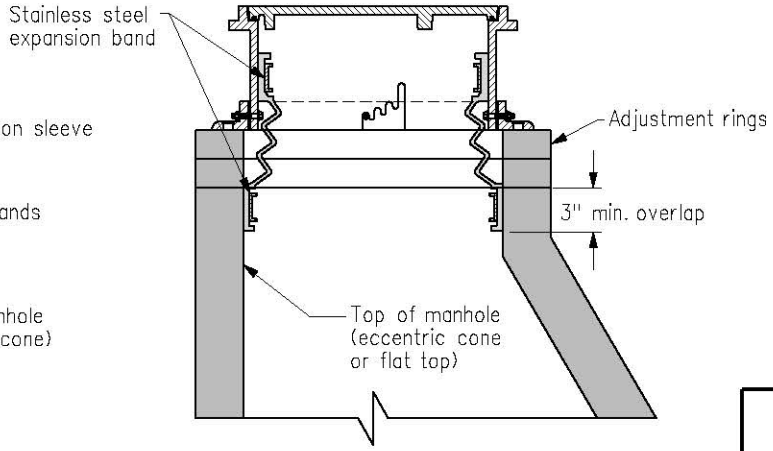

2-PIECE CASTING, EXTERNAL SEAL




2-PIECE CASTING, INTERNAL SEAL




3-PIECE CASTING, EXTERNAL SEAL




3-PIECE CASTING, INTERNAL SEAL

FIGURE: 6010.306 SHEET 1 OF 1

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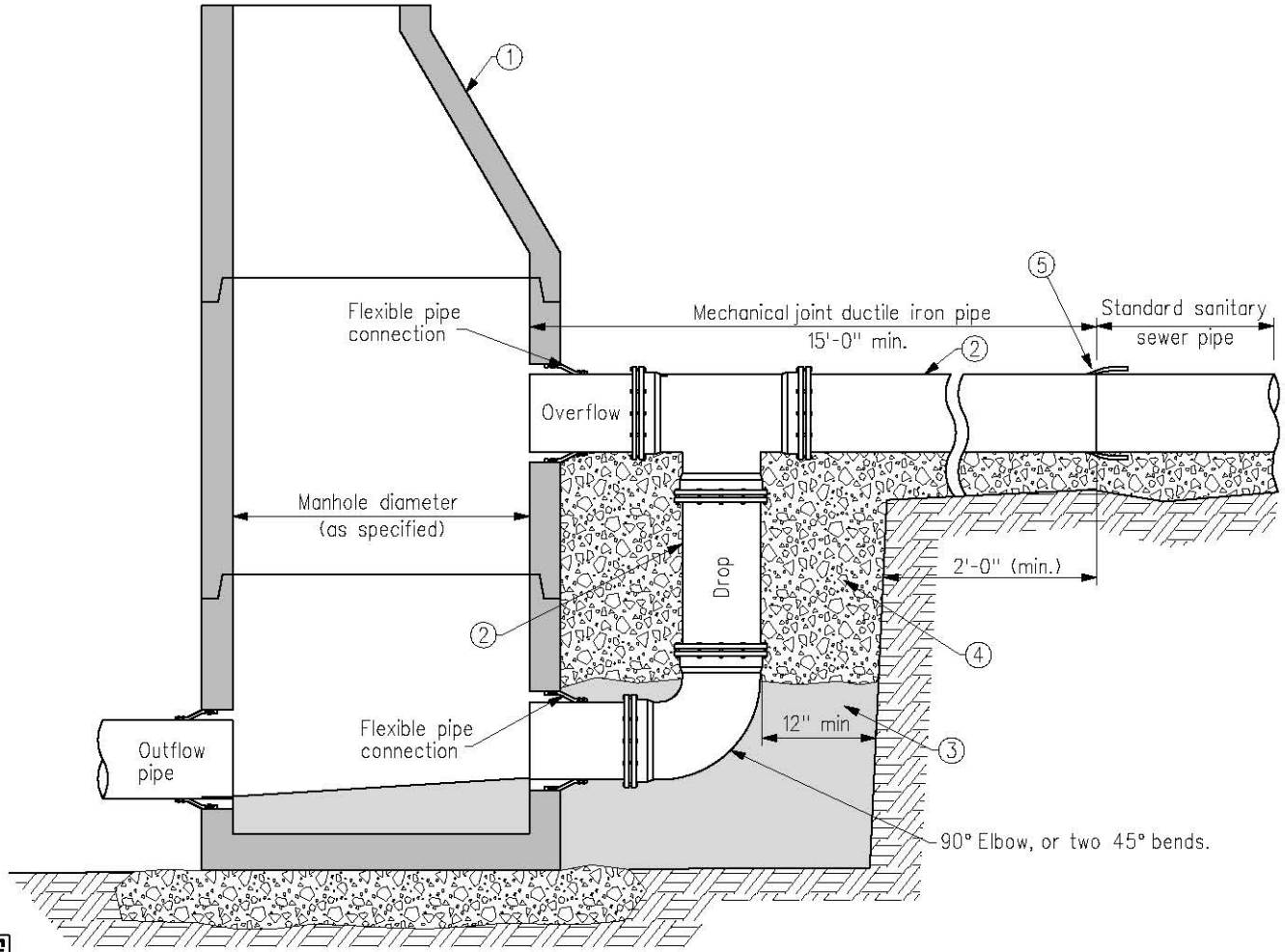
FIGURE: 6010.306

# CHIMNEY SEALS FOR SANITARY SEWER MANHOLES




1. Manhole type as specified (standard manhole shown). This detail may be used with other manhole types as specified in the contract documents.
2. Construct drop and overflow from ductile iron pipe, with the same diameter specified for the sewer main. Provide mechanical joints (MJ) for all ductile iron pipe and fittings.
3. Encase elbow in concrete.
4. Place Class I bedding material, CLSM, flowable mortar, or concrete from top of elbow to bottom of sewer.
5. Sleeve or transition coupling may be required.

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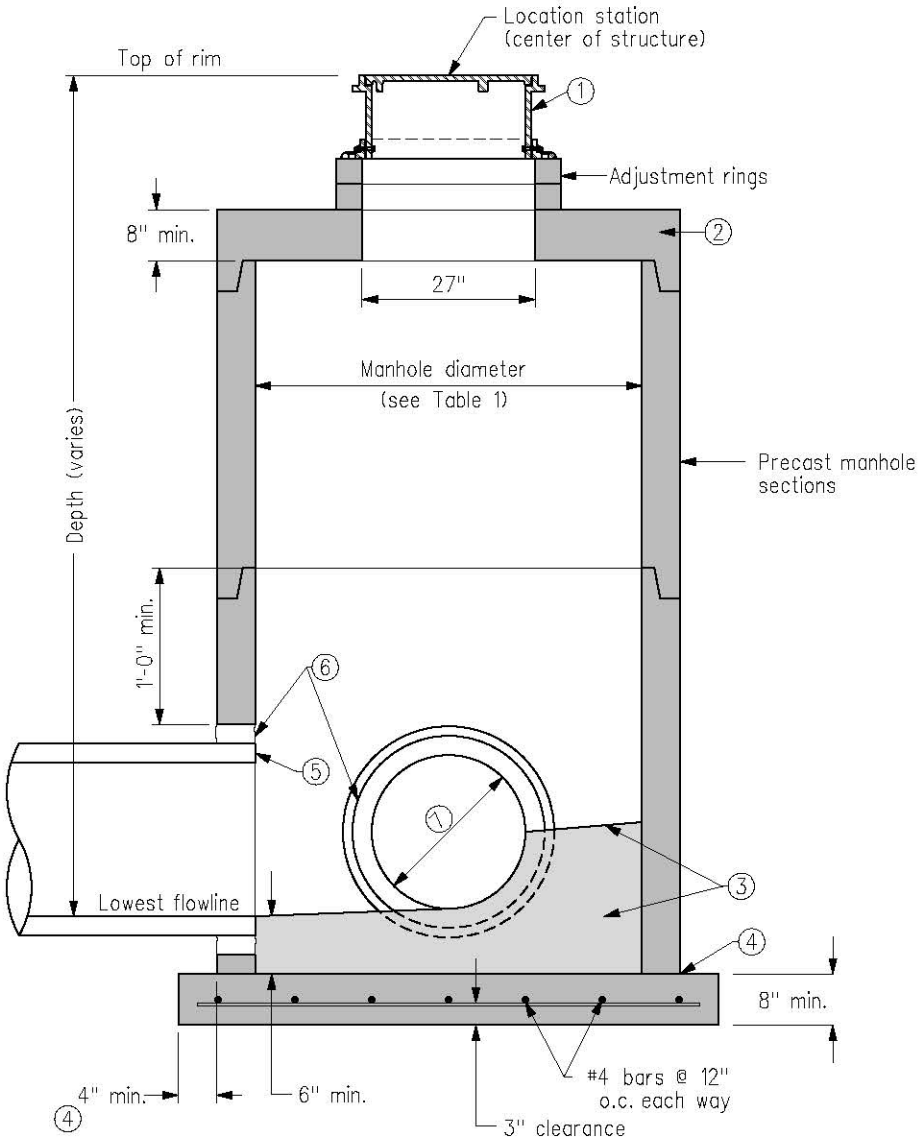
| FIGURE: 6010.307 | SHEET 1 OF 1 |

# DROP CONNECTION FOR SANITARY SEWER

FIGURE: 6010.307 SHEET 1 OF 1




TYPICAL SECTION

1. Casting. When specified, attach casting to manhole with four, ½ inch diameter bolts.
2. Precast flat top (shown) or eccentric cone.
3. Invert: slope toward channel minimum ½ inch per foot.
4. Cast-in-place base (shown). If base is cast integral with manhole structure, the footprint of the base is not required to extend beyond the outside walls of the structure.
5. Install pipe flush with inside of manhole wall.
6. Fill annular space between pipe and manhole opening with non-shrink grout.
7. Maximum pipe size. See Table 1.
8. For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings.

TABLE 1 (8)

| Manhole diameter (in.) | Maximum pipe diameter, (D), for 2 pipes | |
|---|---|---|
| | At 180° (in.) | At 90° (in.) |
| 48 | 24 | 18 |
| 60 | 36 | 24 |
| 72 | 42 | 30 |
| 84 | 48 | 36 |
| 96 | 60 | 42 |

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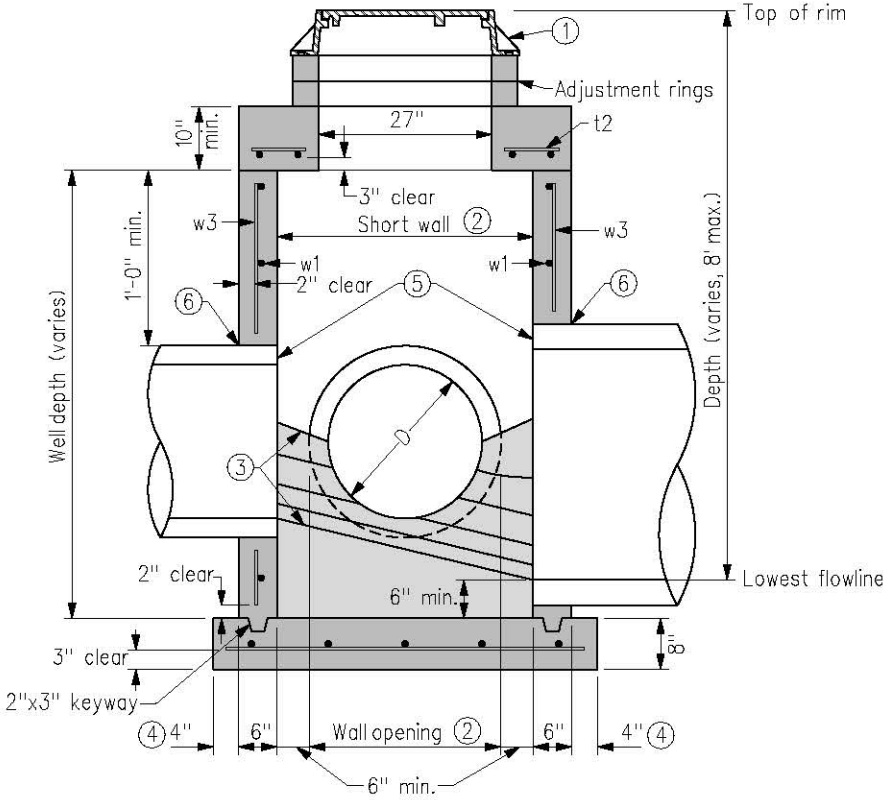
FIGURE: 6010.401

SHEET 1 OF 1

# CIRCULAR STORM SEWER MANHOLE

FIGURE: 6010.401 SHEET 1 OF 1




TYPICAL SECTION

1. Casting. When specified, attach casting to manhole with four, ½ inch diameter bolts.
2. Dimension varies with pipe diameter (40 inch minimum). For parallel walls with different pipe sizes, inside dimension for both walls is based upon largest pipe. Perpendicular walls may have different dimensions (structure must be rectangular).
3. Invert: slope toward channel ½ inch per foot.
4. Cast-in-place base (shown). If base is cast integral with manhole structure, the footprint of the base is not required to extend beyond the outside walls of the structure.
5. Install pipe flush with inside of manhole wall.
6. Form and cast walls around pipes. Fill annular space between pipe and precast manhole opening with non-shrink grout.
7. The number of reinforcing bars required varies with structure size. Bar counts are not shown.

| | |
|---|---|
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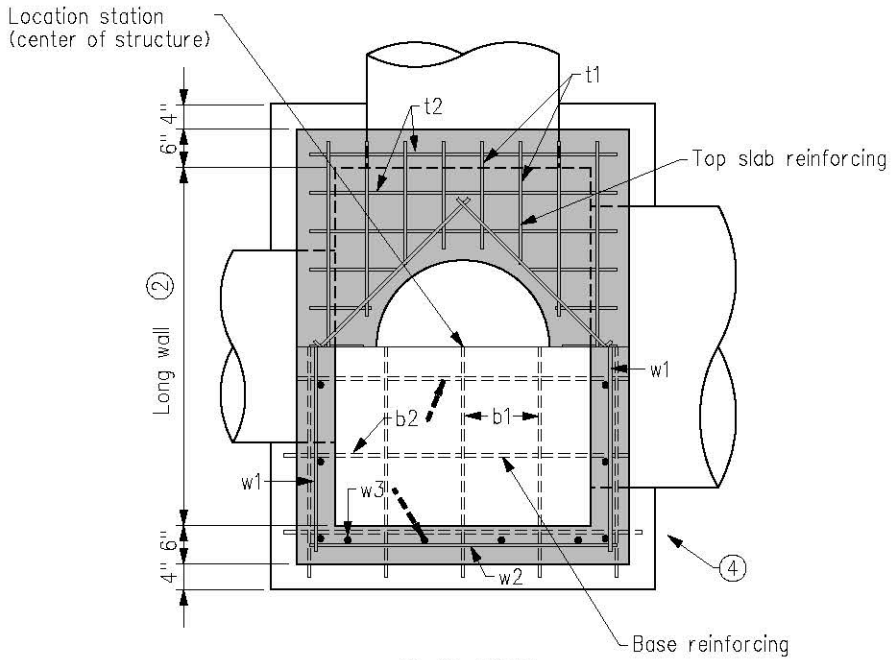
| FIGURE: 6010.402 | SHEET 1 OF 2 |

# RECTANGULAR STORM SEWER MANHOLE




PLAN VIEW

TABLE 1

| Maximum pipe dia. D | Minimum bar size |
|---|---|
| 54" | 6 |
| 48" | 6 |
| 42" | 5 |
| 36" | 5 |
| 30" | 4 |
| 24" or less | 4 |
| None | 4 |

TABLE 2

| REINFORCING BAR LIST ⑦ | | | | | |
|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Length | Spacing |
| t1 | See Table 1 | Top | —— | Long wall + 8" | 6" |
| t2 | See Table 1 | Top | —— | Short wall + 8" | 6" |
| b1 | See Table 1 | Base | —— | Long wall + 1'-4" | 12" |
| b2 | See Table 1 | Base | —— | Short wall + 1'-4" | 12" |
| w1 | See Table 1 | Walls | —— | Long wall + 8" | 12" |
| w2 | See Table 1 | Walls | —— | Short wall + 8" | 12" |
| w3 | See Table 1 | Walls | —— | Well depth - 4" | 12" |

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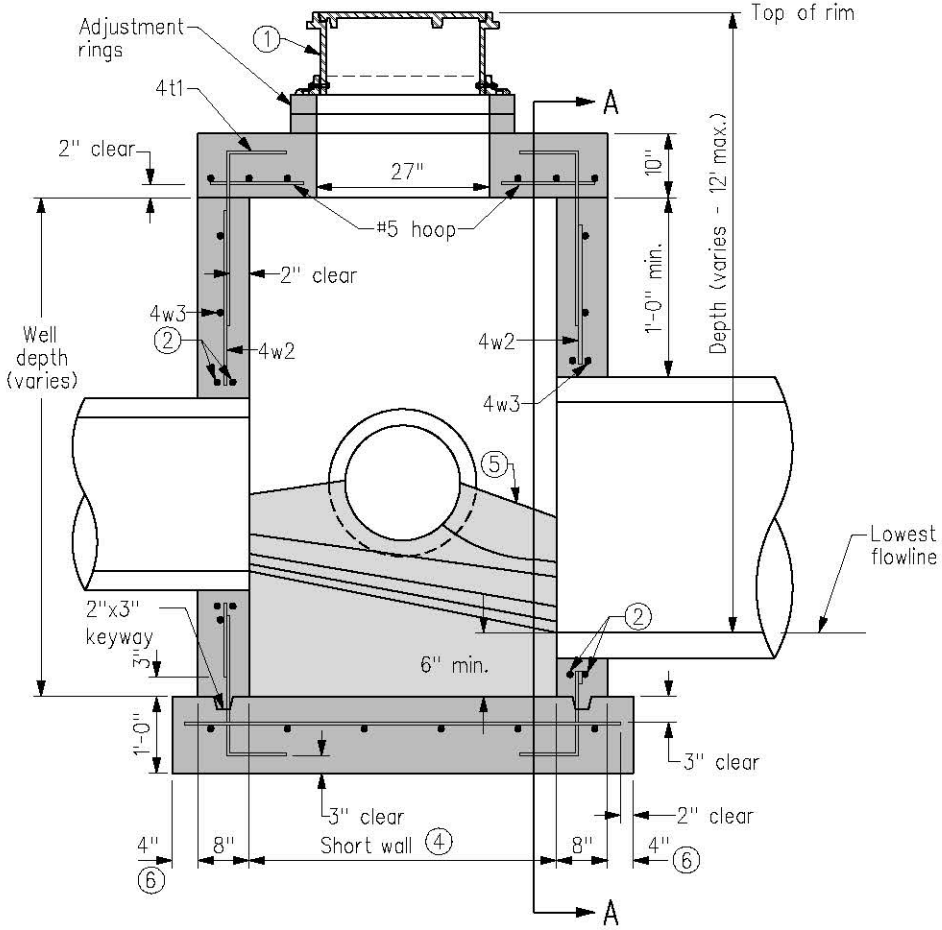
FIGURE: 6010.402

SHEET 2 OF 2

# RECTANGULAR STORM SEWER MANHOLE

FIGURE: 6010.402 SHEET 2 OF 2




TYPICAL SECTION

① Casting. When specified, attach casting to manhole with four, ½ inch diameter bolts.

② Two, #4 hoops, field bend (typical at each pipe opening).

③ The number of reinforcing bars required varies with structure size. Bar counts are not shown.

④ Dimension varies with pipe diameter. For parallel walls with different pipe sizes, inside dimension for both walls is based upon largest pipe. Minimum inside wall dimension is 48 inches. Maximum inside wall dimension is 110 inches. Perpendicular walls may have different dimensions (structure must be rectangular).

⑤ Invert: slope toward channel minimum ½ inch per foot.

⑥ Cast-in-place base (shown). If base is cast integral with manhole structure, the footprint of the base is not required to extend beyond the outside walls of the structure.

TABLE 1

| REINFORCING BAR LIST ③ | | | | | |
|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Length | Spacing |
| 4t1 | 4 | Top | ⌜ | 3'-0" | 12" |
| 4t2 | 4 | Top | — | Long wall plus 12" | 6" |
| 4t3 | 4 | Top | — | Long wall plus 12" | 6" |
| 4b1 | 4 | Base | ⌞ | 3'-0" | 12" |
| 4b2 | 4 | Base | — | Long wall plus 1'-8" | 12" |
| 4b3 | 4 | Base | — | Short wall plus 1'-8" | 12" |
| 4w1 | 4 | Walls | ⌜⌝ | Short wall plus 2'-4" | 12" |
| 4w2 | 4 | Walls | — | Well depth minus 4" | 12" |
| 4w3 | 4 | Walls | — | Long wall plus 12" | 12" |

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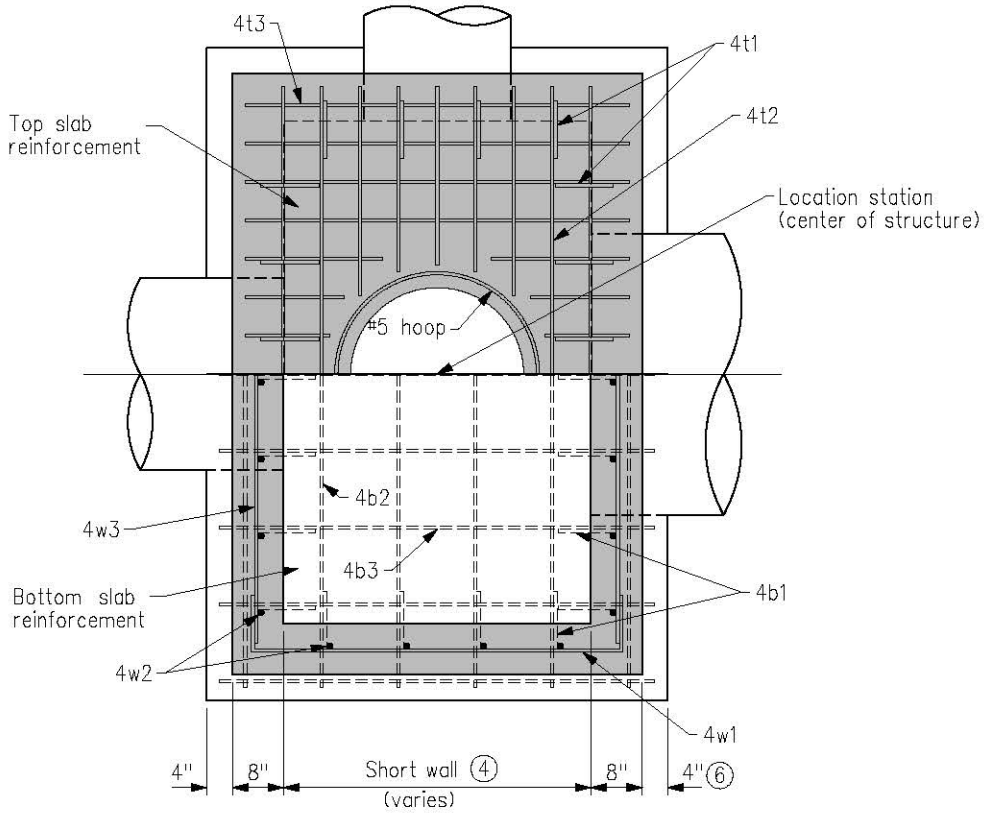
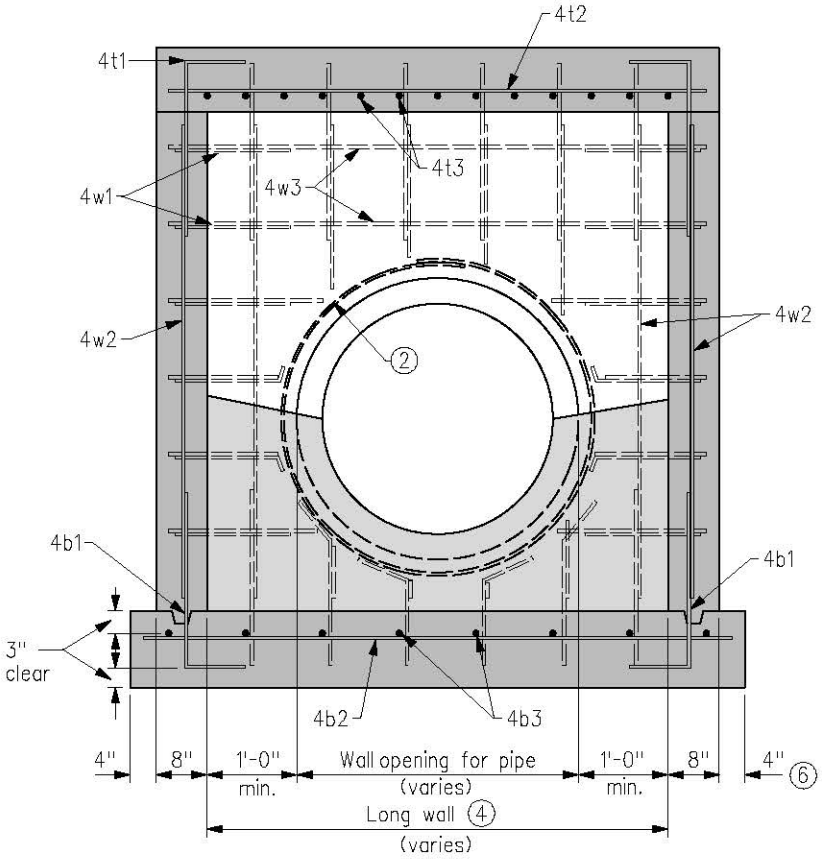
FIGURE: 6010.403

SHEET 1 OF 2

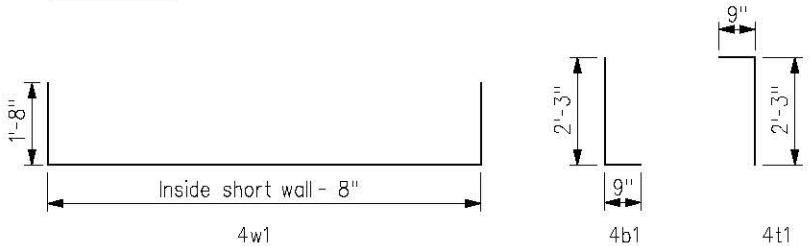
# DEEP-WELL RECTANGULAR STORM SEWER MANHOLE




PLAN VIEW




SECTION A-A




BENT BAR DETAILS

FIGURE: 6010.403 SHEET 2 OF 2

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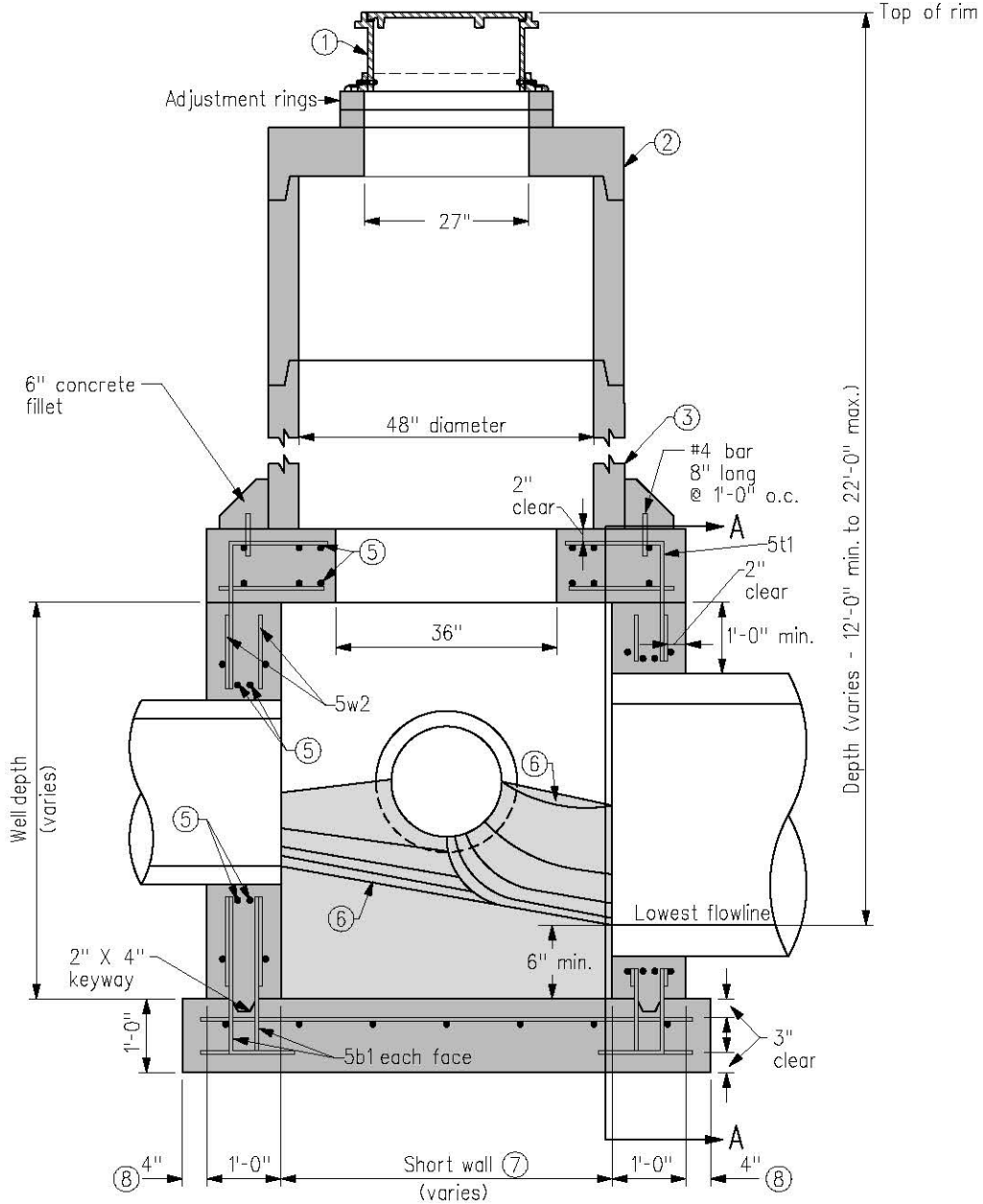
FIGURE: 6010.403

# DEEP-WELL RECTANGULAR STORM SEWER MANHOLE




TYPICAL SECTION

1. Casting. When specified, attach casting to manhole with four, ½ inch diameter bolts.
2. Precast flat top (shown) or eccentric cone.
3. Standard 48 inch diameter precast manhole sections. Provide bottom section with square bearing edge.
4. The number of reinforcing bars required varies with structure size. Bar counts are not shown.
5. Two #5 hoops (field bend).
6. Invert: slope toward channel ½ inch per foot.
7. Dimension varies with pipe diameter. Minimum inside wall dimension is 48 inches. Maximum inside wall dimension is 124 inches. Perpendicular walls may have different widths based upon pipe configuration (structure must be rectangular).
8. Cast-in-place base (shown) If base is cast integral with manhole structure, the footprint of the base is not required to extend beyond the outside walls of the structure.

SUDAS

| | |
|---|---|
| FIGURE: 6010.404 | SHEET 1 OF 2 |
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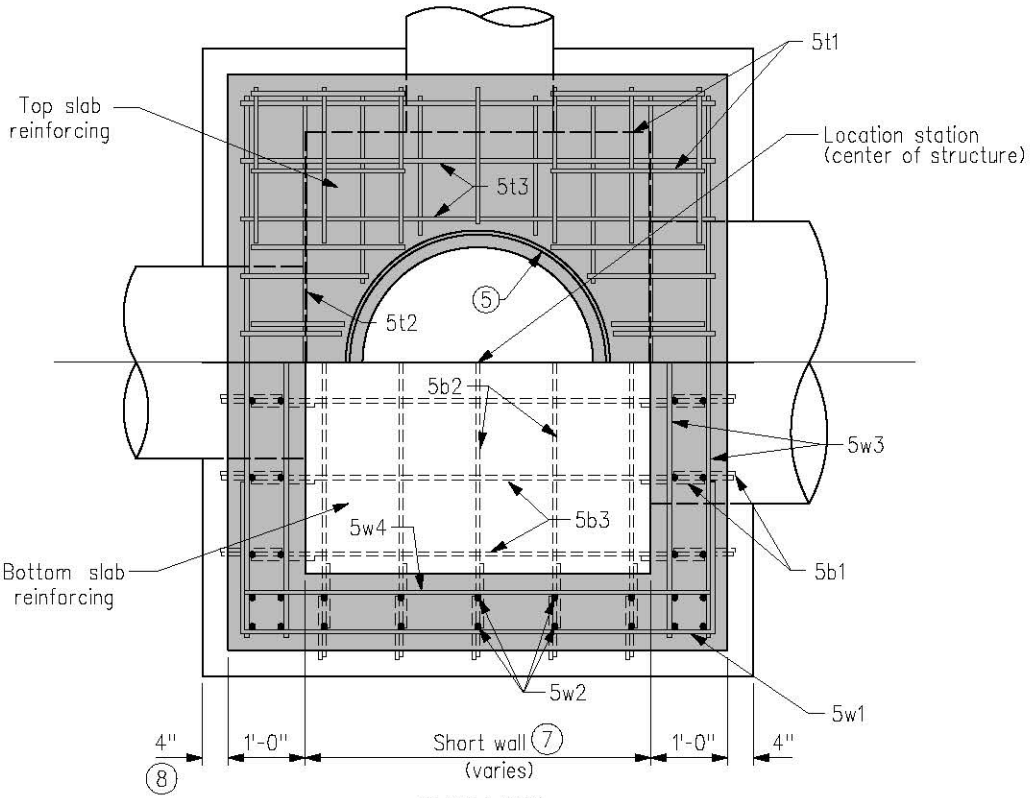
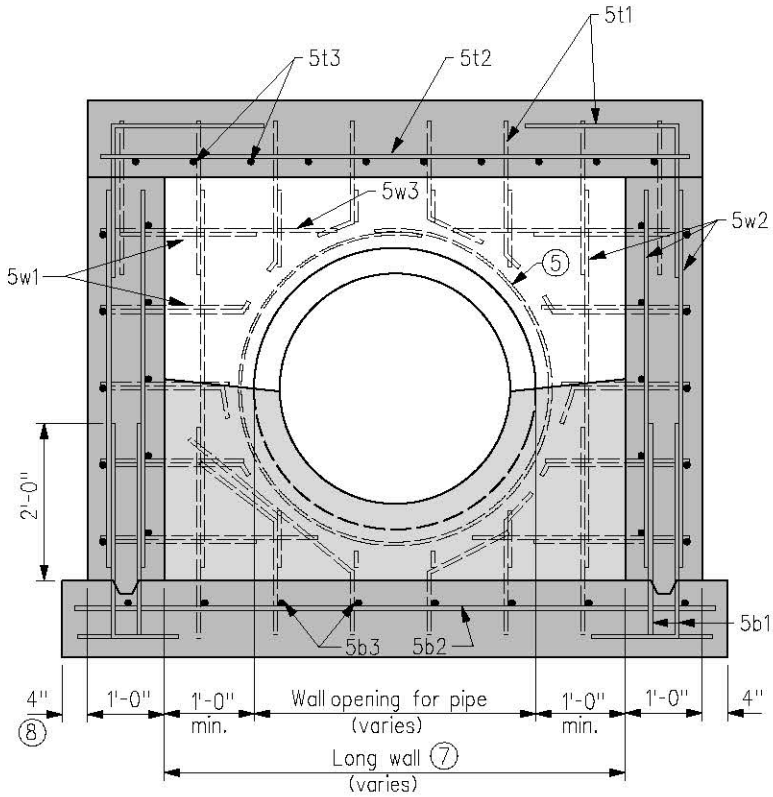
# RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE



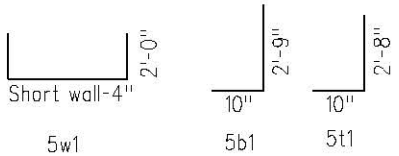

PLAN VIEW




SECTION A-A

TABLE 1

| REINFORCING BAR LIST (4) | | | | | |
|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Length | Spacing |
| 5t1 | 5 | Top | ⌊ | 4'-0" | 12" |
| 5t2 | 5 | Top | —— | Long wall plus 1'-8" | 9" |
| 5t3 | 5 | Top | —— | Short wall plus 1'-8" | 9" |
| 5b1 | 5 | Base | ⌊ | 3'-7" | 12" |
| 5b2 | 5 | Base | —— | Long wall plus 2'-4" | 12" |
| 5b3 | 5 | Base | —— | Short wall plus 2'-4" | 12" |
| 5w1 | 5 | Wall | ⌐ | Short wall plus 3'-4" | 12" |
| 5w2 | 5 | Wall | —— | Well depth minus 4" | 12" |
| 5w3 | 5 | Wall | —— | Long wall plus 1'-8" | 12" |
| 5w4 | 5 | Wall | —— | Short wall plus 1'-8" | 12" |




BENT BAR DETAILS

SUDAS

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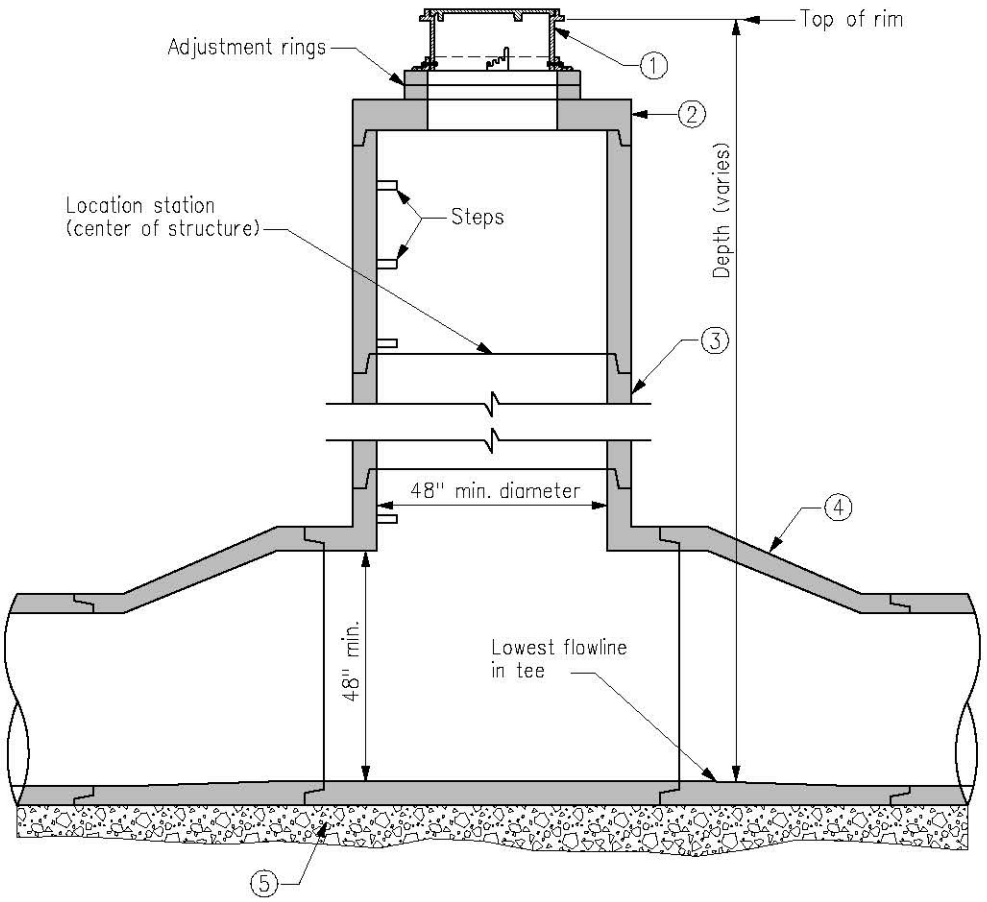
FIGURE: 6010.404

SHEET 2 OF 2

# RECTANGULAR BASE/ CIRCULAR TOP STORM SEWER MANHOLE

This detail is for use with reinforced concrete sewer pipe only. Do not use with other pipe materials.

1. Casting. When specified, attach casting to manhole with four, ½ inch diameter bolts.
2. Precast flat top (shown) or eccentric cone.
3. Install standard precast manhole barrel sections as required.
4. For sewer pipes less than 48 inch diameter, install eccentric reducers/increasers with a standard tee section or utilize a composite tee.
5. For standard tee section, provide Class I bedding material as required for concrete pipe. For composite tee, provide a minimum of 8 inches of Class I material over undisturbed soil.




STANDARD TEE SECTION

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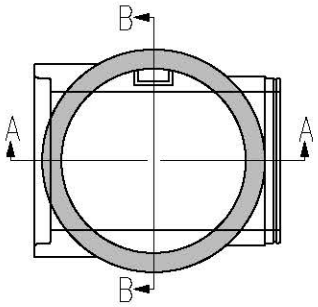
FIGURE: 6010.405

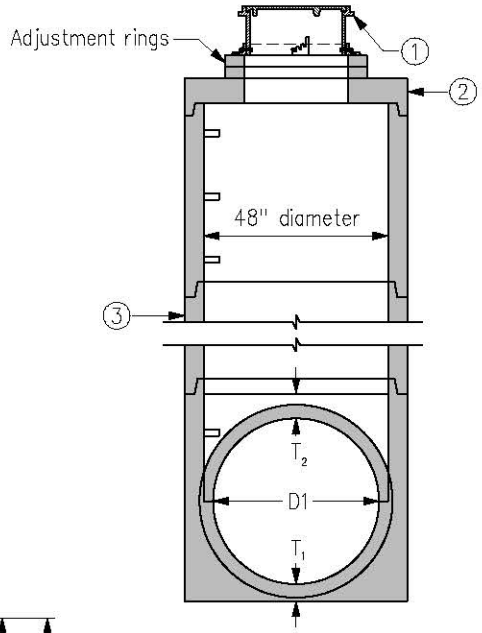
SHEET 1 OF 2

# TEE-SECTION
# STORM SEWER MANHOLE

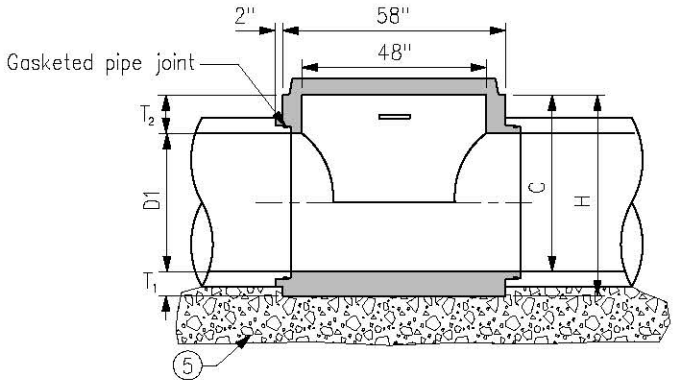
FIGURE: 6010.405 SHEET 1 OF 2




PLAN VIEW




SECTION B-B




SECTION A-A

TABLE 1

| COMPOSITE TEE DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Size | D1 | H | $T_1$ | $T_2$ | C | Weight |
| 48" on 12" | 12" | 50" | 8 ½" | 29 ½" | 41 ½" | 5600 lbs. |
| 48" on 15" | 15" | 50" | 7" | 28" | 43" | 5400 lbs. |
| 48" on 18" | 18" | 50" | 5 ½" | 26 ½" | 44 ½" | 5200 lbs. |
| 48" on 21" | 21" | 48" | 9 ½" | 17 ½" | 38 ½" | 5800 lbs. |
| 48" on 24" | 24" | 48" | 8" | 16" | 40" | 5600 lbs. |
| 48" on 27" | 27" | 48" | 9 ½" | 11 ½" | 38 ½" | 5900 lbs. |
| 48" on 30" | 30" | 48" | 8" | 10" | 40" | 5300 lbs. |
| 48" on 33" | 33" | 54" | 9 ½" | 11 ½" | 44 ½" | 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).

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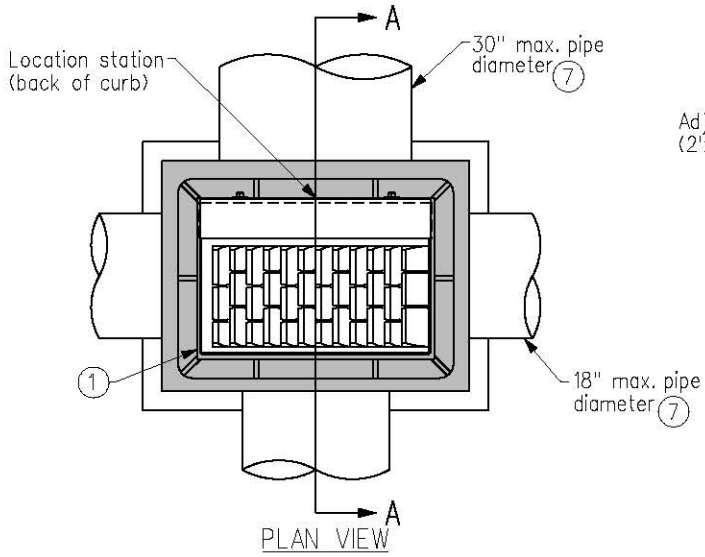
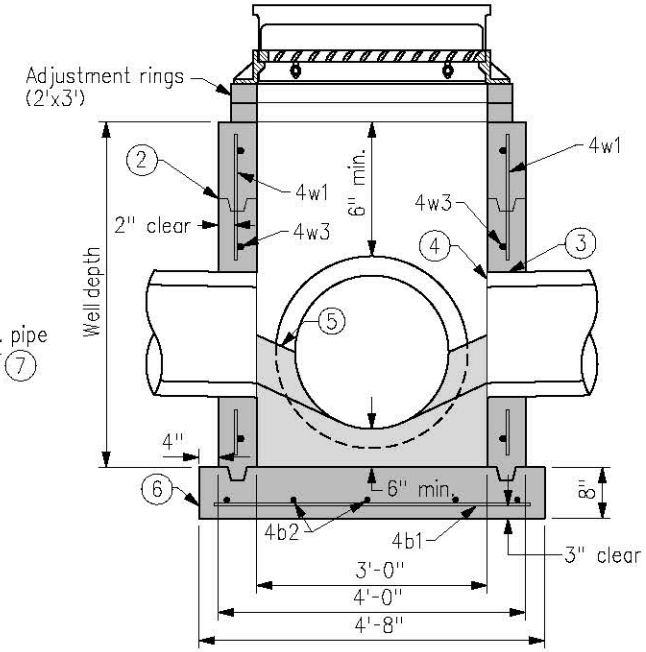
FIGURE: 6010.405

SHEET 2 OF 2

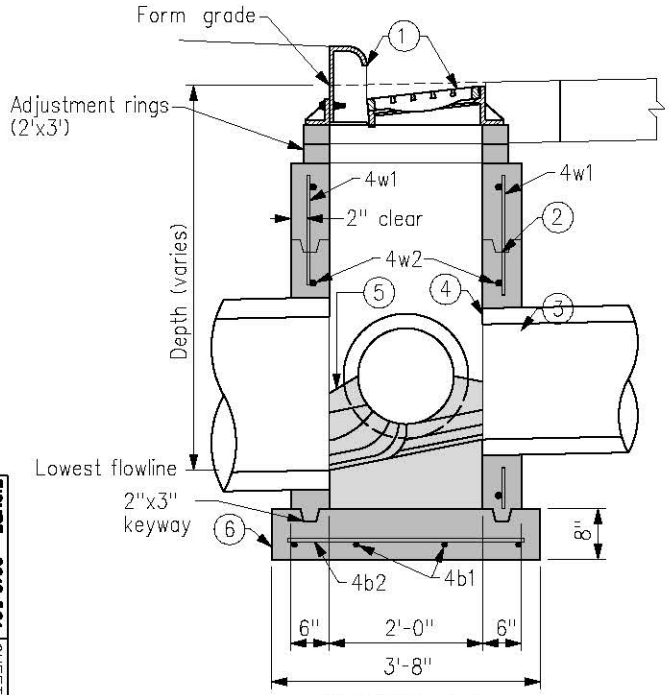
# TEE-SECTION STORM SEWER MANHOLE



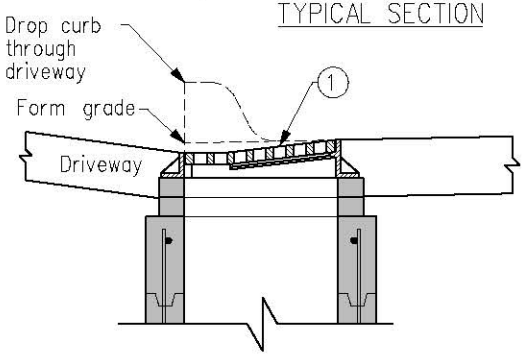

PLAN VIEW




TYPICAL SECTION




SECTION A-A
Shown with Type R casting




PARTIAL SECTION A-A
Shown with Type Q casting

1. Casting: Type R unless Type Q is specified in the contract documents.
2. Optional construction joint: secure with 1 inch x 2 inch keyway (shown) or #4 x 12 inch bars at 12 inch spacing all around structure.
3. Install #4 diagonal bars at all openings.
4. End of pipe flush with inside wall of structure. Form wall around pipe. If precast structure is provided, construct concrete collar at pipe opening.
5. Invert: slope toward channel $\frac{1}{2}$ inch per foot.
6. Cast-in-place base (shown). If base is cast integral with intake structure, the footprint of the base is not required to extend beyond the outside walls of the structure.
7. Maximum allowable pipe diameter: diameters shown are for cast-in-place structures. For precast structures, the maximum allowable pipe diameter is one standard pipe size smaller than those indicated unless the Engineer approves modifications to precast structure to accommodate larger pipe. Provide pipe size as specified in the contract documents.

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Length | Count | Spacing |
| 4w1 | 4 | Walls | ——— | Well depth minus 4" | 10 | 15" |
| 4w2 | 4 | Walls | ——— | 3'-8" | (A) | 15" |
| 4w3 | 4 | Walls | ——— | 2'-8" | (A) | 15" |
| 4b1 | 4 | Base | ——— | 4'-4" | 5 | 12" |
| 4b2 | 4 | Base | ——— | 3'-4" | 6 | 12" |

(A) The number of reinforcing bars required varies with structure depth.

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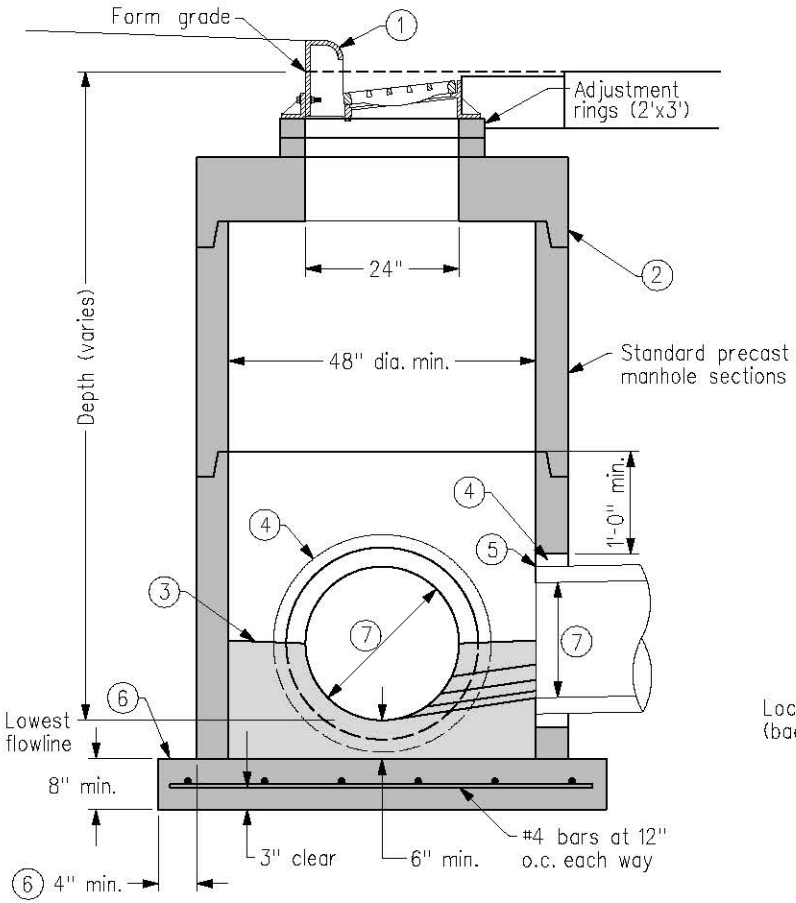
FIGURE: 6010.501

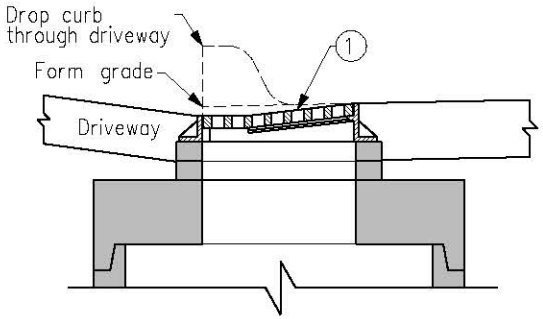
SHEET 1 OF 1

SINGLE GRATE INTAKE

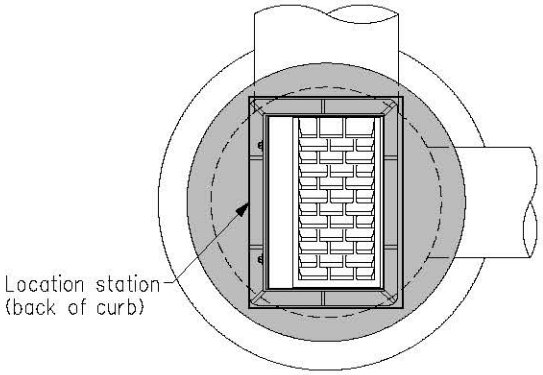
FIGURE: 6010.501 SHEET 1 OF 1




TYPICAL SECTION




PARTIAL SECTION
Shown with Type Q casting




PLAN VIEW

(1) Casting: Type R unless Type Q is specified in the contract documents.

(2) Precast concrete flat top with 2 foot by 3 foot rectangular opening.

(3) Invert: slope toward channel ½ inch per foot.

(4) Fill annular space between pipe and intake with non-shrink grout.

(5) Install pipe flush with inside of intake wall.

(6) Cast-in-place base (shown). (Base may be square). If base is cast intregral with intake structure, the footprint of the base is not required to extend beyond the outside walls of the structure.

(7) Maximum pipe diameter: see Table 1.

TABLE 1

| Structure diameter (in.) | Maximum pipe size, for 2 pipes (A) | |
|---|---|---|
| | at 180° (in.) | at 90° (in.) |
| 48 | 24 | 18 |
| 60 | 36 | 24 |
| 72 | 42 | 30 |
| 84 | 48 | 36 |
| 96 | 60 | 42 |

(A) For additional configurations, maintain a minimum of 12 inches of concrete between vertical edges of pipe openings. Provide additional reinforcement as necessary.

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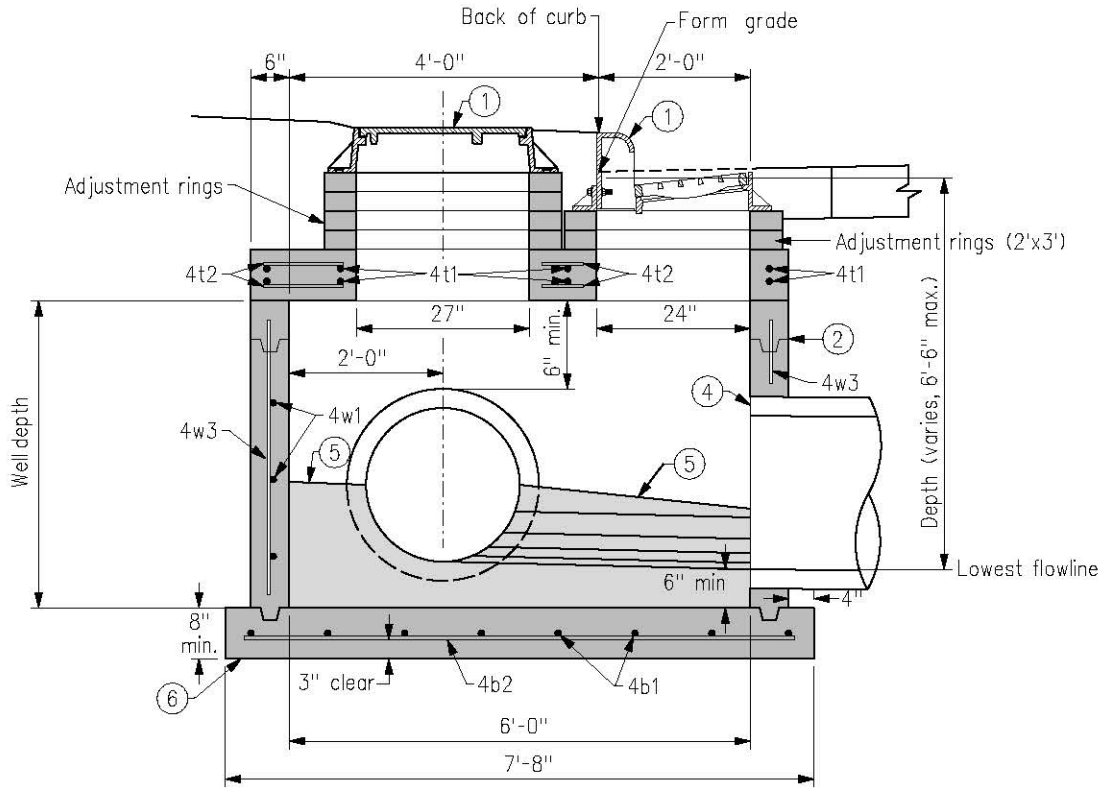
FIGURE: 6010.502

SHEET 1 OF 1

# CIRCULAR SINGLE GRATE INTAKE

FIGURE: 6010.502 SHEET 1 OF 1




TYPICAL SECTION

1. Intake casting: Type R unless Type Q is specified in the contract documents.

   Manhole casting: Type E.

2. Optional construction joint. Secure with 1 inch x 2 inch keyway (shown) or #4 x 12 inch bars at 12 inch spacing all around structure.

3. Install four #4 x 33 inch diagonal bars at manhole opening.

4. End of pipe flush with inside wall of structure. Form wall around pipe. If precast structure is provided, construct concrete collar at pipe opening.

5. Invert: slope toward channel $\frac{1}{2}$ inch per foot.

6. Cast-in-place base (shown). If base is cast intregral with intake structure, the footprint of the base is not required to extend beyond the outside walls of the structure.

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Count | Length | Spacing |
| 4t1 | 4 | Top | —— | 16 | 3'-8" | 12" |
| 4t2 | 4 | Top | —— | 8 | 6'-8" | 12" |
| 4b1 | 4 | Base | —— | 8 | 4'-4" | 12" |
| 4b2 | 4 | Base | —— | 5 | 7'-4" | 12" |
| 4w1 | 4 | Walls | —— | (A) | 3'-8" | 12" |
| 4w2 | 4 | Walls | —— | (A) | 6'-8" | 12" |
| 4w3 | 4 | Walls | —— | 24 | Well depth minus 6" | 12" |

(A) The number of reinforcing bars required varies with structure depth.

FIGURE: 6010.503 SHEET 1 OF 2

SUDAS

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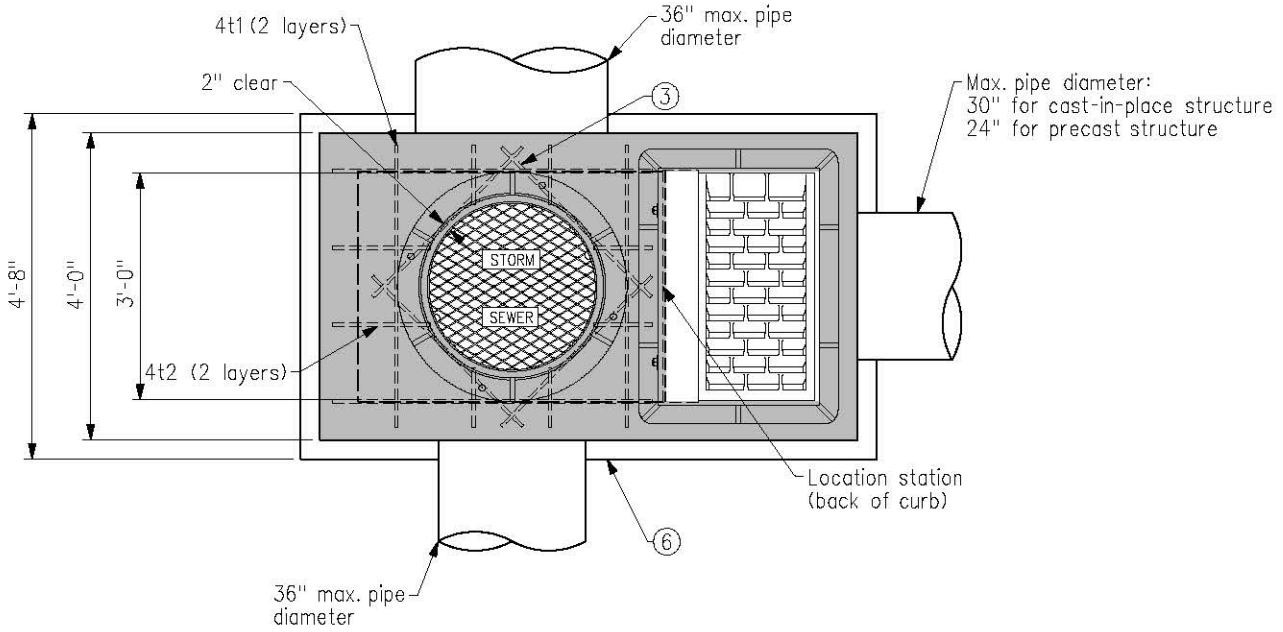
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 6010.503 | SHEET 1 OF 2 |

# SINGLE GRATE INTAKE WITH MANHOLE




PLAN VIEW

SUDAS

REVISION NO. ---

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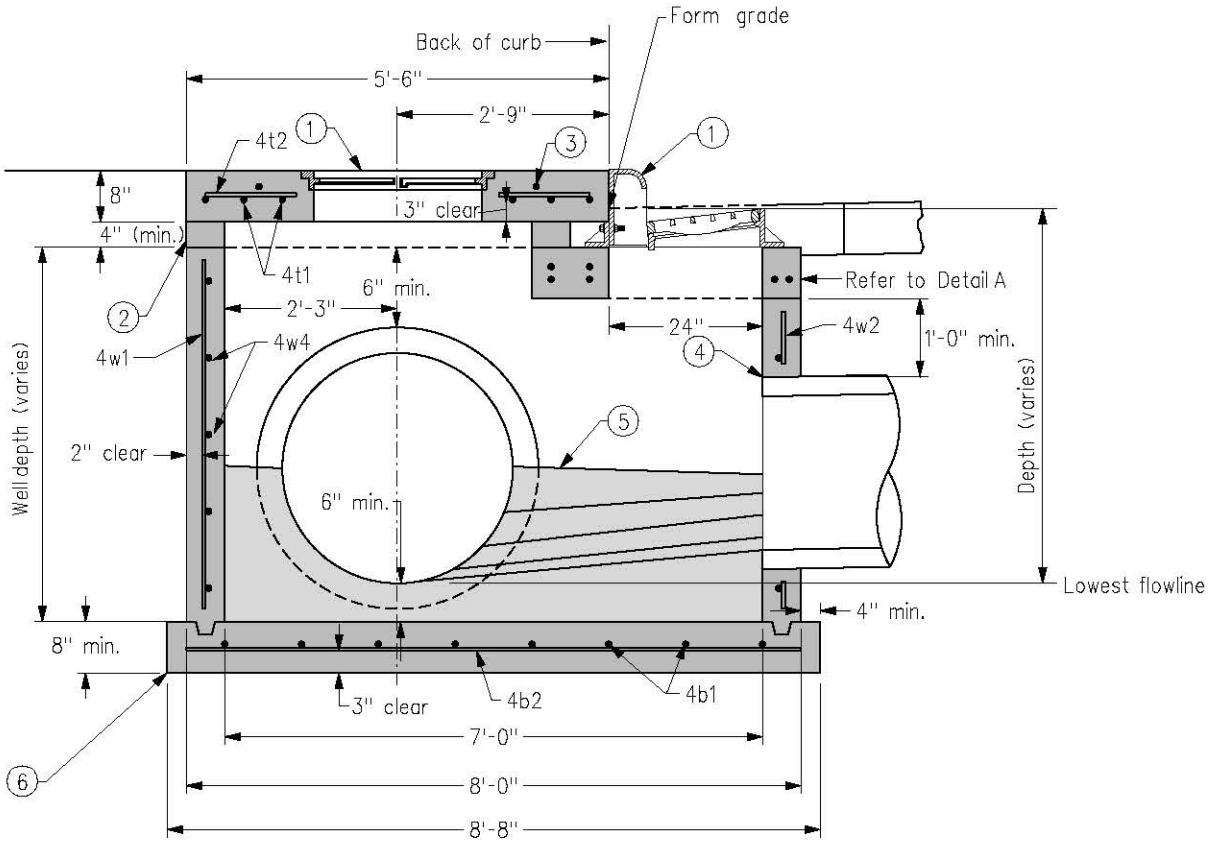
FIGURE: 6010.503

SHEET 2 OF 2

# SINGLE GRATE INTAKE WITH MANHOLE

FIGURE: 6010.503 SHEET 2 OF 2




TYPICAL SECTION

1. Intake casting: Type R unless Type Q is specified in the contract documents.

   Manhole casting: Type G.

2. Adjustment (grade) ring: 6 inches wide. 66 inch x 48 inch outside dimensions.

3. Install four #4 x 30 inch diagonal bars at manhole opening.

4. End of pipe flush with inside wall of structure. Form wall around pipe. If precast structure is provided, construct concrete collar at pipe opening.

5. Invert: slope toward channel $\frac{1}{2}$ inch per foot.

6. Cast-in-place base (shown). If base is cast intregral with intake structure, the footprint of the base is not required to extend beyond the outside walls of the structure.

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|---|---|
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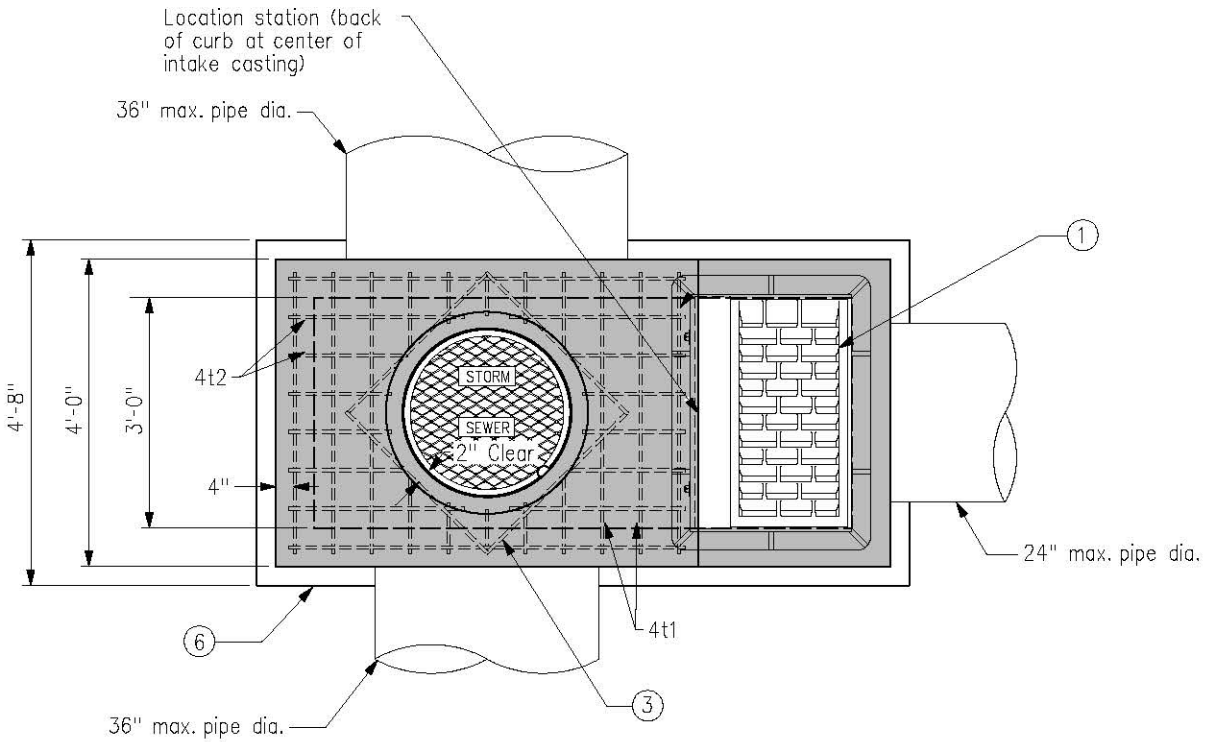
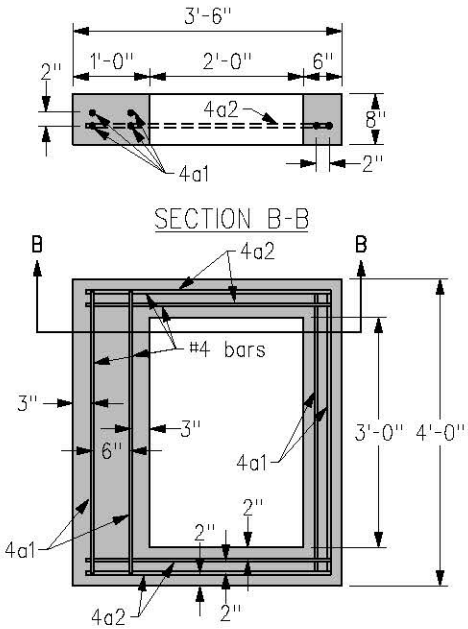
| FIGURE: 6010.504 | SHEET 1 OF 2 |

# SINGLE GRATE INTAKE WITH FLUSH-TOP MANHOLE




PLAN VIEW




DETAIL A
Adjustment ring/beam

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Count | Length | Spacing |
| 4t1 | 4 | Top | —— | 11 | 3'-8" | 6" |
| 4t2 | 4 | Top | —— | 8 | 5'-2" | 6" |
| 4b1 | 4 | Base | —— | 5 | 4'-4" | 12" |
| 4b2 | 4 | Base | —— | 9 | 8'-4" | 12" |
| 4a1 | 4 | Adj. ring | —— | 6 | 3'-8" | See Detail A |
| 4a2 | 4 | Adj. ring | —— | 4 | 3'-2" | See Detail A |
| 4w1 | 4 | Walls | —— | 13 | Well depth minus 4" | 12" |
| 4w2 | 4 | Walls | —— | 11 | Well depth minus 12" | 12" |
| 4w3 | 4 | Walls | —— | (A) | 7'-8" | 12" |
| 4w4 | 4 | Walls | —— | (A) | 3'-8" | 12" |

(A) The number of reinforcing bars required varies with structure depth.

SUDAS

FIGURE: 6010.504

REVISION NO. ---
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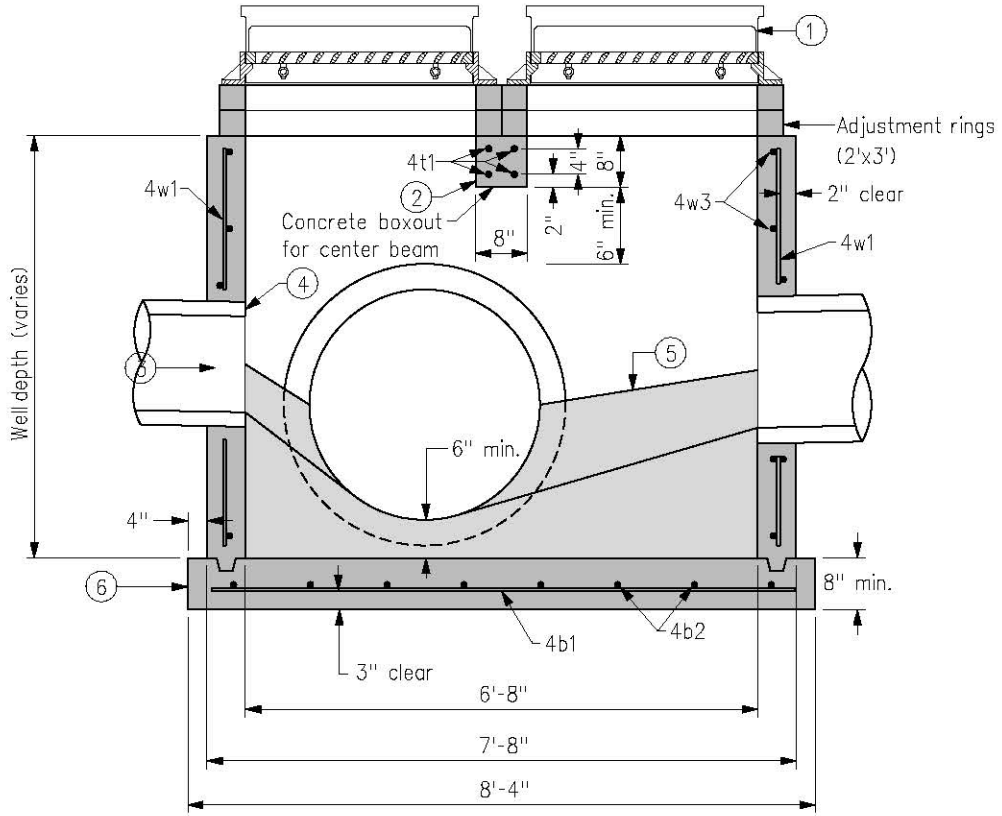
SHEET 2 OF 2

# SINGLE GRATE INTAKE WITH FLUSH-TOP MANHOLE




TYPICAL SECTION

1. Casting: Type R unless Type Q is specified in the contract documents.
2. Precast concrete beam. 4,000 psi concrete with four #4 longitudinal bars. 8 inch x 8 inch x 36 inch.
3. Install #4 diagonal bars at all openings.
4. End of pipe flush with inside wall of structure. Form wall around pipe. If precast structure is provided, construct concrete collar at pipe opening.
5. Invert: slope toward channel $\frac{1}{2}$ inch per foot.
6. Cast-in-place base (shown). If base is cast intregral with intake structure, the footprint of the base is not required to extend beyond the outside walls of the structure.
7. Maximum allowable pipe diameters shown are for cast-in-place structures. For precast structures, the maximum allowable pipe diameter is one standard pipe size smaller than those indicated unless the Engineer approves modifications to precast structure to accomodate larger pipe. Provide pipe size as specified in the contract documents.

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Count | Length | Spacing |
| 4t1 | 4 | Beam | —— | 4 | 2'-8" | See drawing |
| 4b1 | 4 | Base | —— | 4 | 8'-0" | 12" |
| 4b2 | 4 | Base | —— | 9 | 3'-4" | 12" |
| 4w1 | 4 | Walls | —— | 20 | Well depth minus 4" | 12" |
| 4w2 | 4 | Walls | —— | (A) | 7'-4" | 12" |
| 4w3 | 4 | Walls | —— | (A) | 2'-8" | 12" |

(A) The number of reinforcing bars required varies with structure depth.

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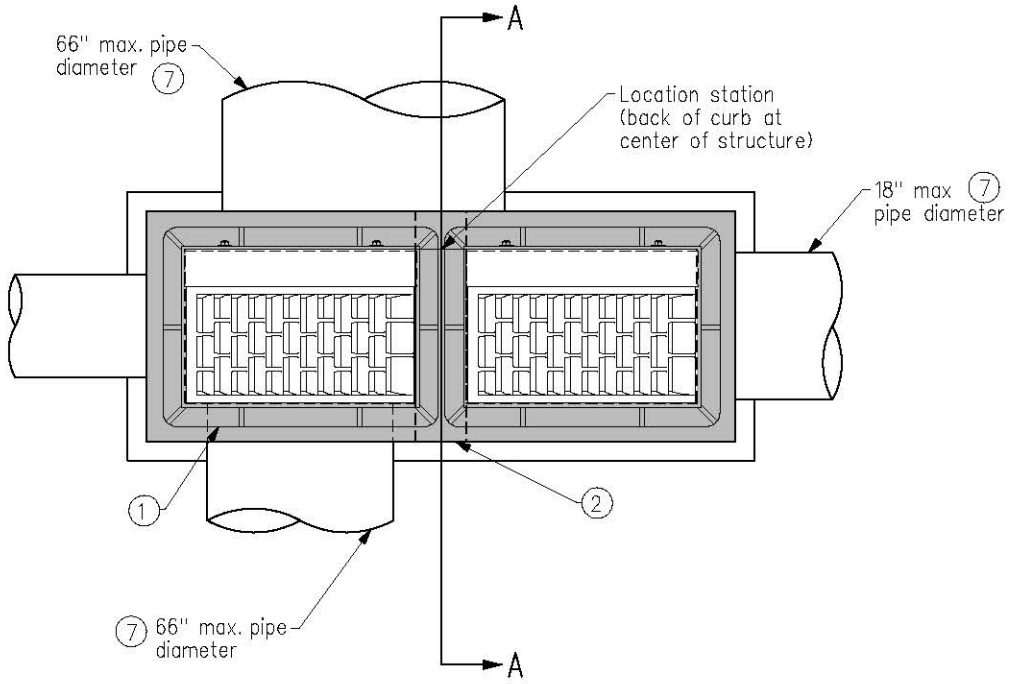
FIGURE: 6010.505

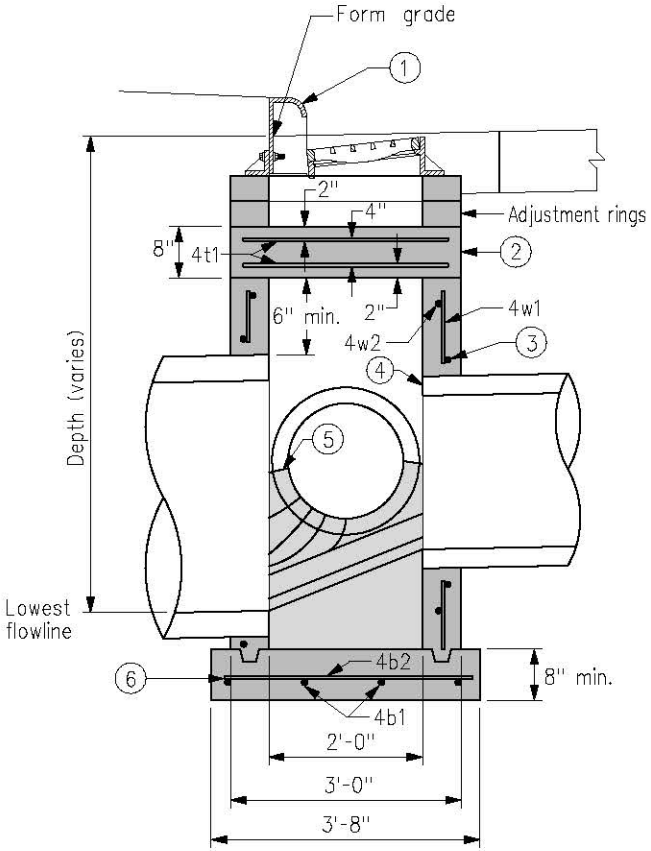
SHEET 1 OF 2

# DOUBLE GRATE INTAKE

FIGURE: 6010.505 SHEET 1 OF 2




PLAN VIEW

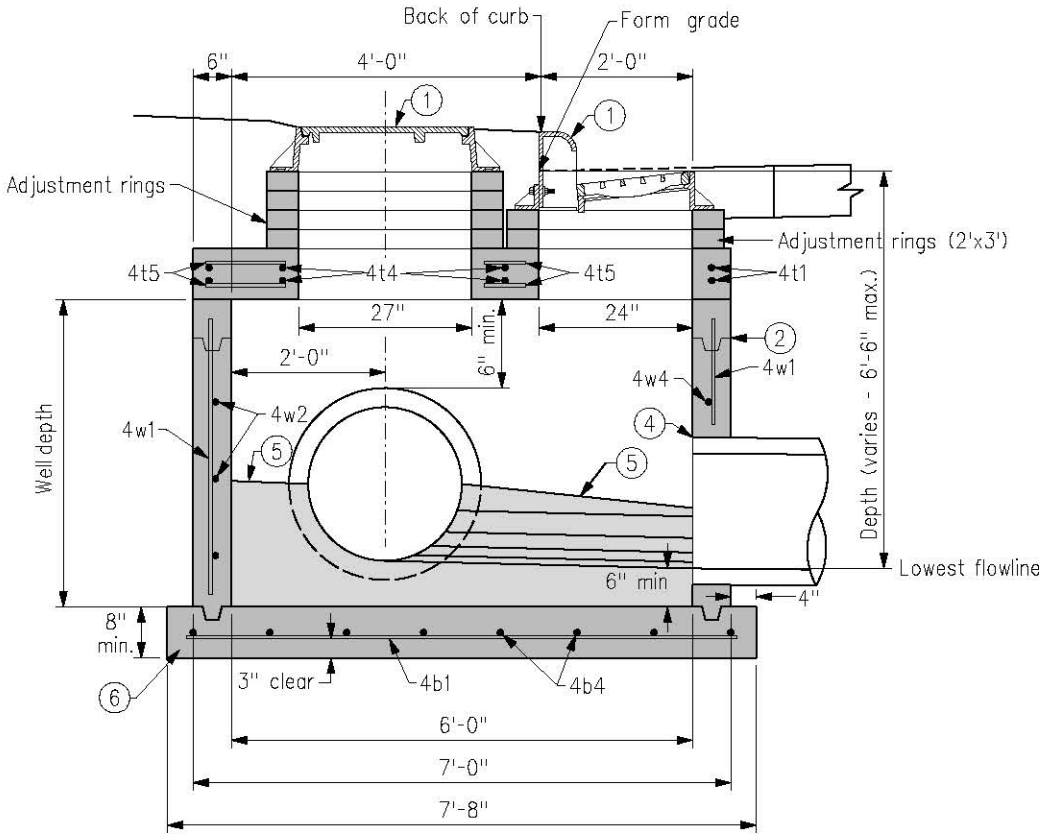



SECTION A-A

SUDAS

| | |
|---|---|
| REVISION NO. | --- |
| REVISION DATE | 10/21/08 |
| FIGURE: 6010.505 | SHEET 2 OF 2 |

# DOUBLE GRATE INTAKE




TYPICAL SECTION

1. Intake casting: Type R unless Type Q is specified in the contract documents.

   Manhole casting: Type G.

2. Optional construction joint. Secure with 1 inch x 2 inch keyway (shown) or #4 x 12 inch bars at 12 inch spacing all around structure.

3. Install four #4 x 33 inch diagonal bars at manhole opening.

4. End of pipe flush with inside wall of structure. Form wall around pipe. If precast structure is provided, construct concrete collar at pipe opening.

5. Invert: slope toward channel $\frac{1}{2}$ inch per foot.

6. Cast-in-place base (shown). If base is cast integral with intake structure, the footprint of the base is not required to extend beyond the outside walls of the structure.

7. When required, increase dimension to 4 feet in order to accommodate 36 inch pipe.

8. 8 inch x 8 inch concrete beam with four #4 bars. Construct with top slab.

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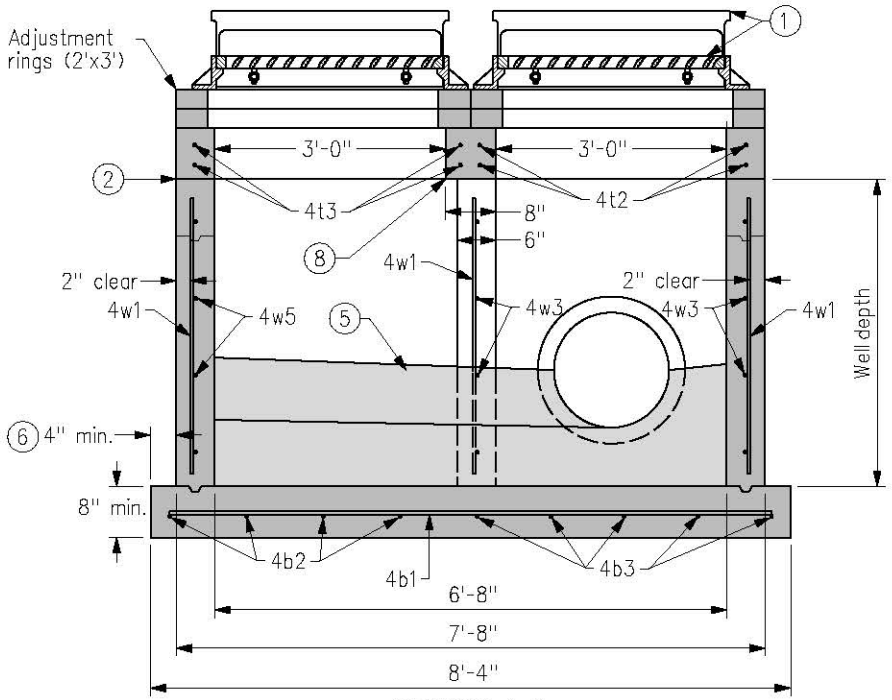
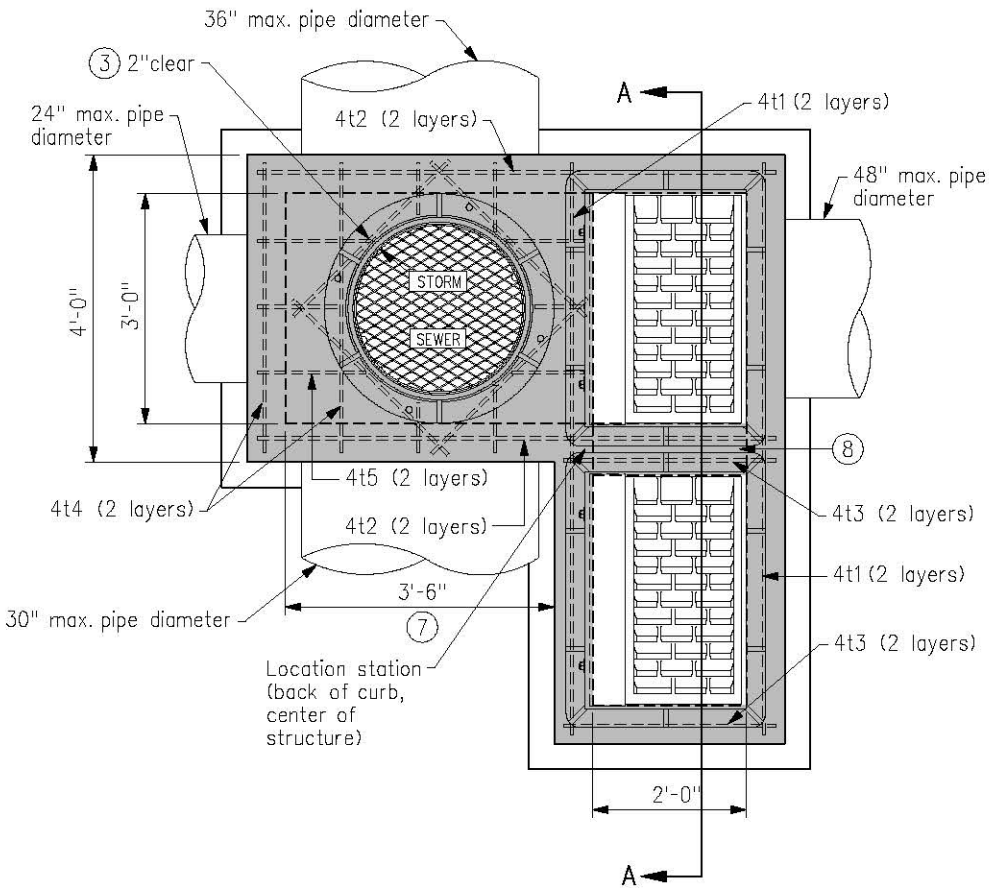
| SHEET 1 OF 2 |

FIGURE: 6010.506

# DOUBLE GRATE INTAKE WITH MANHOLE




SECTION A-A




PLAN VIEW

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Count | Length | Spacing |
| 4t1 | 4 | Top | —— | 4 | 7'-4" | 12" |
| 4t2 | 4 | Top | —— | 4 | 6'-8" | 12" |
| 4t3 | 4 | Top | —— | 4 | 2'-8" | 12" |
| 4t4 | 4 | Top | —— | 8 | 3'-8" | 12" |
| 4t5 | 4 | Top | —— | 6 | 4'-2" | 12" |
| 4b1 | 4 | Base | —— | 4 | 8'-0" | 12" |
| 4b2 | 4 | Base | —— | 4 | 3'-4" | 12" |
| 4b3 | 4 | Base | —— | 5 | 7'-4" | 12" |
| 4b4 | 4 | Base | —— | 5 | 4'-4" | 12" |
| 4w1 | 4 | Walls | —— | 32 | Well depth minus 6" | 12" |
| 4w2 | 4 | Walls | —— | (A) | 3'-8" | 12" |
| 4w3 | 4 | Walls | —— | (A) | 6'-8" | 12" |
| 4w4 | 4 | Walls | —— | (A) | 7'-4" | 12" |
| 4w5 | 4 | Walls | —— | (A) | 2'-8" | 12" |
| 4w6 | 4 | Walls | —— | (A) | 3'-10" | 12" |

(A) The number of reinforcing bars required varies with structure depth.

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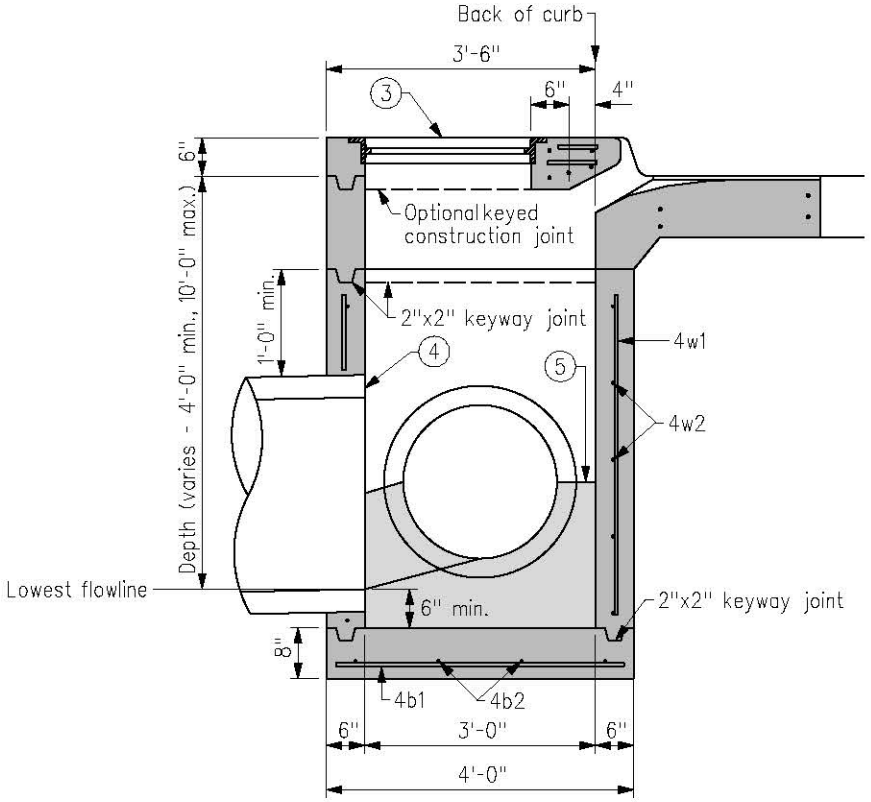
FIGURE: 6010.506

SHEET 2 OF 2

# DOUBLE GRATE INTAKE WITH MANHOLE

FIGURE: 6010.506 SHEET 2 OF 2




TYPICAL SECTION

1. Transverse joint spacing on new 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.

2. Insert shaping may be modified for insert widths less than 3 feet. For an 18 inch insert, reduce dimensions indicated by $\frac{1}{2}$ inch.

3. Casting: Type G.

4. End of pipe flush with inside wall of structure. Form wall around pipe. If precast structure is provided, construct concrete collar at pipe opening.

5. Invert: slope toward channel $\frac{1}{4}$ inch per foot.

6. Shape of curb shown is for standard 6 inch curb. Modify as required to accommodate other curb heights when specified.

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Count | Length | Spacing |
| 4t1 | 4 | Top | —— | 2 | 4'-9" | See Detail 1 |
| 4t2 | 4 | Top | —— | 3 | 4'-9" | See Detail 1 |
| 4t3 | 4 | Top | —— | 4 | 4'-9" | ---------- |
| 4t4 | 4 | Top | —— | 4 | 3'-4" | See Detail 1 |
| 4t5 | 4 | Top | —— | 8 | 1'-2" | 6" |
| 4b1 | 4 | Base | —— | 4 | 4'-9" | 12" |
| 4b2 | 4 | Base | —— | 5 | 3'-9" | 13" |
| 4i1 | 4 | Insert | —— | 4 | 10'-8" (B) | See Detail 1 |
| 4w1 | 4 | Walls | —— | 14 | Well depth minus 4" | 12" |
| 4w2 | 4 | Walls | —— | (A) | 4'-8" | 12" |
| 4w3 | 4 | Walls | —— | (A) | 3'-8" | 12" |

(A) The number of reinforcing bars varies with structure depth.

(B) Bar length shown is for an 11 foot boxout. Length varies based on length of boxout.

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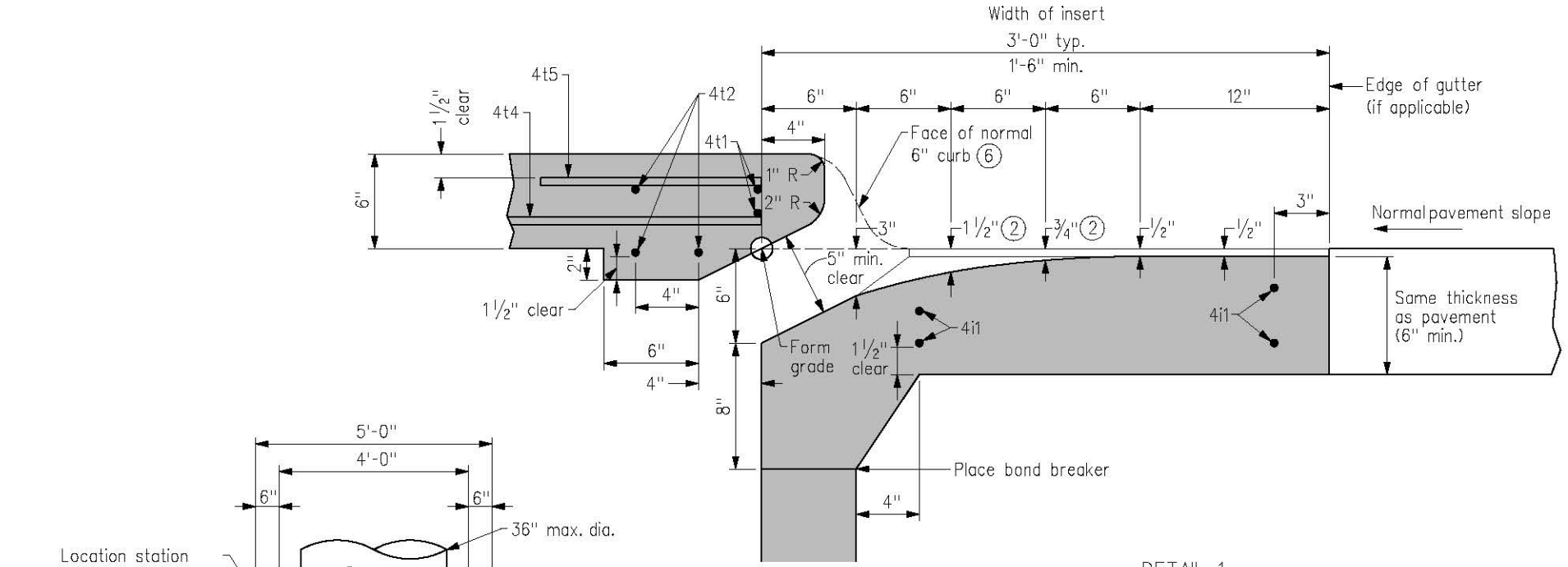
| SHEET 1 OF 2 |

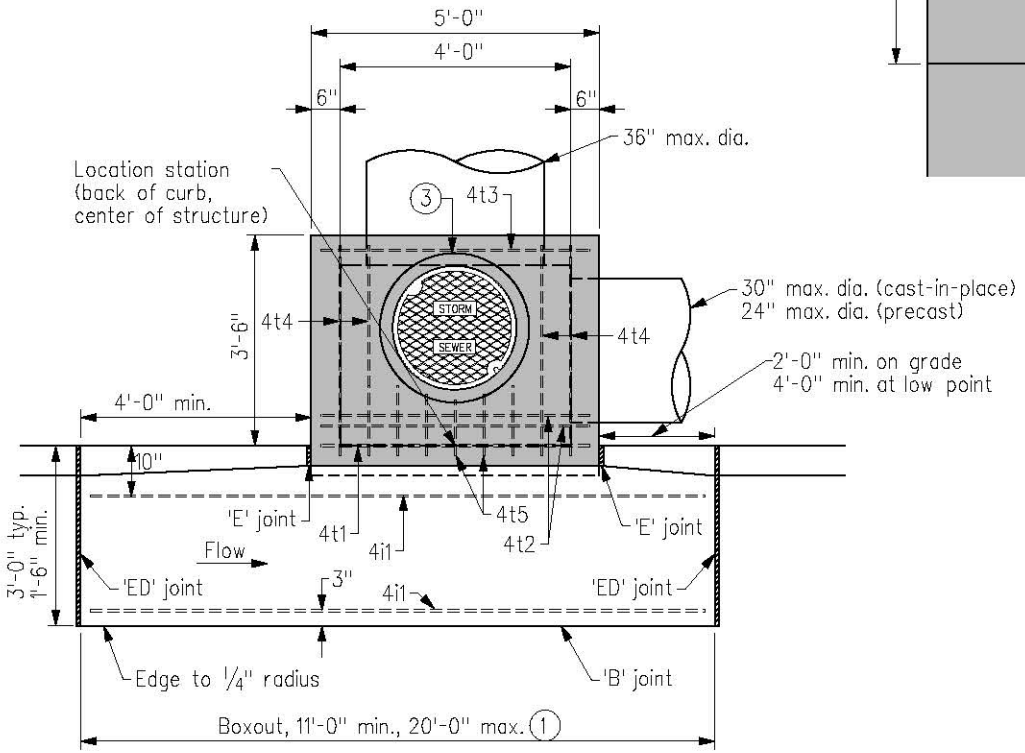
FIGURE: 6010.507

# SINGLE OPEN-THROAT INTAKE, SMALL BOX

FIGURE: 6010.507 SHEET 1 OF 2




DETAIL 1
(Curb opening)




PLAN VIEW

SUDAS

| REVISION NO. |
|---|
| --- |
| REVISION DATE |
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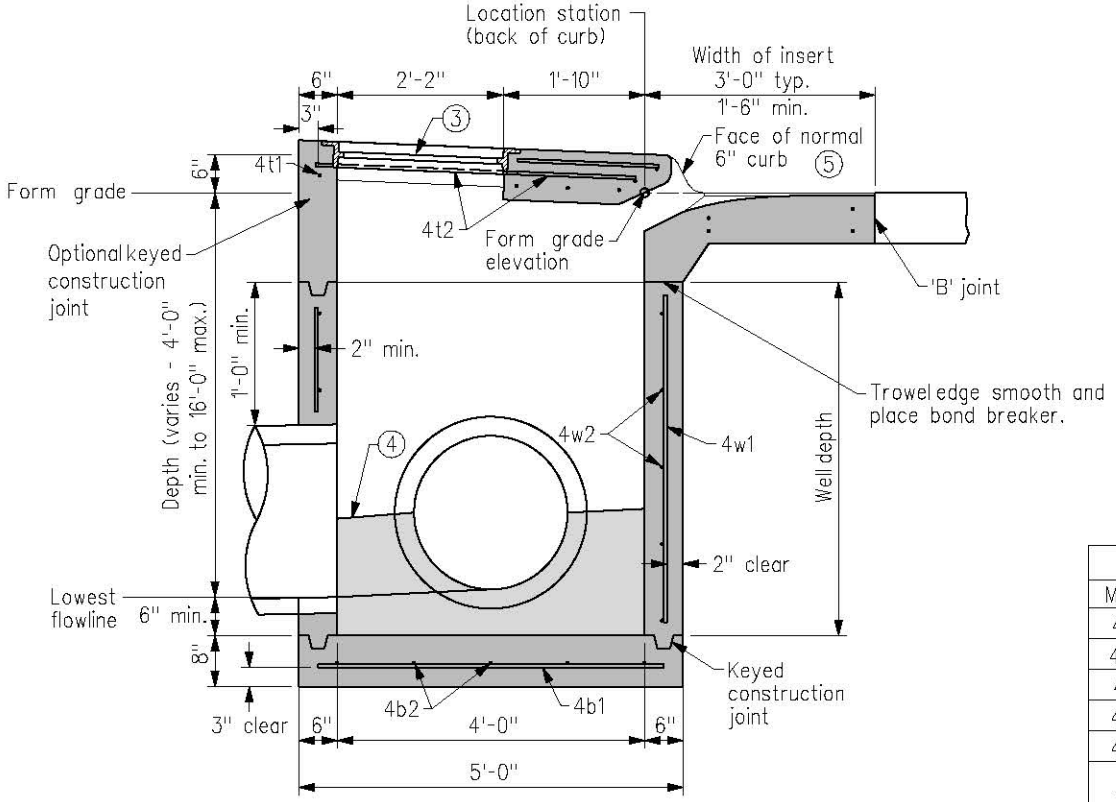
| SHEET 2 OF 2 |

FIGURE: 6010.507

# SINGLE OPEN-THROAT INTAKE, SMALL BOX

FIGURE: 6010.507 | SHEET 2 OF 2




TYPICAL SECTION

① Transverse joint spacing on new 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 are.

② Insert shaping may be modified for insert widths less than 3 feet. For an 18 inch insert, reduce dimensions indicated by 1/4 inch.

③ Casting: Type G.

④ Invert: slope toward channel 1/2 inch per foot.

⑤ Shape of curb shown is for standard 6 inch curb. Modify as required to accommodate other curb heights when specified.

TABLE 1

REINFORCING BAR LIST

| Mark | Size | Location | Shape | Count | Length | Max. Spacing |
|---|---|---|---|---|---|---|
| 4b1 | 4 | Base | ——— | 5 | 4'-8" | 14" |
| 4b2 | 4 | Base | ——— | 5 | 4'-8" | 14" |
| 4t1 | 4 | Top | ——— | 7 | 4'-8" | See Detail |
| 4t2 | 4 | Top | ——— | 4 | 4'-2" | 13 1/2" |
| 4t3 | 4 | Top | ——— | 8 | 1'-10" | 7 3/4" |
| 4i1 | 4 | Insert | ——— | 4 | 10'-4" | 11'-4" Insert |
| | | | | | 19'-4" | 20'-0" Insert |
| 4w1 | 4 | Wall | ——— | 16 | Well depth minus 4" | 12" |
| 4w2 | 4 | Wall | ——— | (A) | 4'-8" | 12" |
| 4w3 | 4 | Wall | ——— | (A) | 4'-8" | 12" |

(A) Steel quantity depends upon well depth

SUDAS

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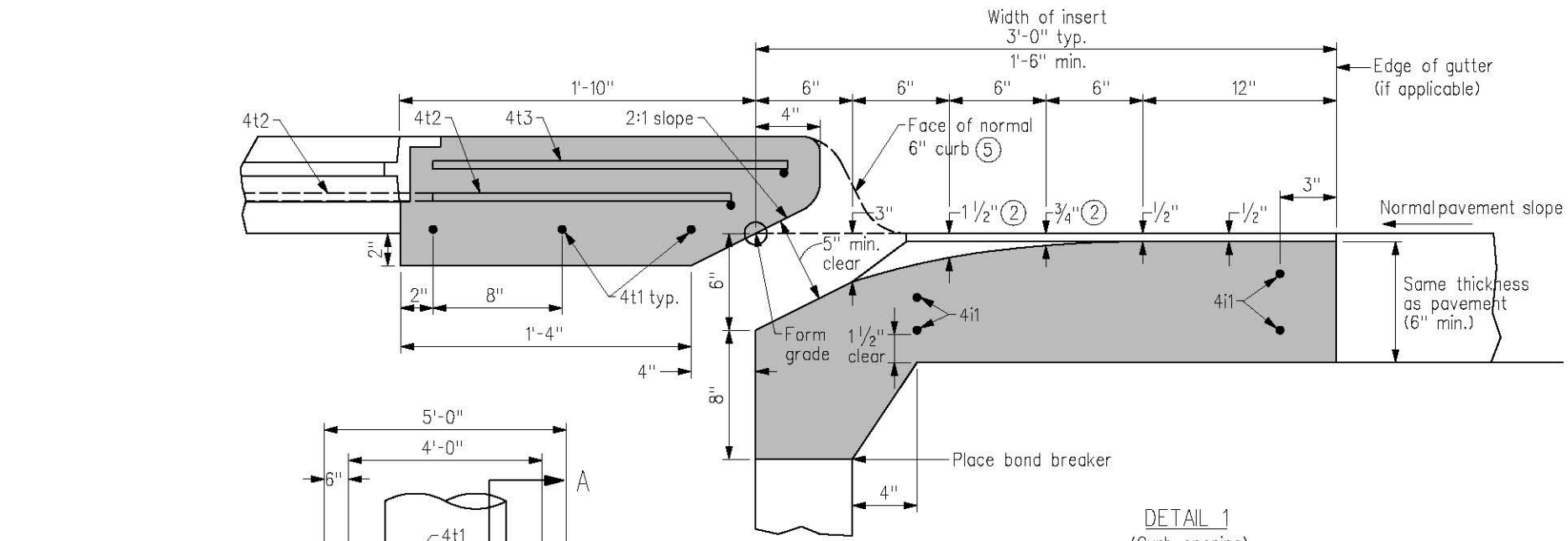
FIGURE: 6010.508

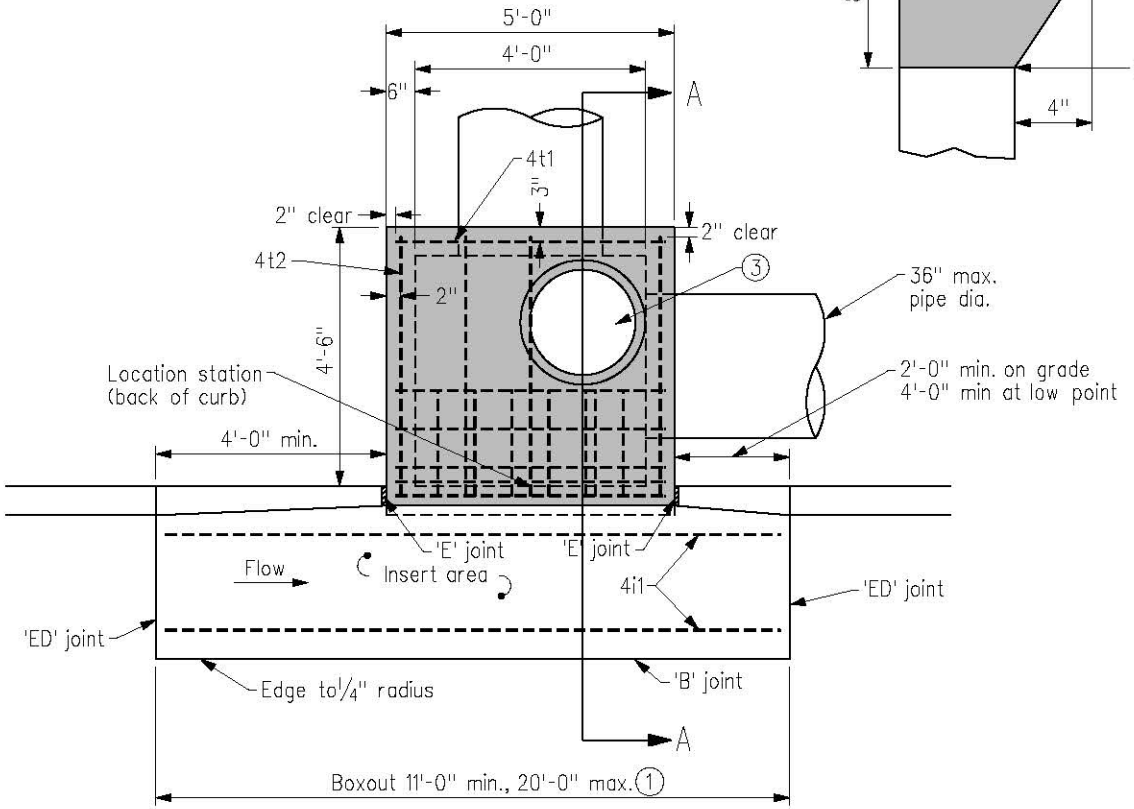
SHEET 1 OF 2

# SINGLE OPEN-THROAT INTAKE, LARGE BOX

FIGURE: 6010.508 SHEET 1 OF 2




DETAIL 1
(Curb opening)




PLAN VIEW

SUDAS

FIGURE: 6010.508

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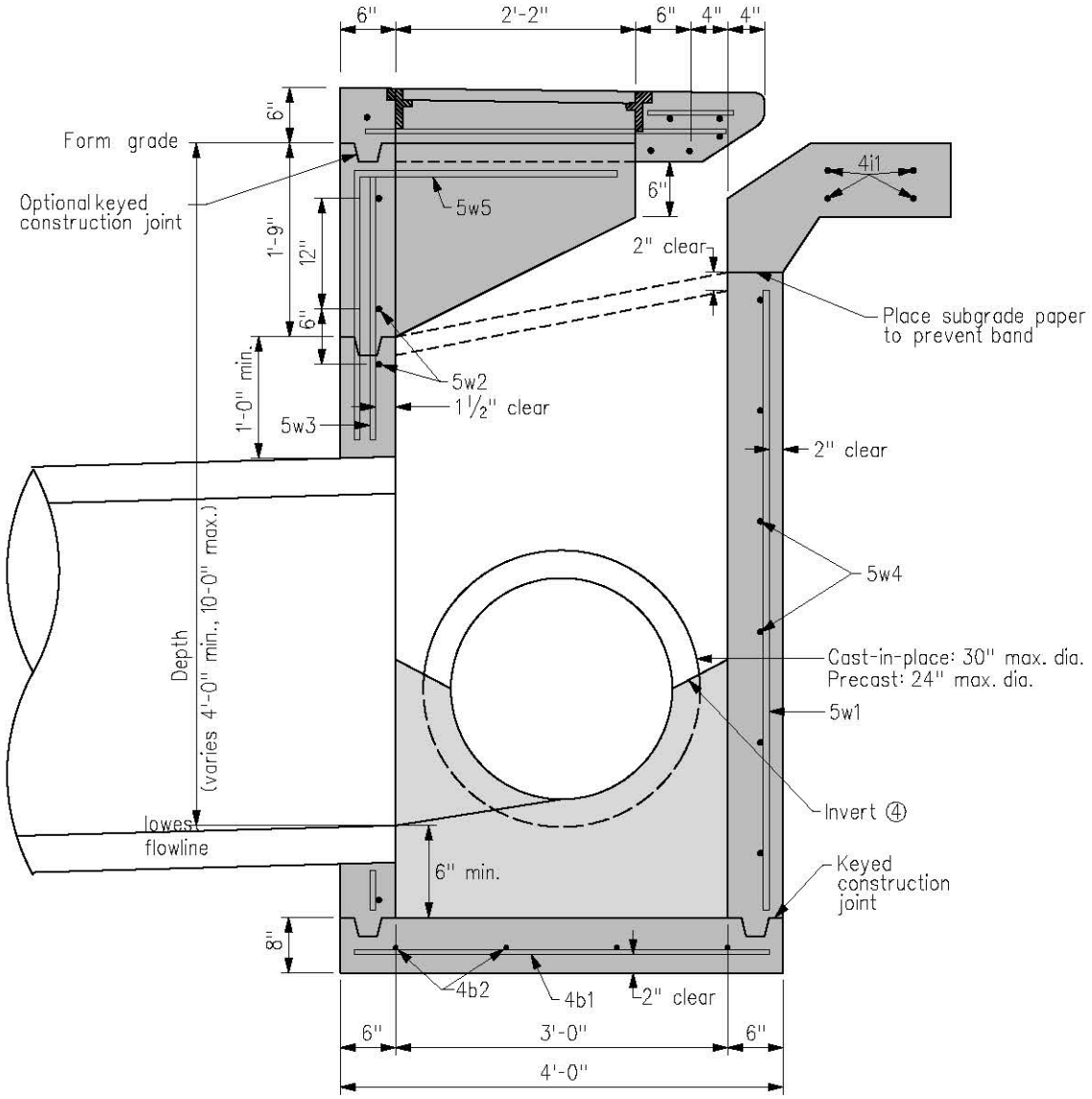
SHEET 2 OF 2

# SINGLE OPEN-THROAT INTAKE, LARGE BOX

FIGURE: 6010.508 SHEET 2 OF 2




SECTION A-A

① Transverse joint spacing on new pavement is controlled by the intake boxout. Adjacent joint spacing may need to be field adjusted to fit boxouts.

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

② Insert shaping may be modified for insert widths less than 3'-0".

③ Intake casting: Type G.

④ Invert: 6 inch (min.) concrete fill. Shape toward channel $\frac{1}{2}$ inch per foot.

SUDAS

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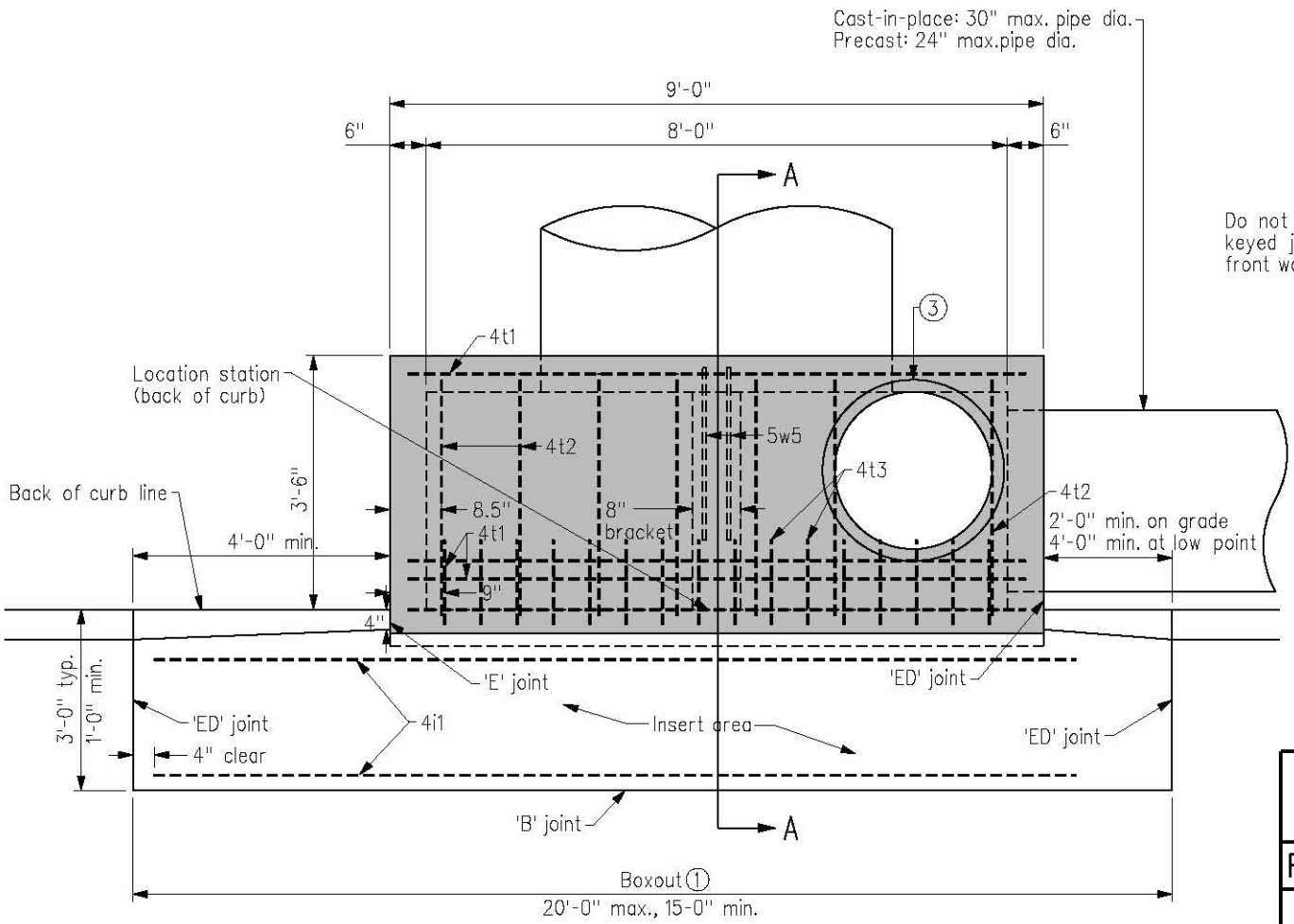
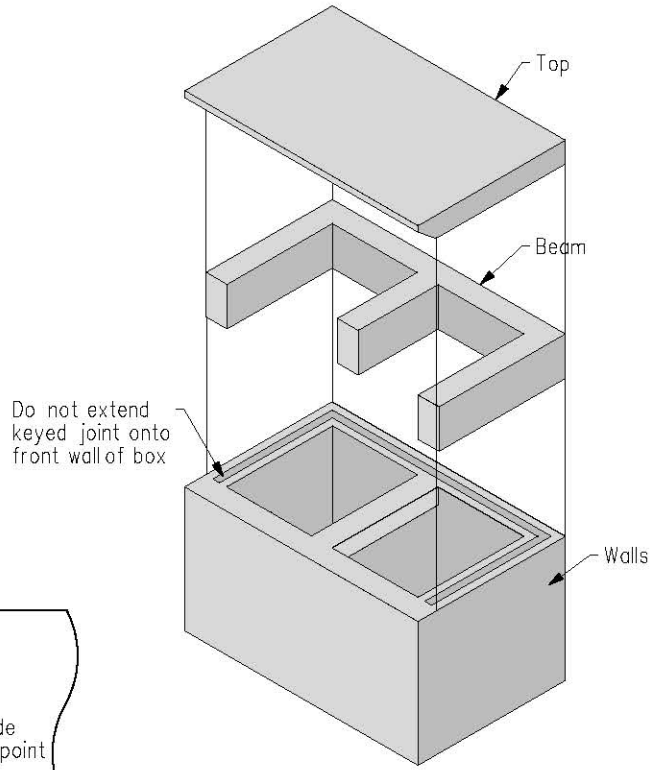
FIGURE: 6010.509

# DOUBLE OPEN-THROAT INTAKE, SMALL BOX




PLAN VIEW




ISOMETRIC VIEW
(Intake well, walls, and top)

SUDAS

| | |
|---|---|
| REVISION NO. | --- |
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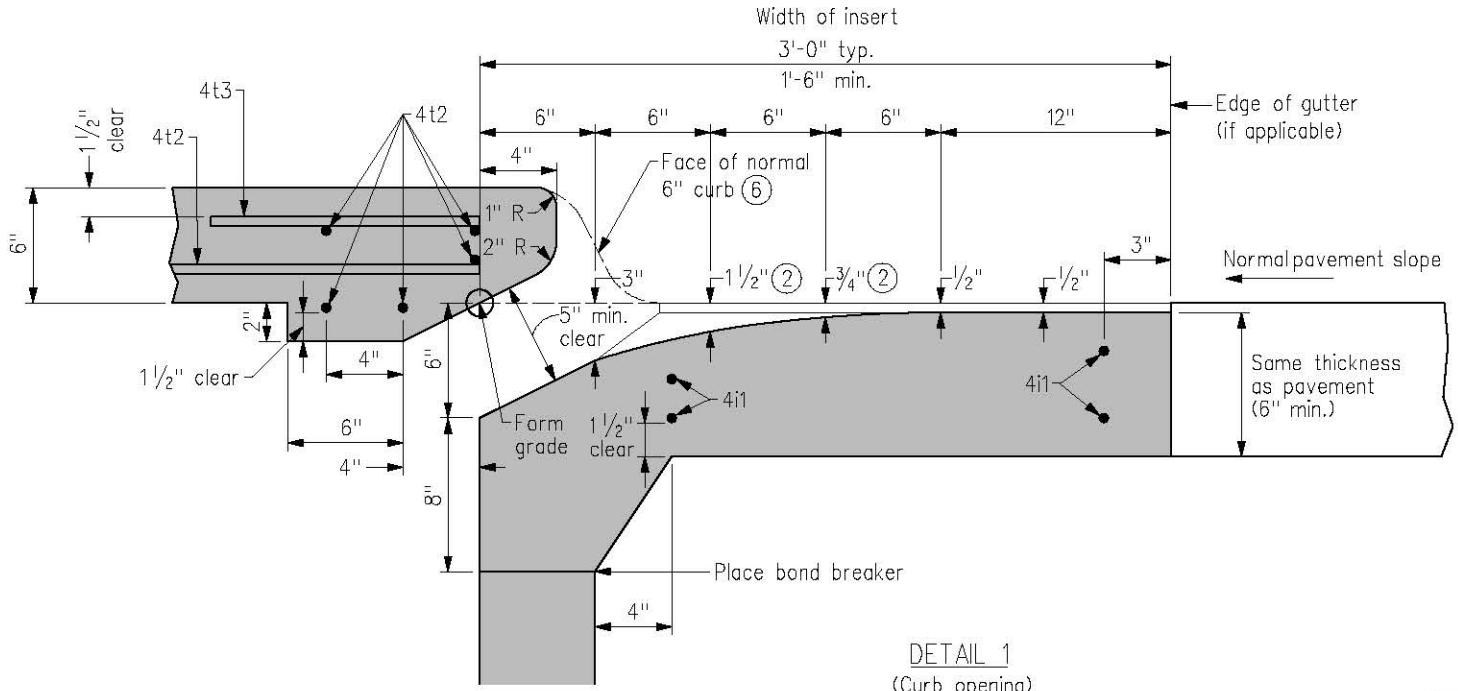
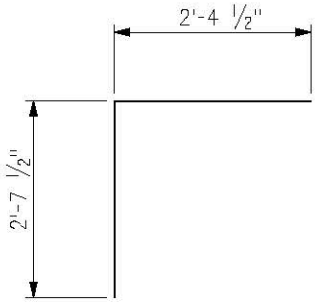
| FIGURE: 6010.509 | SHEET 2 OF 3 |

# DOUBLE OPEN-THROAT INTAKE, SMALL BOX

FIGURE: 6010.509 | SHEET 2 OF 3




DETAIL 1
(Curb opening)




DETAIL 2
(Bent bar detail - 5w5)

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | Shape | Count | Length | Spacing |
| 4t1 | 4 | top | —— | 6 | 8'-6" | See detail |
| 4t2 | 4 | top | —— | 7 | 3'-4" | 1'-1" |
| 4t3 | 4 | top | —— | 16 | 1'-2" | 6" |
| 4b2 | 4 | base | —— | 4 | 8'-6" | 12" |
| 4b1 | 4 | base | —— | 8 | 3'-9" | 12" |
| 4i1 | 4 | insert | —— | 4 | (A) | See detail |
| 5w1 | 5 | walls | —— | 6 | (B) | 12" |
| 5w2 | 5 | walls | —— | max. 7 (B) | 8'-6" | 12" typ. see detail |
| 5w3 | 5 | walls | —— | 6 | (B) | 12" |
| 5w4 | 5 | walls | —— | max. 7 (B) | 8'-6" | 12" |
| 5w5 | 5 | walls | ⌐ | 2 | 5'-0" (C) | 4" |

(A) Varies depending upon length of insert
(B) Varies depending upon depth of intake
(C) See bent bar detail

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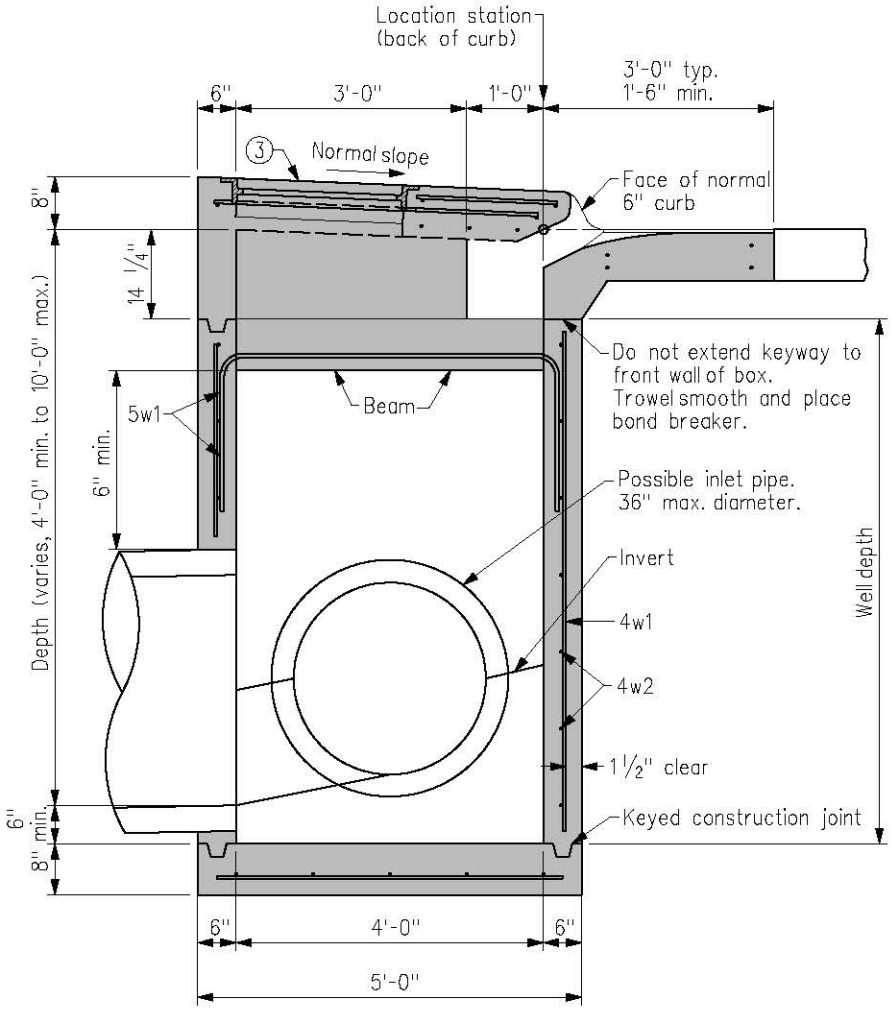
FIGURE: 6010.509

# DOUBLE OPEN-THROAT INTAKE, SMALL BOX

FIGURE: 6010.509 SHEET 3 OF 3




TYPICAL SECTION

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

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

2. Insert shaping may be modified for insert widths less than 3'-0".

3. Intake casting: Type G.

4. Invert: slope toward channel 1/4 inch per foot.

5. Shape of curb shown is for standard 6 inch curb. Design may be modified to accomodate other curb design when necessary.

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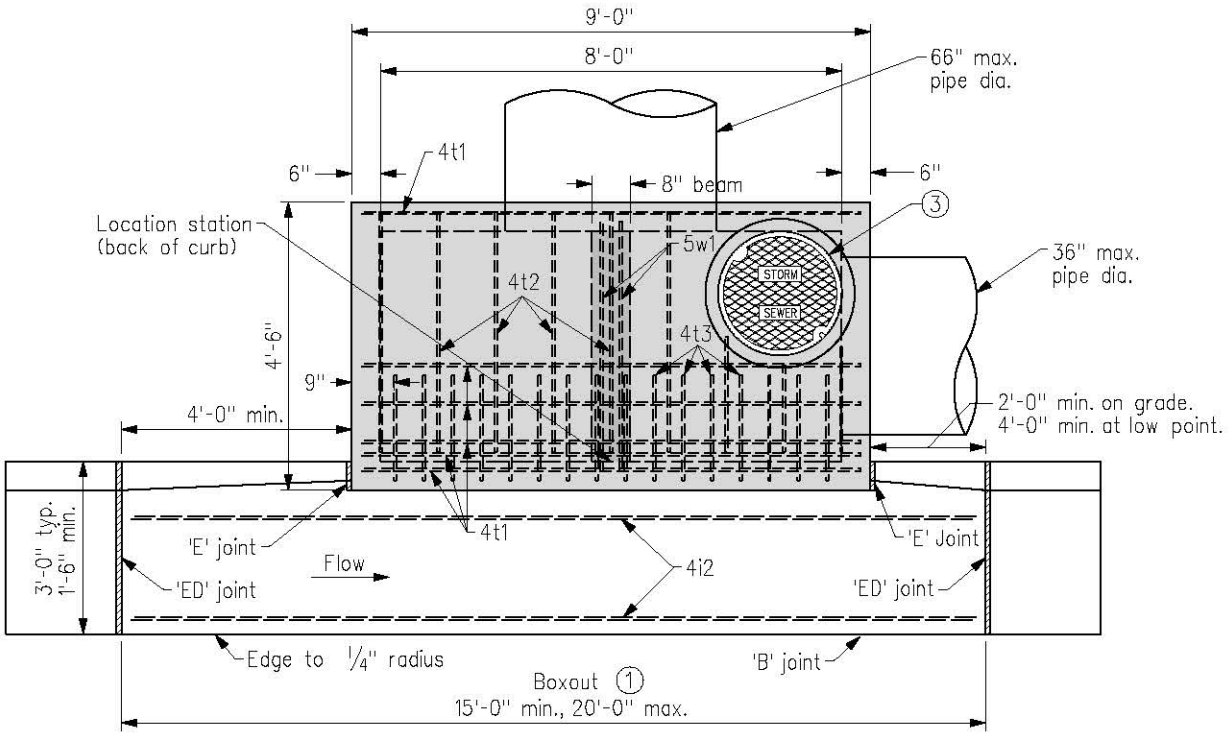
| SHEET 1 OF 3 |

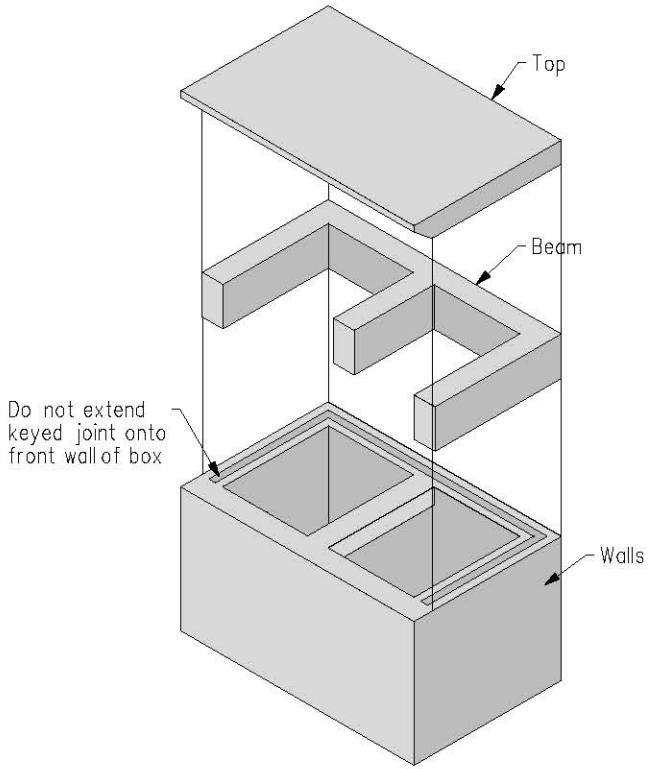
FIGURE: 6010.510

# DOUBLE OPEN-THROAT INTAKE, LARGE BOX

FIGURE: 6010.510 SHEET 1 OF 3




PLAN VIEW




ISOMETRIC VIEW
(Intake well, walls, and top)

TABLE 1

| REINFORCING BAR LIST | | | | | | |
|---|---|---|---|---|---|---|
| Mark | Size | Location | | Count | Length | Spacing |
| 4b1 | 4 | Base | —— | 9 | 4'-8" | 12" |
| 4b2 | 4 | Base | —— | 5 | 8'-8" | 14" |
| 4i1 | 4 | Insert | —— | 4 | 19'-4" | 20' insert |
| | | | | | 14'-4" | 15' insert |
| 4t1 | 4 | Top | —— | 7 | 8'-8" | See Detail |
| 4t2 | 4 | Top | —— | 9 | 4'-4" | 12" |
| 4t3 | 4 | Top | —— | 16 | 1'-10" | 6" |
| 4w1 | 4 | Wall | —— | 40 | Well depth minus 4" | 12" |
| 4w2 | 4 | Wall | —— | (A) | 4'-8" | 12" |
| 4w3 | 4 | Wall | —— | (A) | 8'-8" | 12" |
| 5w1 | 5 | Beam | ⌐¬ | 2 | 8'-3" | 4" |

(A) Steel quantity depends on depth

SUDAS

FIGURE: 6010.510

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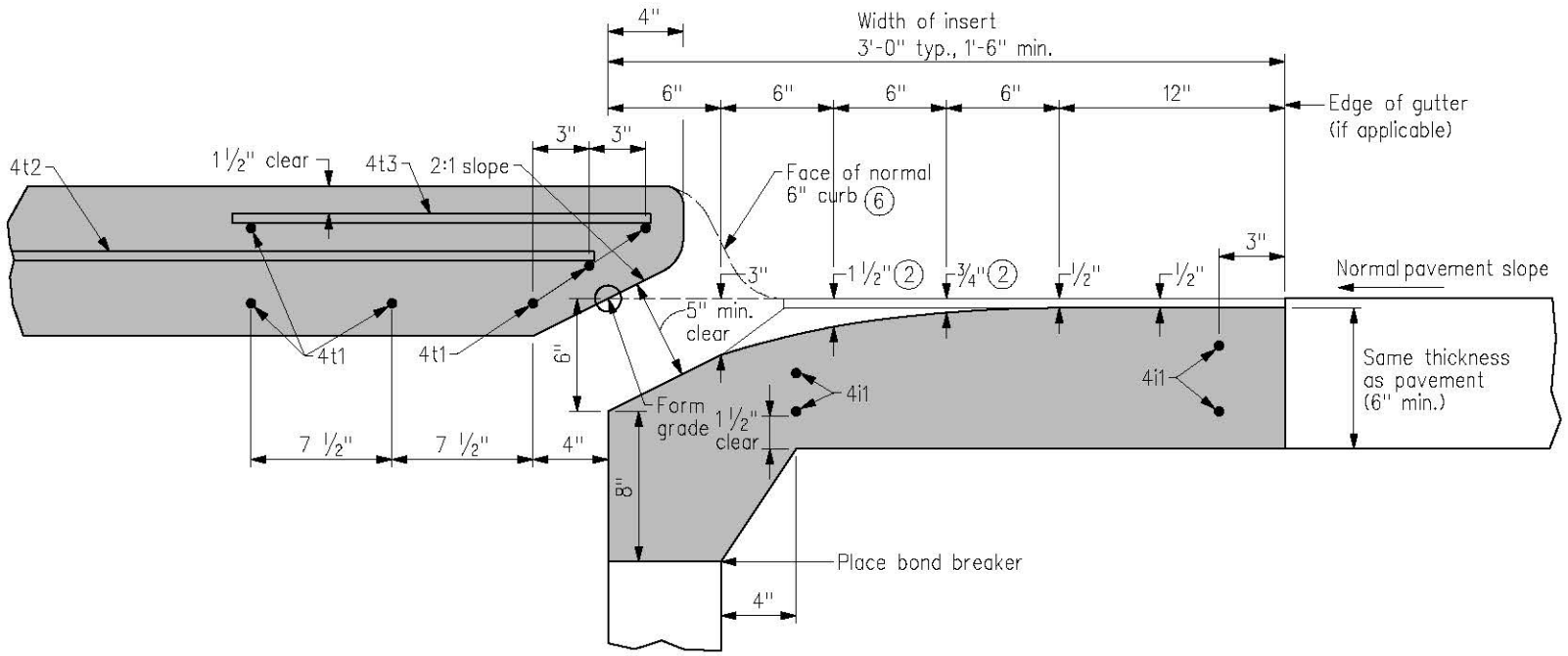
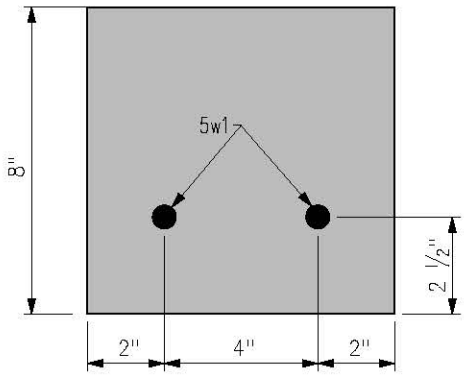
SHEET 2 OF 3

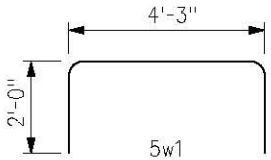
DOUBLE OPEN-THROAT
INTAKE, LARGE BOX




DETAIL 1
(Curb Opening)




DETAIL 2
(Center Beam)




DETAIL 3
(Bent Bar)

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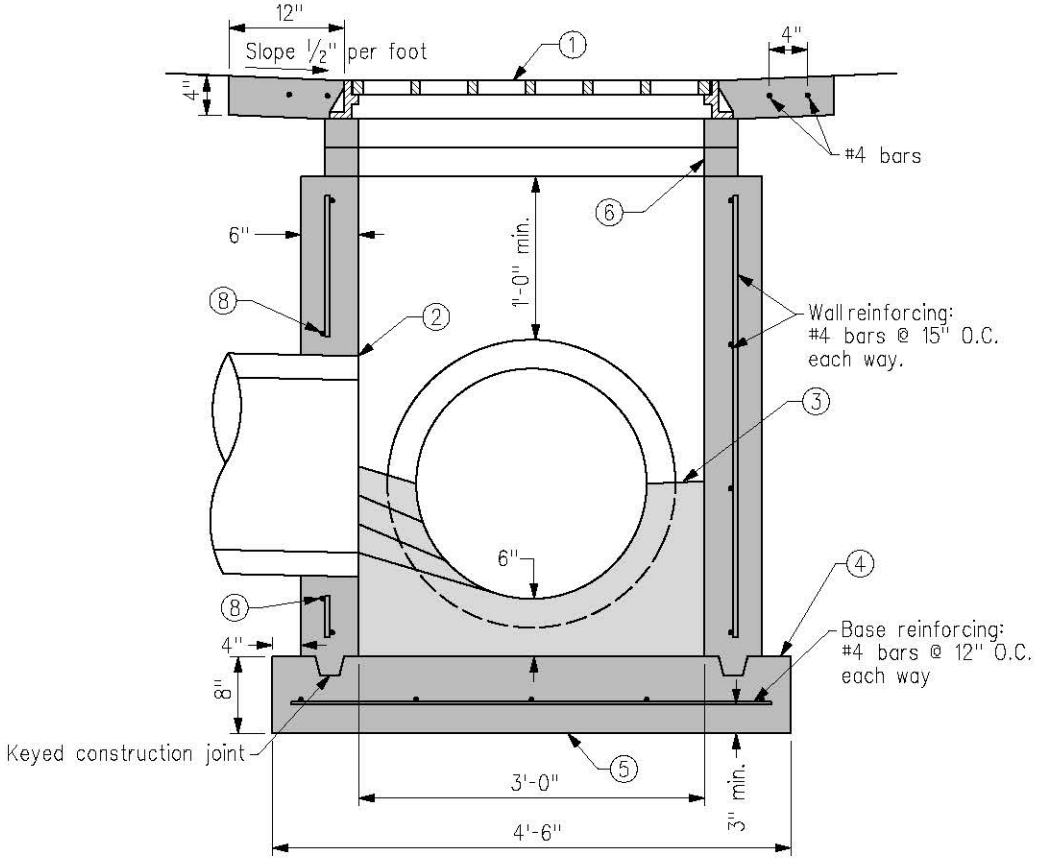
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 6010.510 | SHEET 3 OF 3 |

# DOUBLE OPEN-THROAT INTAKE, LARGE BOX

FIGURE: 6010.510 | SHEET 3 OF 3




TYPICAL SECTION

1. Casting: Type 6.
2. End of pipe flush with inside wall of structure. Form wall around pipe. If precast structure is provided, construct concrete collar at pipe opening.
3. Invert: 6 inch (min.) concrete fill. Slope toward channel ½ inch per foot.
4. Cast-in-place base slab. If base is precast integral with intake structure, footprint of base slab is not required to extend beyond the outside wall of the structure.
5. Undisturbed soil or prepared subgrade. If precast structure is provided, install an 8 inch thick pad of Class I bedding material a minimum of 12 inches outside footprint of structure.
6. Adjustment (grade) rings: 2 foot x 3 foot rectangular.
7. Maximum allowable pipe diameters shown are for cast-in-place structures. For precast structures, the maximum allowable pipe diameter is one standard pipe size smaller than those indicated unless the Engineer approves modifications to the precast structure to accomodate larger pipe. Provide pipe size as specified in the contract documents.
8. Place diagonal bars in walls at all circular openings.

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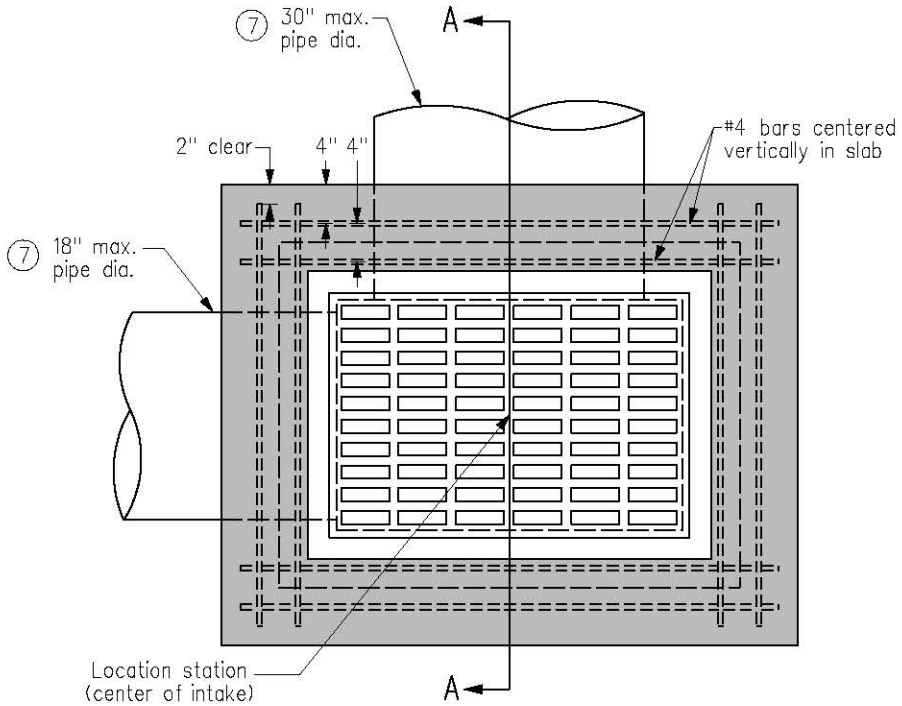
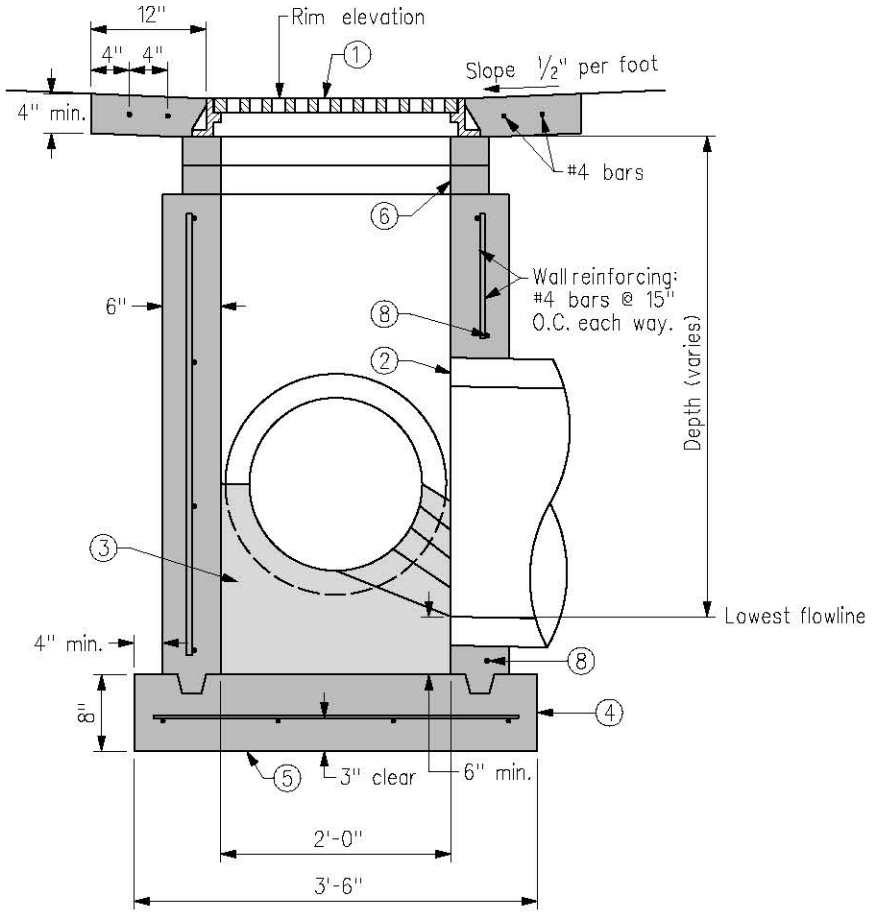
FIGURE: 6010.511

# RECTANGULAR AREA INTAKE




PLAN VIEW




SECTION A-A

FIGURE: 6010.511 | SHEET 2 OF 2

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|---|---|
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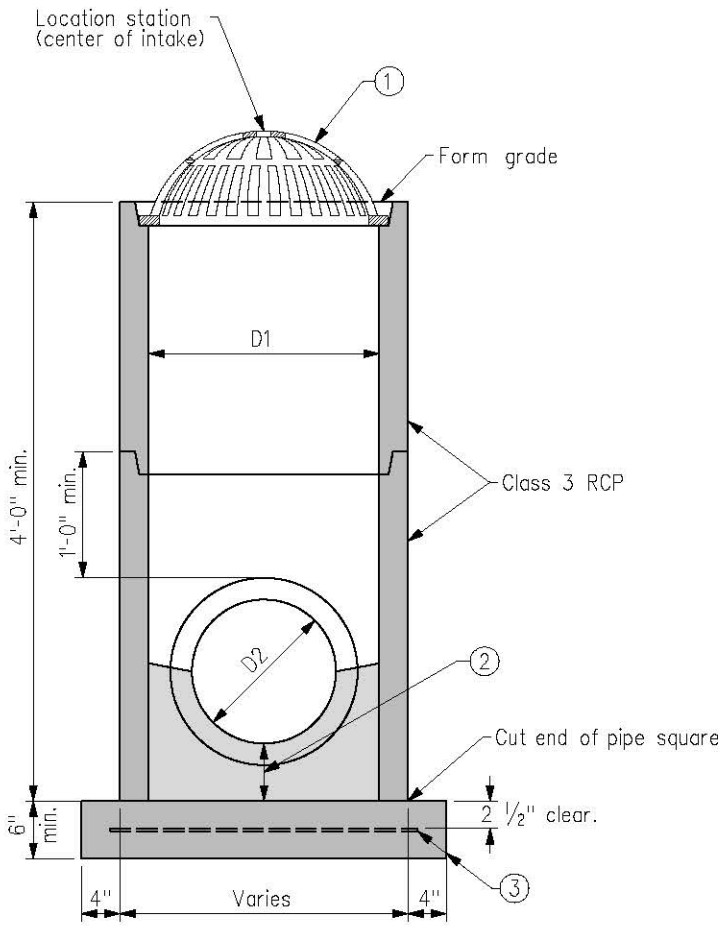
| FIGURE: 6010.511 | SHEET 2 OF 2 |

# RECTANGULAR AREA INTAKE




TYPICAL SECTION

1. Intake casting: Type 3, 4, or 5 as specified in the contract documents.
2. Invert: 6 inch (min.) concrete fill. Slope toward channel 1/2 inch per foot
3. Base: Precast or cast-in-place.

   Precast: 6 inch thick reinforced with No. 6 welded wire mesh on 4 inch centers (WWF 4"x4").

   Cast-in-place: 8 inch thick non-reinforced concrete.

TABLE 1

| AREA INTAKE SIZE | |
|---|---|
| Intake diameter D1 | Maximum pipe diameter D2 |
| 18" | 15" |
| 24" | 18" |
| 30" | 24" |
| 36" | 30" |

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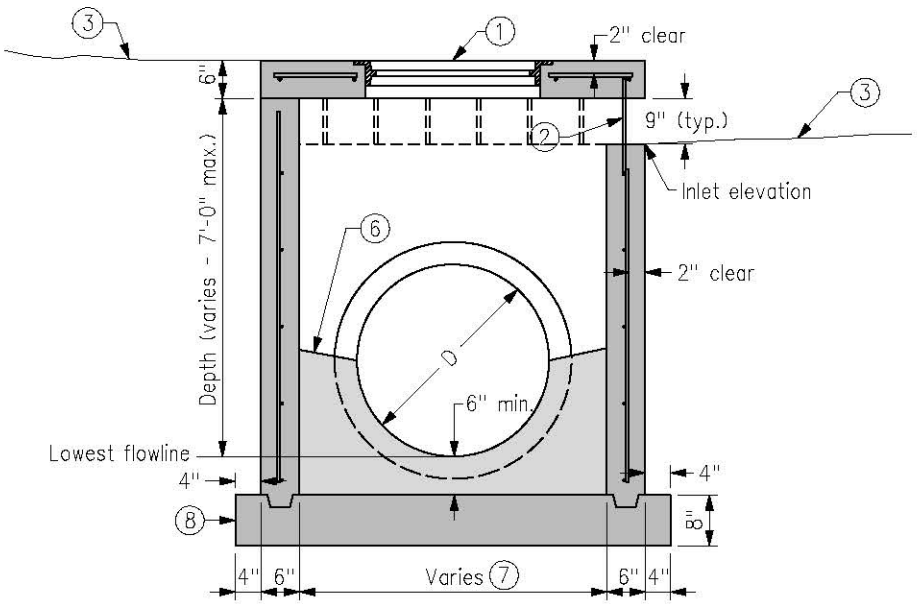
FIGURE: 6010.512

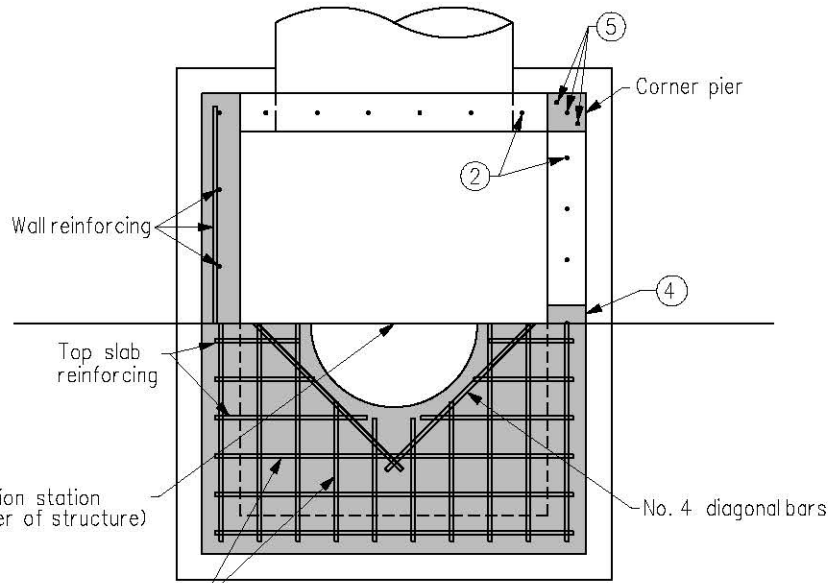
SHEET 1 OF 1

# CIRCULAR AREA INTAKE

FIGURE: 6010.512 SHEET 1 OF 1




TYPICAL SECTION




PLAN VIEW

Provide openings and orientation as specified in the contract documents. At the Contractor's option, structure may be precast.

(1) Rim elevation: 15 inches above inlet unless otherwise specified.

Casting: Type G.

(2) Grate opening: form 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 wall openings.

(3) Grade to inlet elevation on open sides. Grade to rim elevation on closed sides.

(4) Center pier: 6 inch x 6 inch x height of opening. Required when inside wall dimension is 5 feet or greater.

(5) Extend reinforcing into piers (where appropriate). Add two 12 inch dowels between each pier and wall.

(6) Invert: Slope toward channel $\frac{1}{2}$ inch per foot.

(7) Inside wall dimension as specified in contract documents. If no length is specified, refer to Table 1. For parallel walls with different pipe sizes, inside dimension for both walls is based upon largest pipe. Perpendicular walls may have different dimensions (structure must be rectangular).

(8) Cast-in-place base (shown). If base is precast integral with inake structure, footprint of base slab is not required to extend beyond the outside wall of the structure.

TABLE 1

| Pipe diameter D | Min. inside dimension |
|---|---|
| 27" or less | 3' |
| 30" - 36" | 4' |
| 42" - 48" | 5' |
| 54" - 60" | 6' |

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|---|---|
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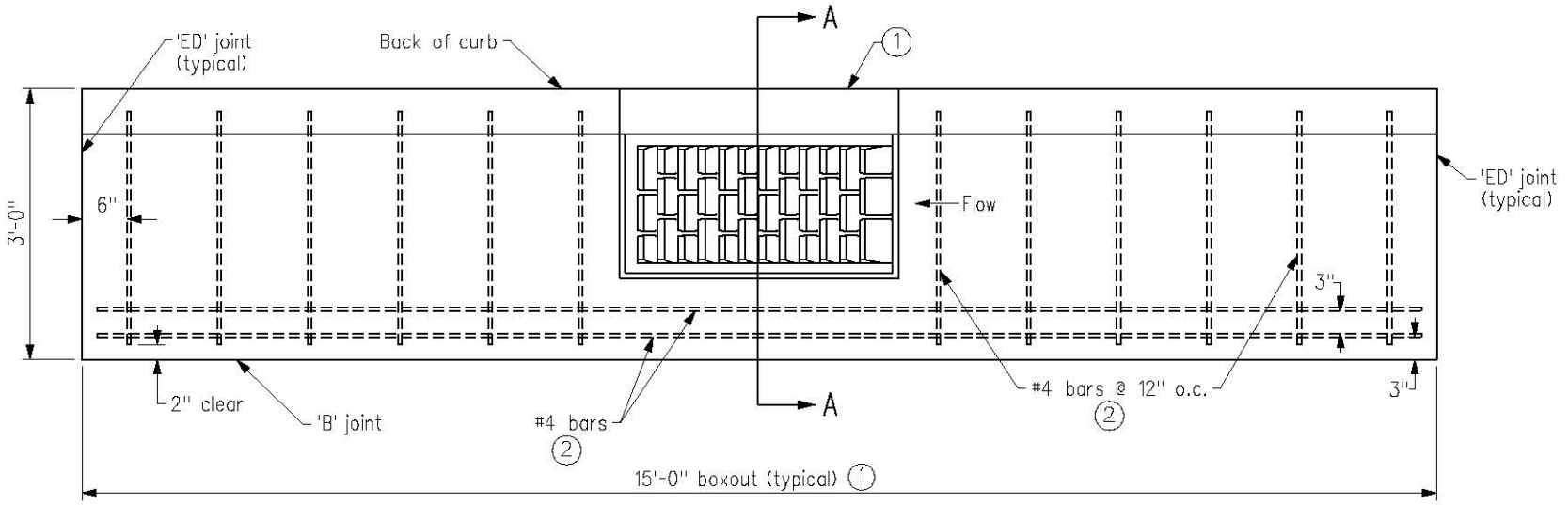
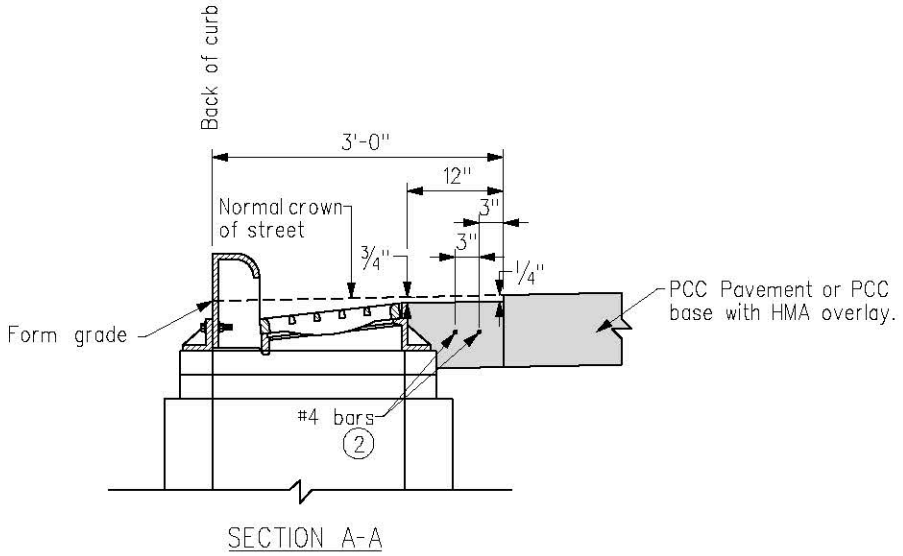
| SHEET 1 OF 1 | |

FIGURE: 6010.513

# OPEN-SIDED AREA INTAKE




PLAN VIEW - BOXOUT IN PCC PAVEMENT




SECTION A-A

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

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

2. Center bars vertically within slab.

SUDAS

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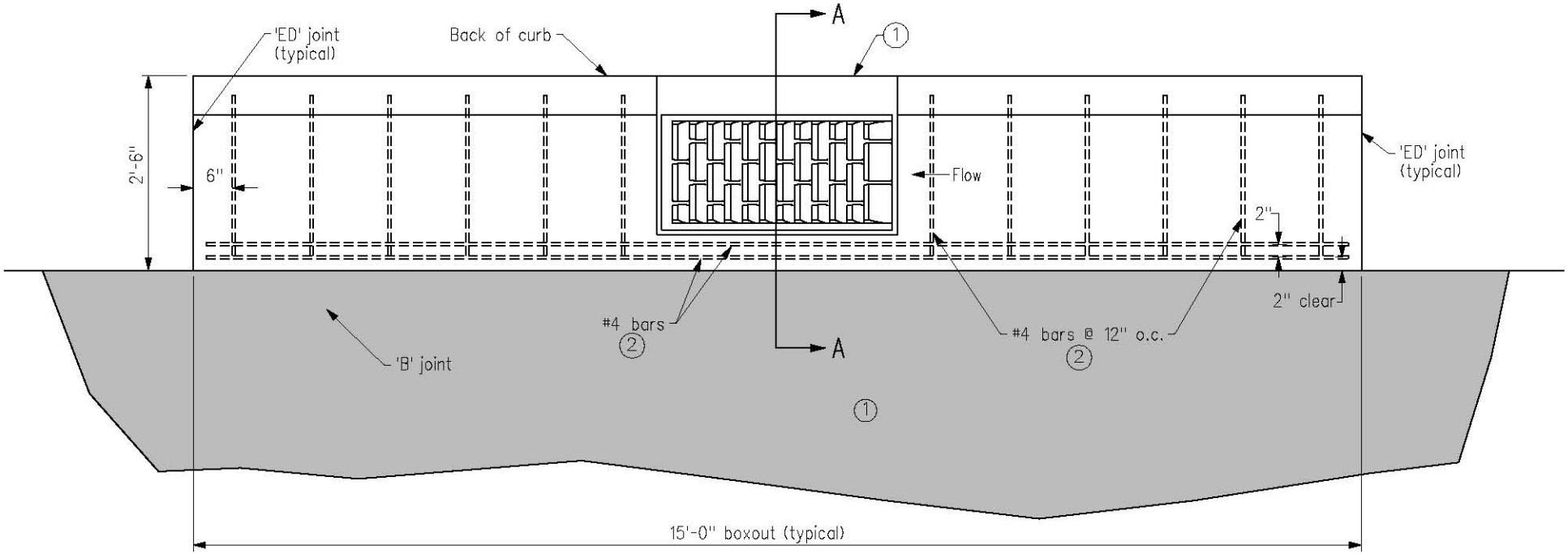
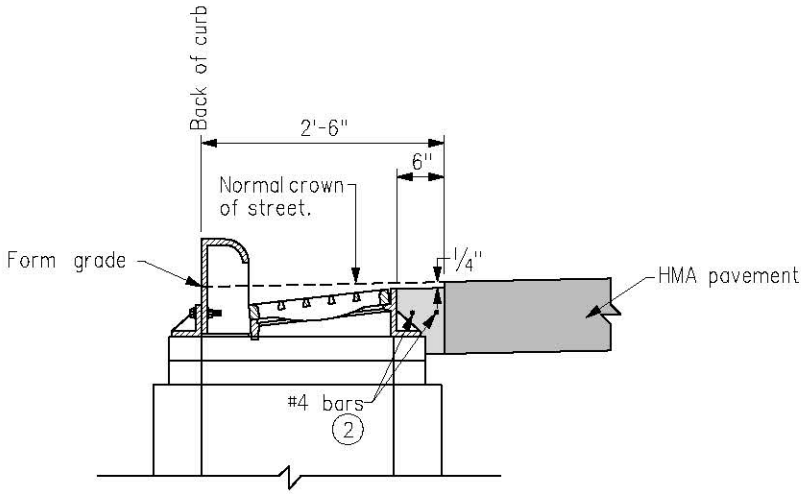
FIGURE: 6010.514

# GRATE INTAKE BOXOUTS




PLAN VIEW - STANDARD BOXOUT IN HMA PAVEMENT/PCC CURB AND GUTTER




SECTION A-A

SUDAS

FIGURE: 6010.514

| REVISION NO. |
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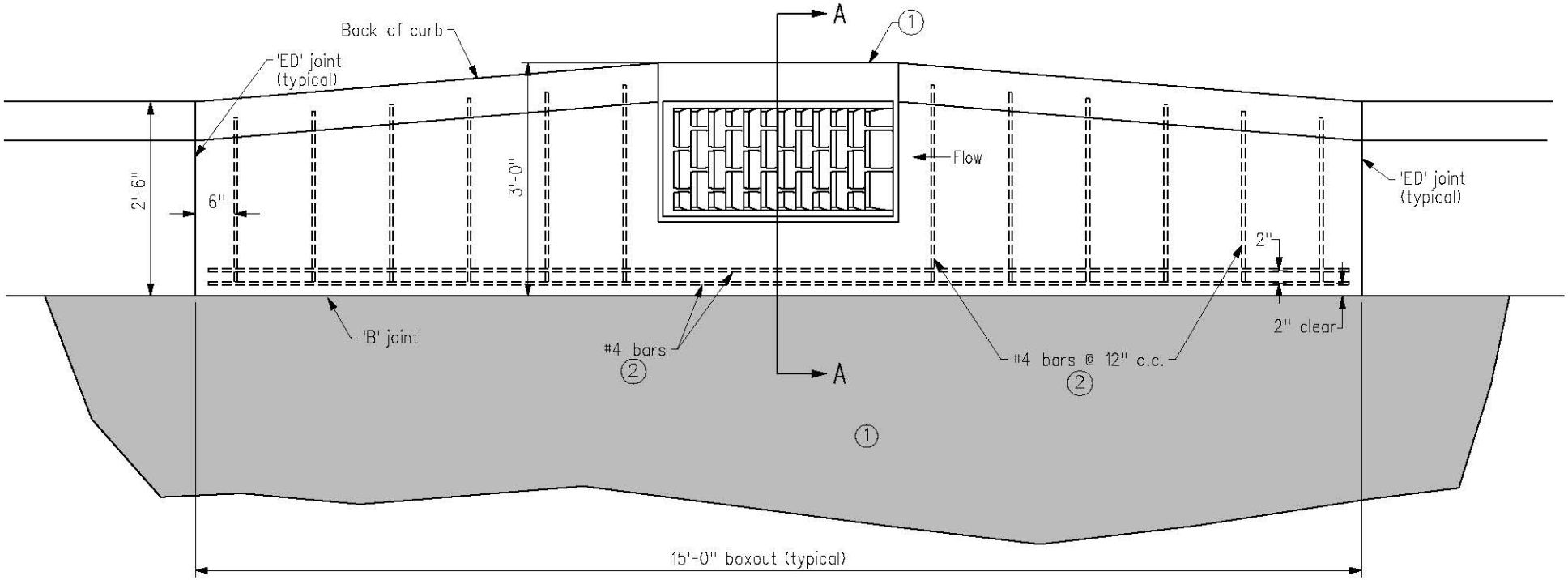
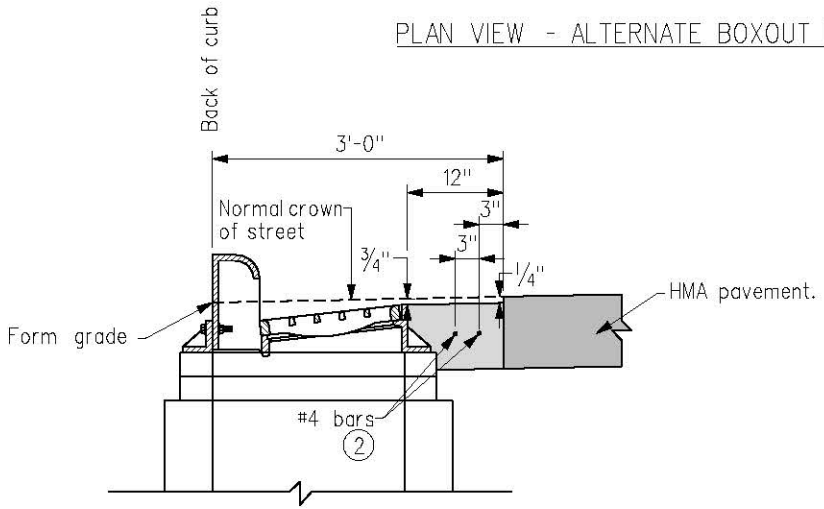
| SHEET 2 OF 3 |

GRATE INTAKE BOXOUTS

FIGURE: 6010.514 SHEET 3 OF 4




PLAN VIEW - ALTERNATE BOXOUT IN HMA PAVEMENT/PCC CURB AND GUTTER




SECTION A-A

SUDAS

REVISION NO. ---

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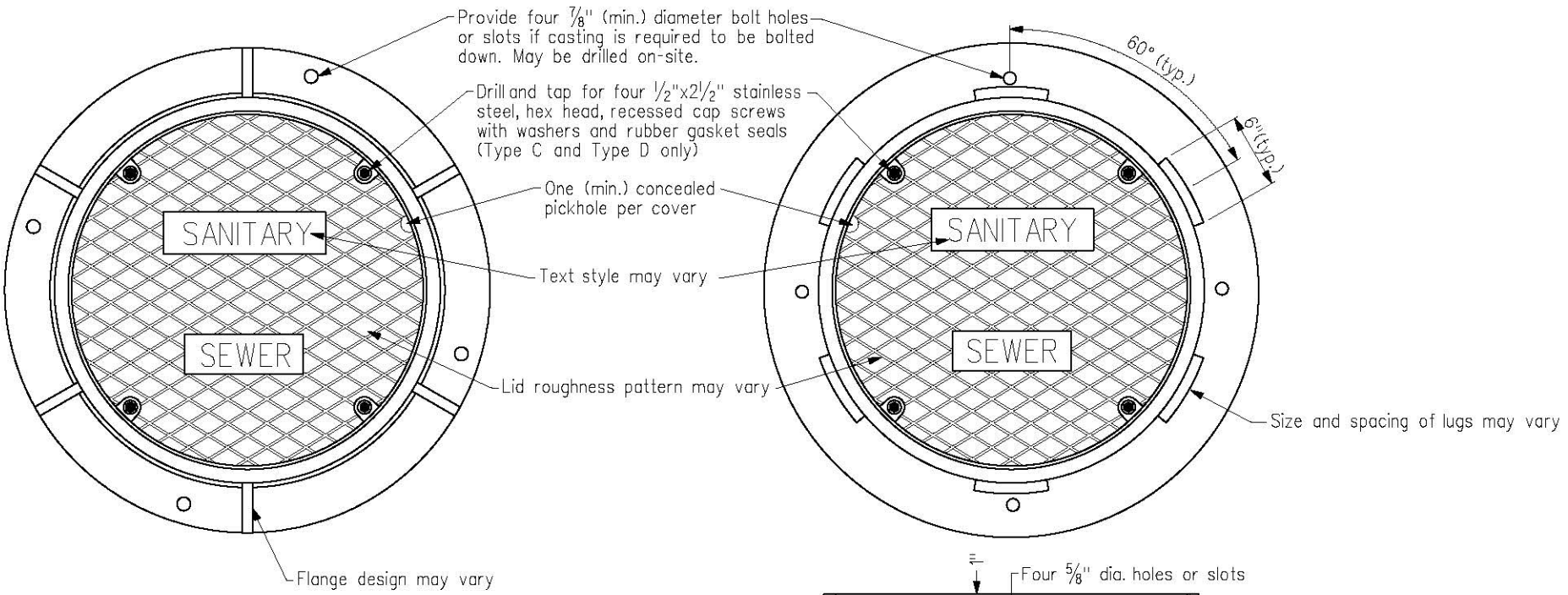
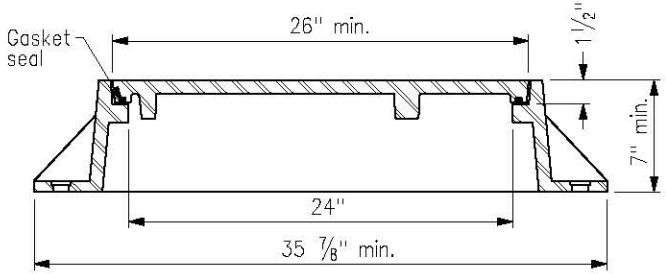
FIGURE: 6010.514

SHEET 3 OF 3

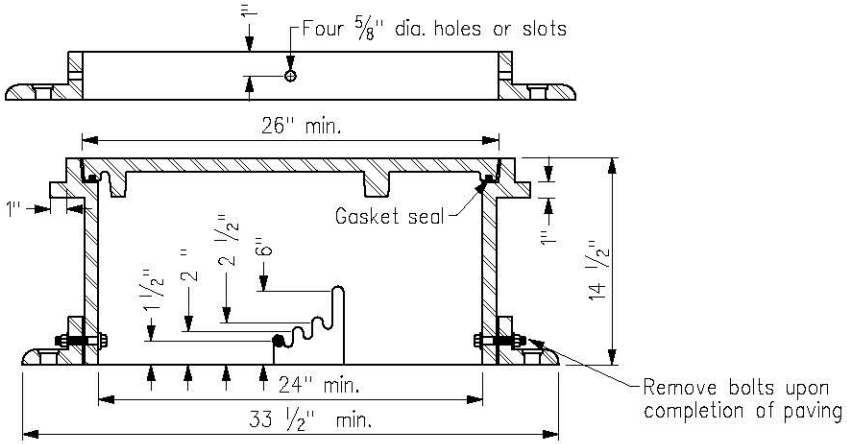
GRATE INTAKE BOXOUTS

FIGURE: 6010.514 SHEET 4 OF 4




TYPE A
Two-piece fixed casting for sanitary manholes
(Standard duty)




TYPE B
Three-piece floating casting
for sanitary manholes
(Standard duty)

TYPE C
Two-piece fixed casting with bolt-down
cover for sanitary manholes
(Standard duty)

TYPE D
Three-piece floating casting with
bolt-down cover for sanitary manholes
(Standard duty)

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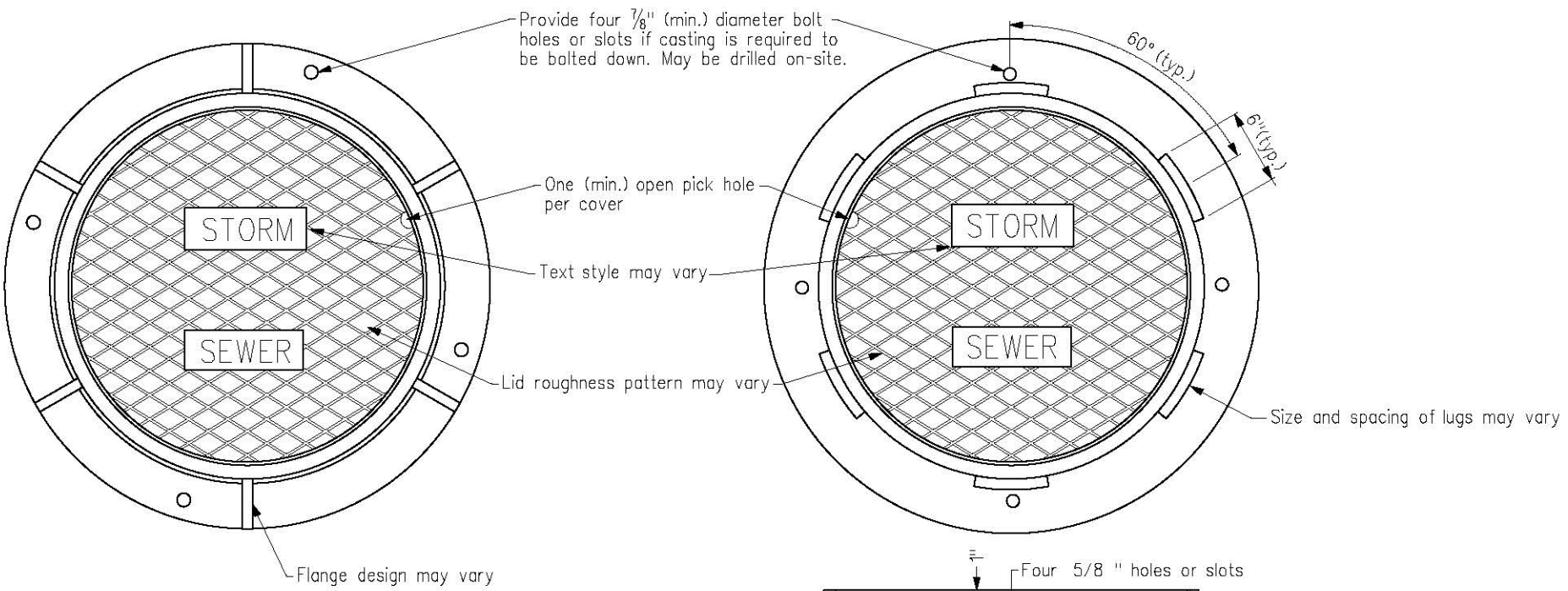
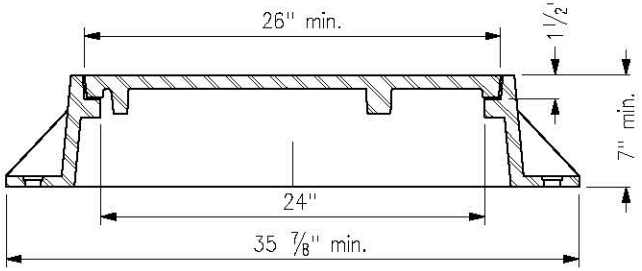
| SHEET 1 OF 1 |

FIGURE: 6010.601

# CASTINGS FOR SANITARY SEWER MANHOLES

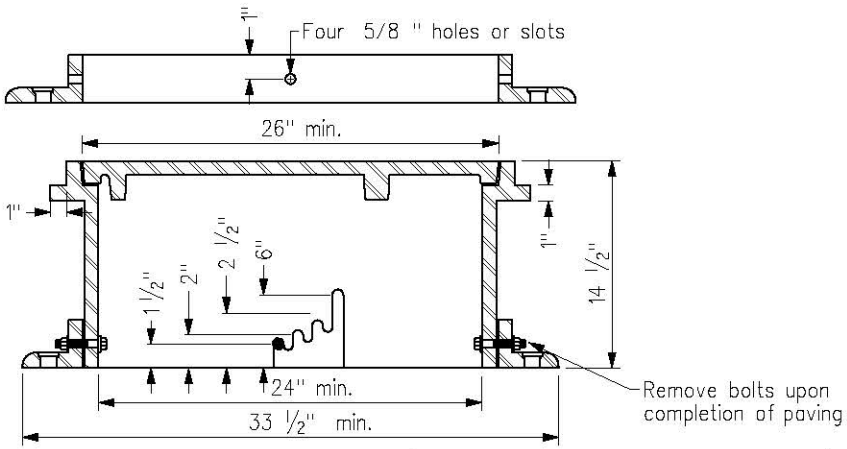
FIGURE: 6010.601 SHEET 1 OF 1




TYPE E

Two-piece fixed casting for storm sewer manholes
(Standard duty)




TYPE F

Three-piece floating casting for storm sewer manholes
(Standard duty)

SUDAS

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REVISION DATE 10/21/08

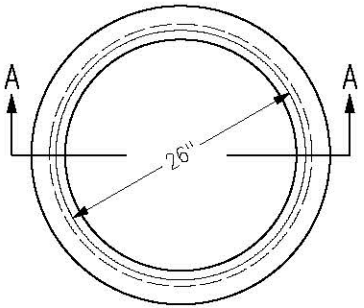
FIGURE: 6010.602

SHEET 1 OF 2

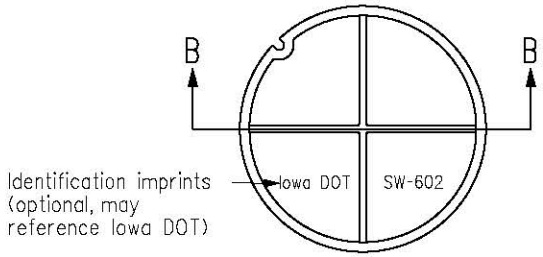
# CASTINGS FOR STORM SEWER MANHOLES

FIGURE: 6010.602 SHEET 1 OF 2

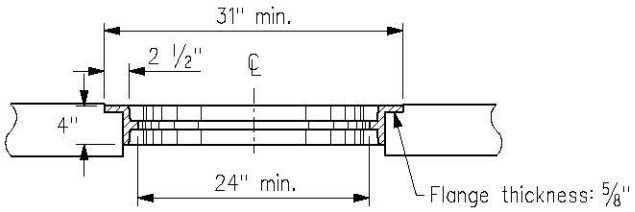
This casting is utilized with storm sewer intakes and other slab-type applications as specified.




PLAN OF FRAME

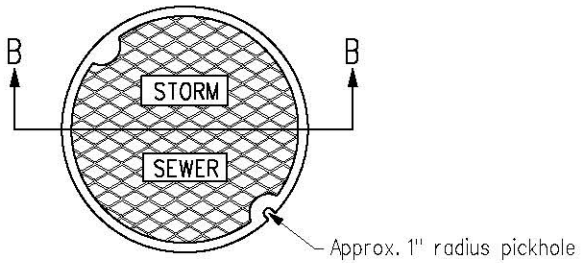



PLAN OF COVER - BOTTOM

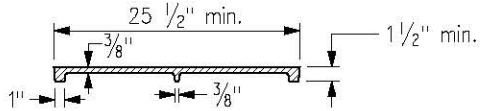



SECTION A-A

Type 1 Frame
Slab-type for cast manholes




PLAN OF COVER - TOP




SECTION B-B
Cover detail

TYPE G
(Standard duty)

SUDAS

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| --- |
| --- |
| REVISION DATE |
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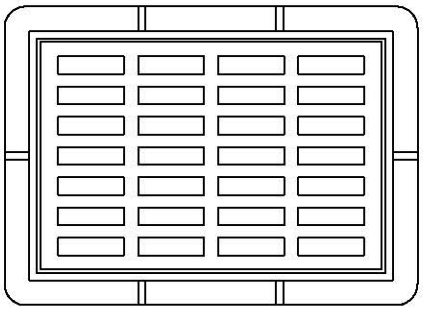
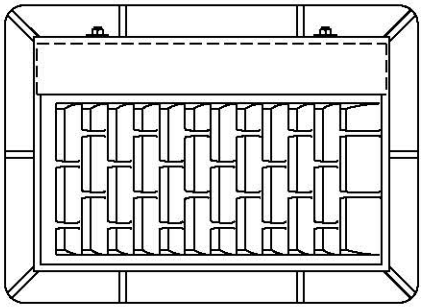
| SHEET 2 OF 2 |

FIGURE: 6010.602

# CASTINGS FOR STORM SEWER MANHOLES

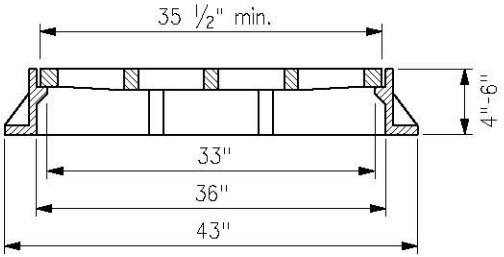


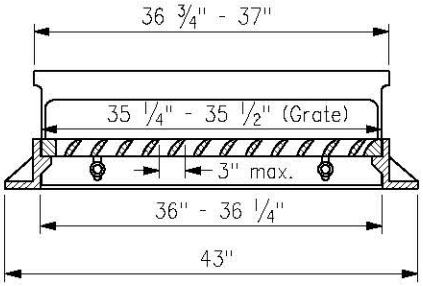


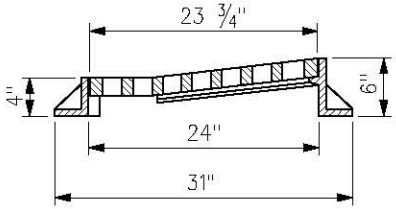

Type "R" Grate: Provide vane-style grate, or bicycle-safe vane-style grate with offset longitudinal ribs between vanes (shown). At low points, grates with vanes facing both directions of flow are allowed. Minimum open area 180 $in^2$.

Type "Q" Grate: For use in street at curb drops for driveways. Use only when specified. Minimum open area 370 $in^2$.

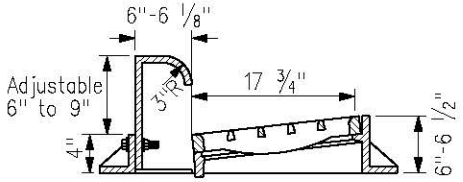
Castings with environmental symbols and/or messages such as "DUMP NO WASTE, DRAINS TO RIVER" will be allowed.




TYPE "Q" GRATE
(Standard duty)




TYPE "R" GRATE
(Standard duty)

FIGURE: 6010.603 SHEET 1 OF 1

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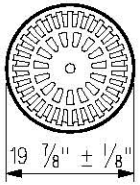
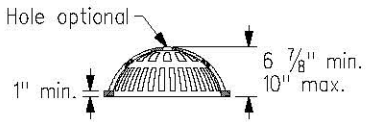
| SHEET 1 OF 1 |

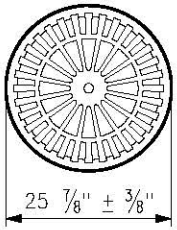
FIGURE: 6010.603

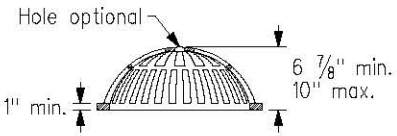
# CASTINGS FOR GRATE-TYPE INTAKES



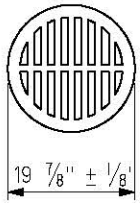



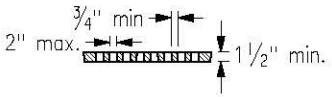

TYPE 3A GRATE
For placement on 18" RCP
(Light duty)



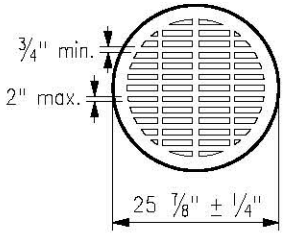



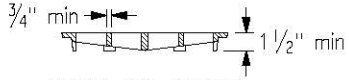

TYPE 3B GRATE
For placement on 24" RCP
(Light duty)



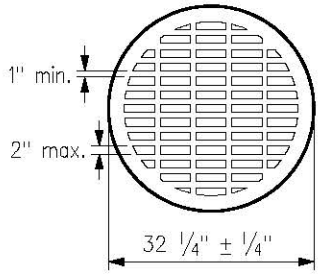



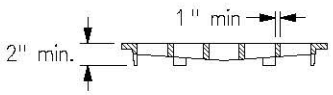

TYPE 4A GRATE
For placement on 18" RCP
(Standard duty)



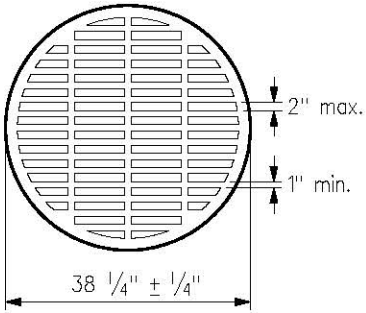



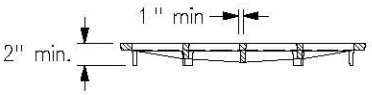

TYPE 4B GRATE
For placement on 24" RCP
(Standard duty)



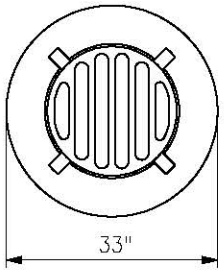



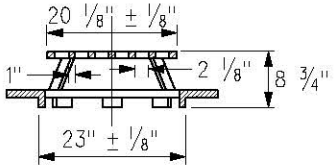

TYPE 4C GRATE
For placement on 30" RCP
(Standard duty)



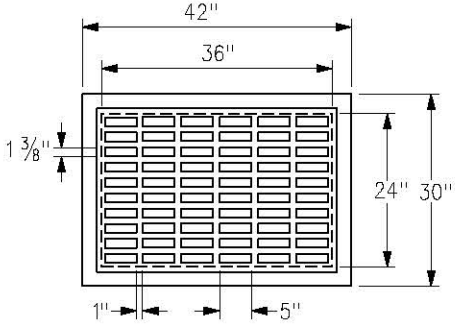



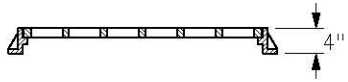

TYPE 4D GRATE
For placement on 36" RCP
(Standard duty)




TYPE 5 GRATE
For placement on 24" to 30" RCP
(Light duty)




TYPE 6 GRATE
For placement on rectangular area intake
(Standard duty)

SUDAS

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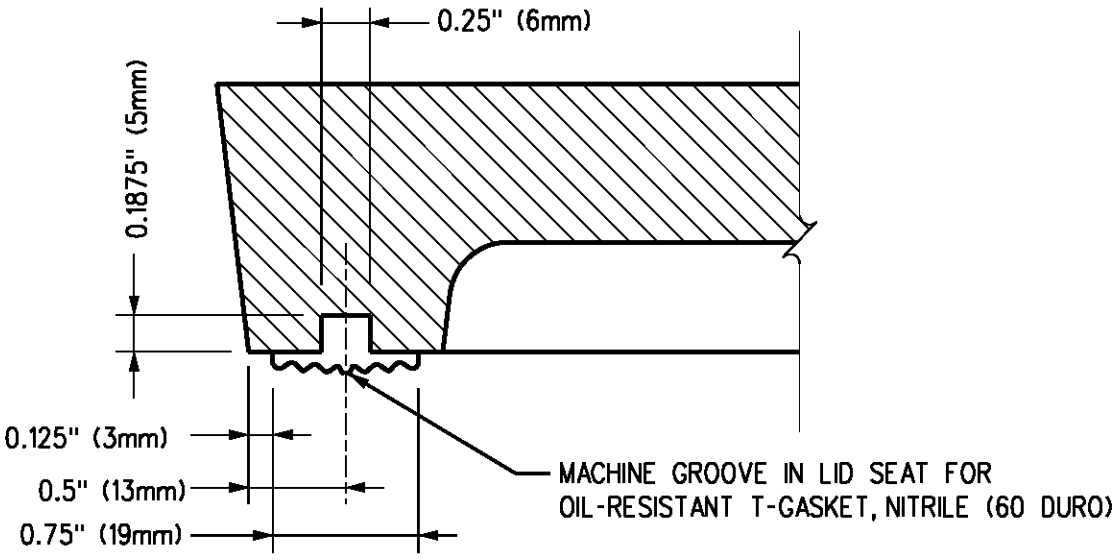
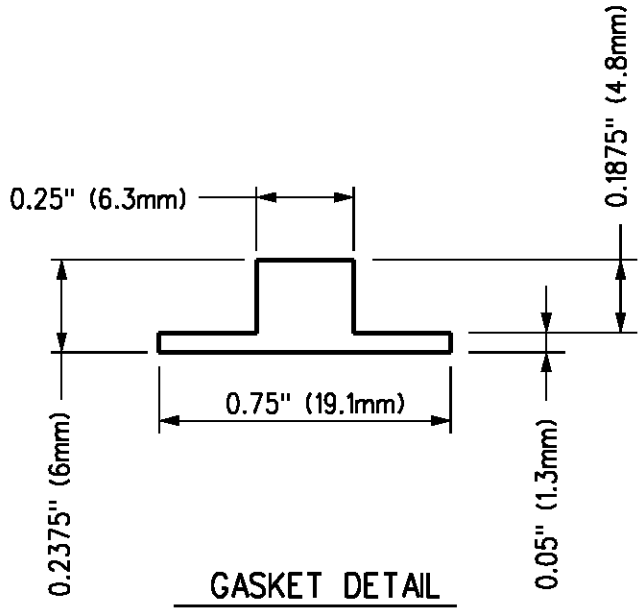
FIGURE: 6010.604

# CASTINGS FOR AREA INTAKES

FIGURE: 6010.604 SHEET 1 OF 1




GROOVE DETAIL

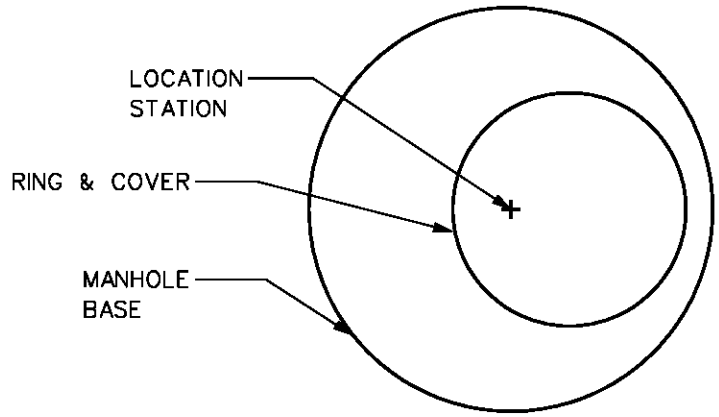



GASKET DETAIL



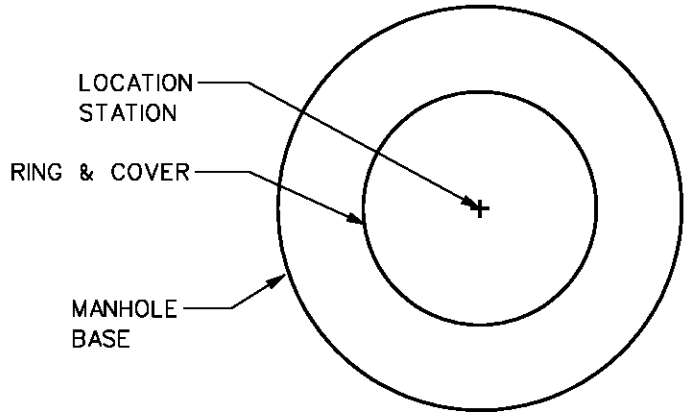
| REV. | DATE | BY | MANHOLE COVER GASKET (SANITARY SEWER) | FIGURE: 6020.11 |
|---|---|---|---|---|
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |

## LOCATION STATION
(CENTER OF MANHOLE)

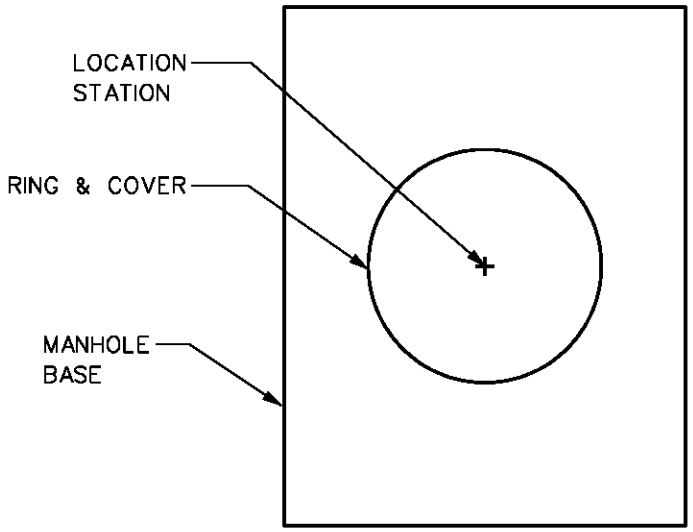



### TYPE OF MANHOLE

TYPE "A" (SANITARY); FIGURE 6020.1
TYPE "I" (SANITARY); FIGURE 6020.4
TYPE "J" (SANITARY); FIGURE 6020.5




TYPE "M-A" (STORM); FIGURE 6020.12
TYPE "M-E" (STORM); FIGURE 6020.16

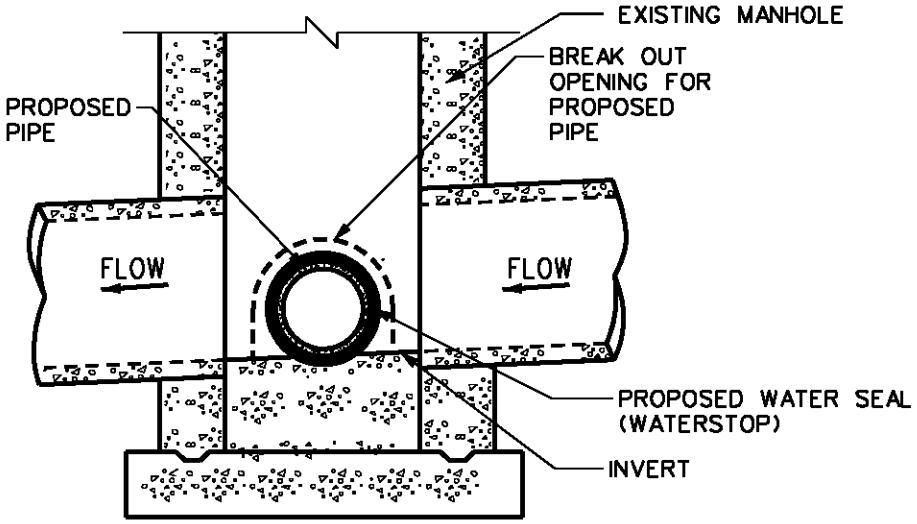


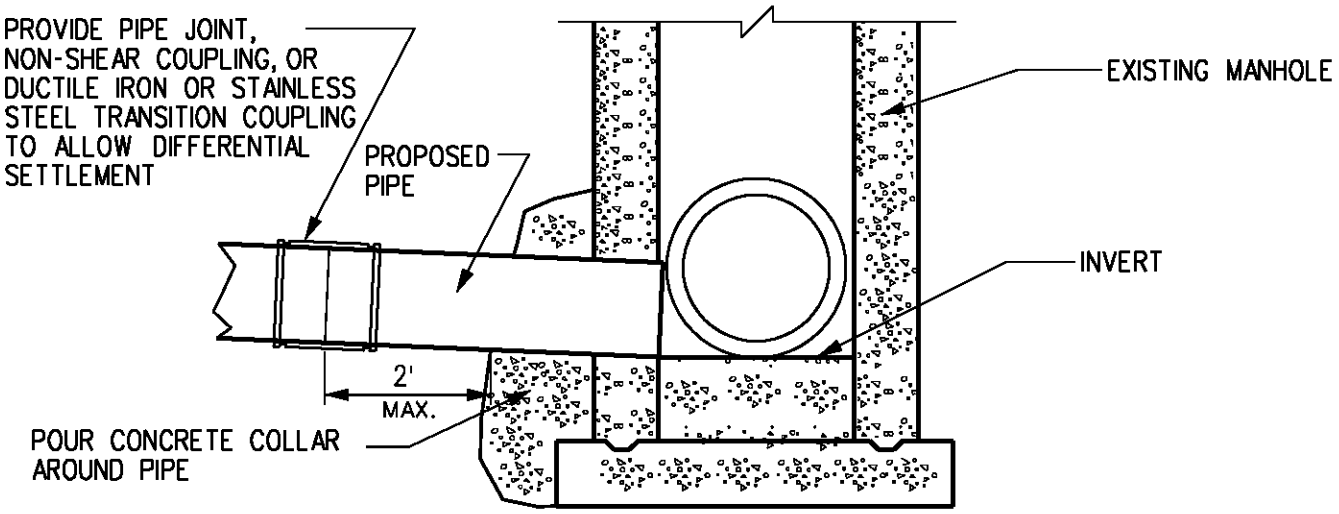

TYPE "E" (SANITARY); FIGURE 6020.2
TYPE "F" (SANITARY); FIGURE 6020.3
TYPE "M-B" (STORM); FIGURE 6020.13
TYPE "M-C" (STORM); FIGURE 6020.14
TYPE "M-D" (STORM); FIGURE 6020.15

NOTE: FIGURE 6020.20 SHOWS LOCATION STATION FOR STAKING MANHOLES.

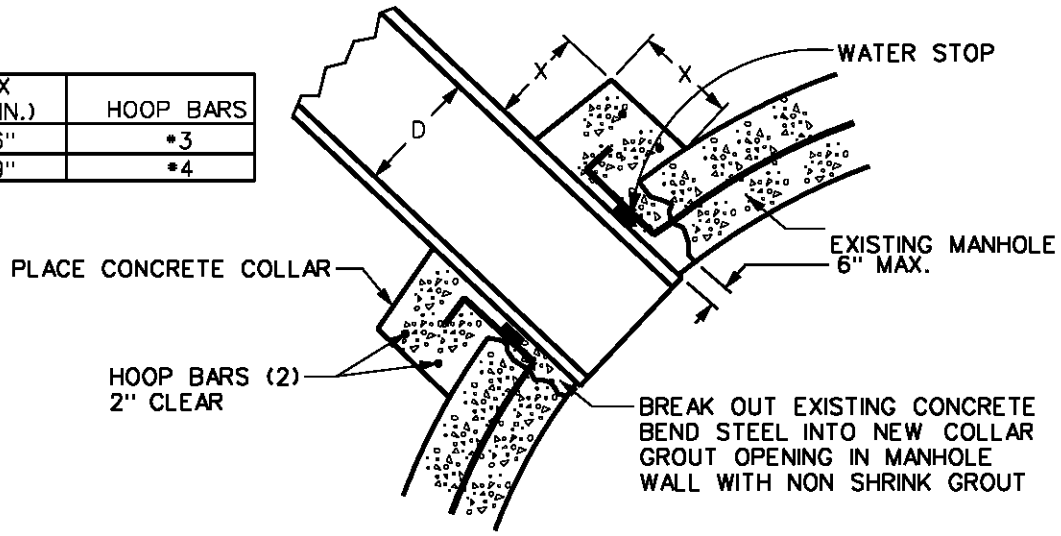


| REV. | DATE | BY | MANHOLE LOCATION STATION | FIGURE: 6020.20 |
|---|---|---|---|---|
| DATE: 01-25-01 | | | | SHEET 1 OF 1 |




| D | X (MIN.) | HOOP BARS |
|---|---|---|
| 12" OR SMALLER | 6" | #3 |
| LARGER THAN 18" | 9" | #4 |




NOTE:
THIS DETAIL SHALL BE USED FOR MANHOLE OPENINGS WHICH ARE BROKEN OR CHIPPED OUT. BREAKING OR CHIPPING NEW OPENING INTO AN EXISTING MANHOLE WILL BE ALLOWED ONLY WHEN SPECIFIED IN THE CONTRACT DOCUMENTS OR WHEN APPROVED BY THE JURISDICTIONAL ENGINEER. IF NOT SPECIFIED OR ALLOWED, A CORED OPENING SHALL BE REQUIRED. FOR CORED OPENINGS, INSTALL A FLEXIBLE WATER TIGHT CONNECTION PER 6020, 2.01I. DO NOT GROUT CORED OPENING.

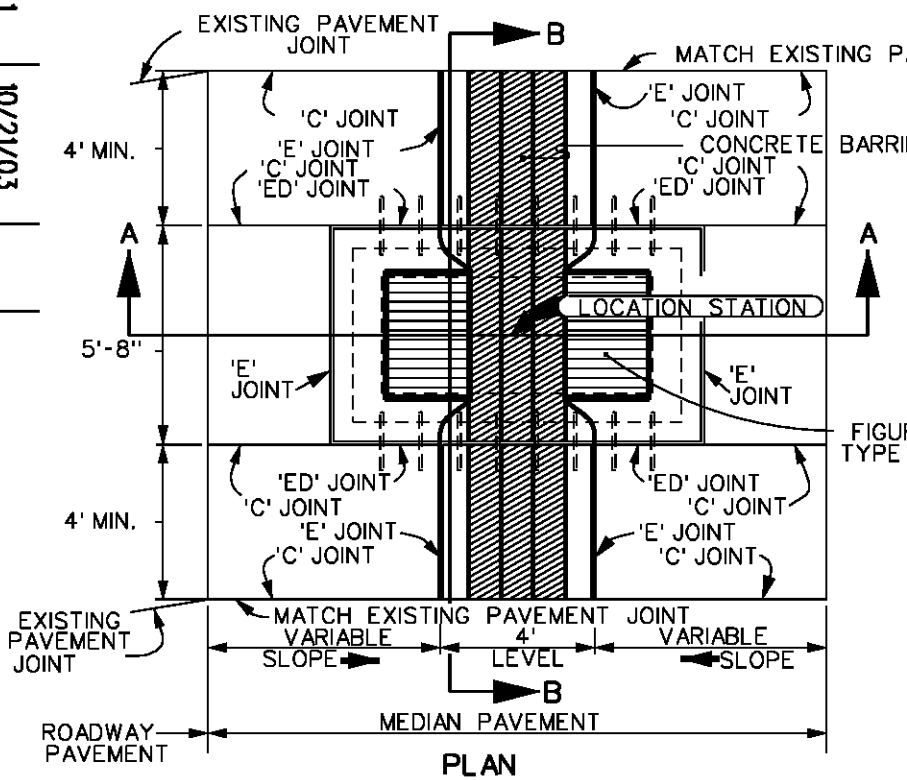


| REV. | DATE | BY | CONNECTION TO EXISTING SANITARY MANHOLE | FIGURE: 6020.21 |
|---|---|---|---|---|
| DATE: 01-29-03 | | | | SHEET 1 OF 1 |

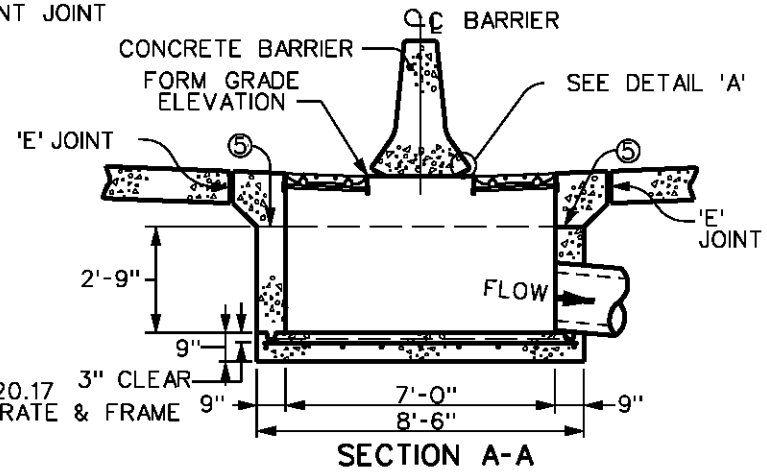
| REV. | DATE | BY |
|---|---|---|
| 1 | 10/21/03 | |

DATE: 01-01-98

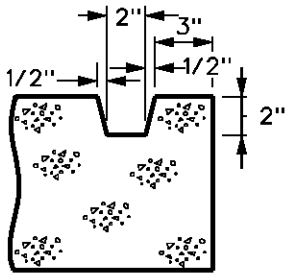
# MEDIAN INTAKE



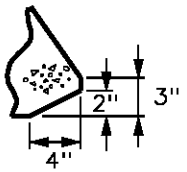

PLAN



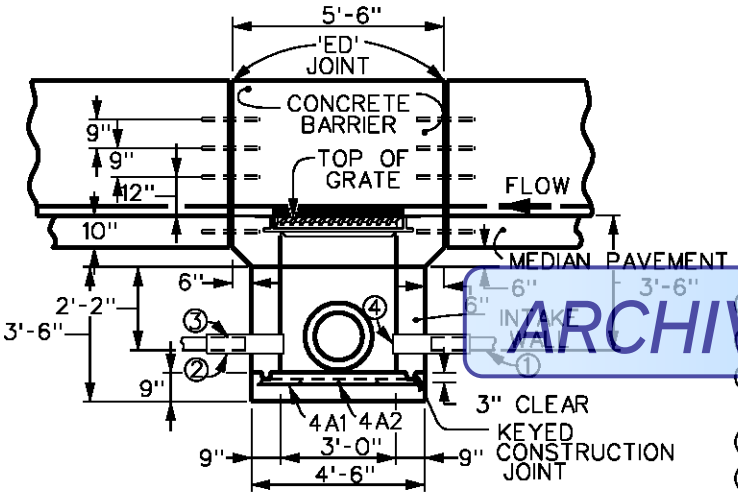

SECTION A-A




KEYED CONSTRUCTION JOINT DETAIL




DETAIL 'A'




SECTION B-B

| REINFORCING BAR LIST | | | | | | | |
|---|---|---|---|---|---|---|---|
| BAR | LOCATION | SHAPE | NO. | LENGTH | LIN.FT. | WEIGHT | SPACING |
| 4A1 | BASE | —— | 9 | 4'-0" | 36 | 24 | 1'-0" |
| 4A2 | BASE | —— | 5 | 8'-0" | 40 | 26.7 | 1'-0" |
| | | | | | TOTAL | 50.7 | |



① 6" PERFORATED SUBDRAIN (POLYETHYLENE CORRUGATED TUBING)
② 6" CMP 2' LONG
③ INSERT PERFORATED SUBDRAIN INTO CMP MINIMUM 12" IF GROUT IS USED. AT CONTRACTOR'S OPTION USE REDUCING COUPLER OR GROUT
④ REMOVABLE MESH CAP 3/8" HARDWARE CLOTH
⑤ TROWEL SMOOTH AND PLACE SUBGRADE PAPER TO PREVENT BOND

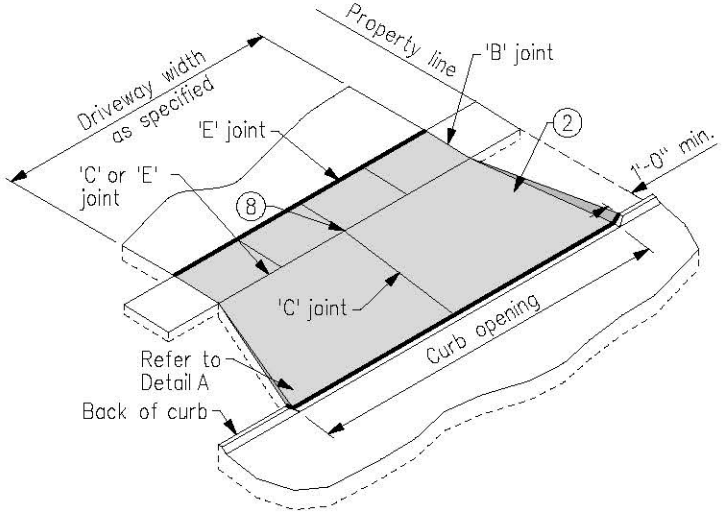
SHEET 1 OF 1

FIGURE: 6030.12

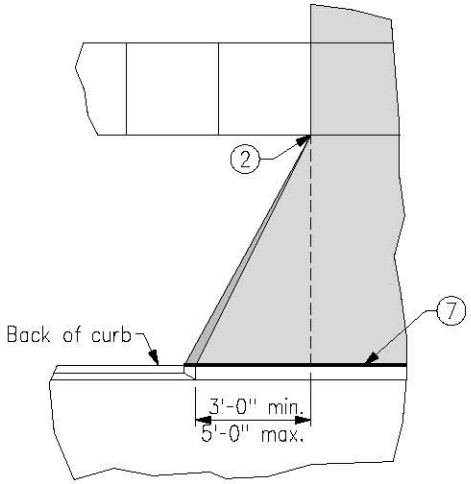
# Division 7 Figures
## Streets and Related Work

## Division 7 - Streets and Related Work

| Current # | Current SUDAS Name | Proposed SUDAS # | Iowa DOT # | Proposed Name |
|---|---|---|---|---|
| 7030.3A | Residential Driveway, Type A with Drop Curb | 7030.101 | None | Concrete Driveway, Type A |
| 7030.3B | Residential Driveway, Type B Boxout Curb | 7030.102 | None | Concrete Driveway, Type B |
| 7030.8 | Classes of Sidewalks and Recreational Trails | 7030.201 | None | Classes of Sidewalks |
| 7030.16 | Curb Details for Class "A" Sidewalk | 7030.202 | None | Curb Details for Class A Sidewalk |
| 7030.15 | Brick Sidewalk | 7030.203 | None | Brick Sidewalk |
| 7030.14 | Detectable Warnings (Truncated Domes) | 7030.204 | None | General Curb Ramp Details |
| 7030.9 | Types of Pedestrian Ramps Outside of Intersection Radius | 7030.205 | None | Curb Ramps Outside of Intersection Radius |
| 7030.10 | Preferred Pedestrian Ramp Within Intersection Radius for Class "A" Sidewalk | 7030.206 | None | Curb Ramps Within Intersection Radius for Class A Sidewalk |
| 7030.11 | Optional Pedestrian Ramp Within Intersection Radius for Claxx "A" Sidewalk | | | |
| 7030.12 | Preferred Perpendicular Ramp Within Intersection Radius for Class "B" or "C" Sidewalk | 7030.207 | None | Curb Ramps Within Intersection Radius for Class B or C Sidewalk |
| 7030.13A | Optional Ramp (Alternate 1) Within Intersection Radius for Class "B" or "C" Sidewalk | | | |
| 7030.13B | Optional Ramp (Alternate 2) Within Intersection Radius for Class "B" or "C" Sidewalk | | | |
| 7030.1 | Driveway Grading Detail | Archive | None | |
| 7030.2 | Parking and Backslopes | Archive | None | |
| 7030.4 | Commercial/Industrial Driveway | Archive | None | |
| 7030.5 | Skewed Driveway Layout for New Pavement | Archive | None | |
| 7030.6 | Special Shaping for Driveway Intake | Archive | None | |
| 7030.7 | Details of Typical Rural Entrance and Safety Ramp | Archive | None | |
| | | | | |

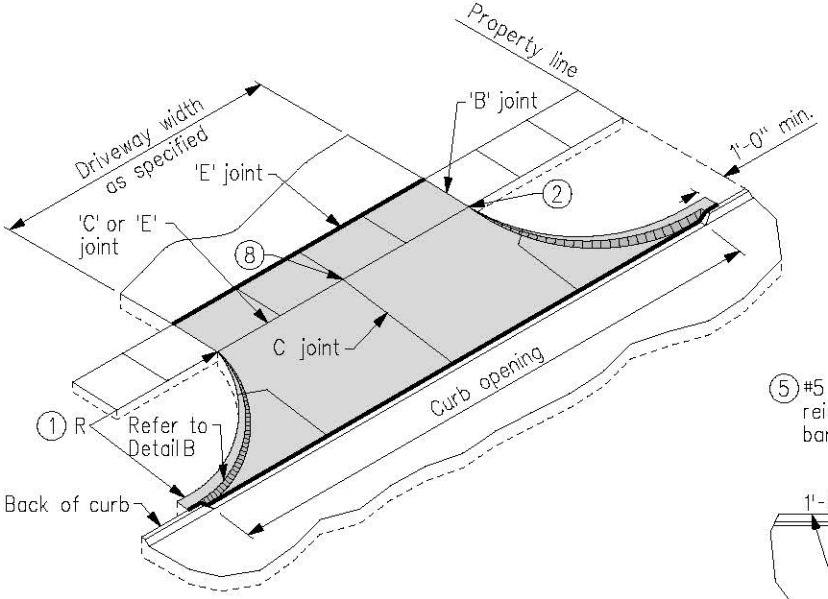



TYPE A WITH FLARES

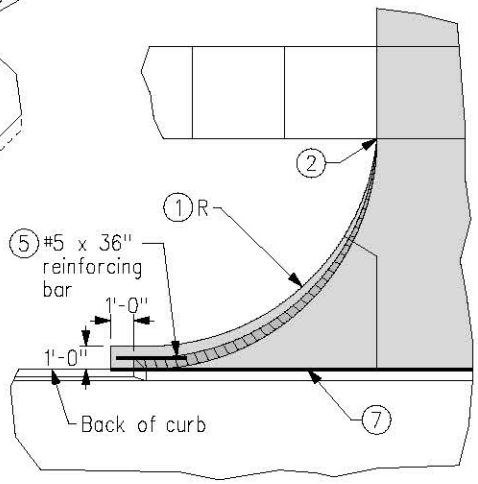



DETAIL A

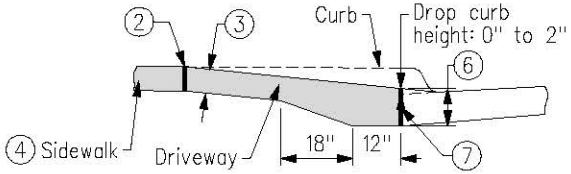
1. Driveway radius (R).
   Residential: 10 foot minimum, 15 foot maximum.
   Commercial and industrial: as specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb across sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. Center reinforcing bar vertically in the pavement.
6. Match thickness of adjacent roadway, 8 inches minimum.
7. Provide 'E' joint at back of curb unless 'B' joint is specified.
8. For alleys, invert the pavement crown 2% toward center of alley.




TYPE A WITH RADII




DETAIL B




TYPICAL SECTION

SUDAS

| REVISION NO. |
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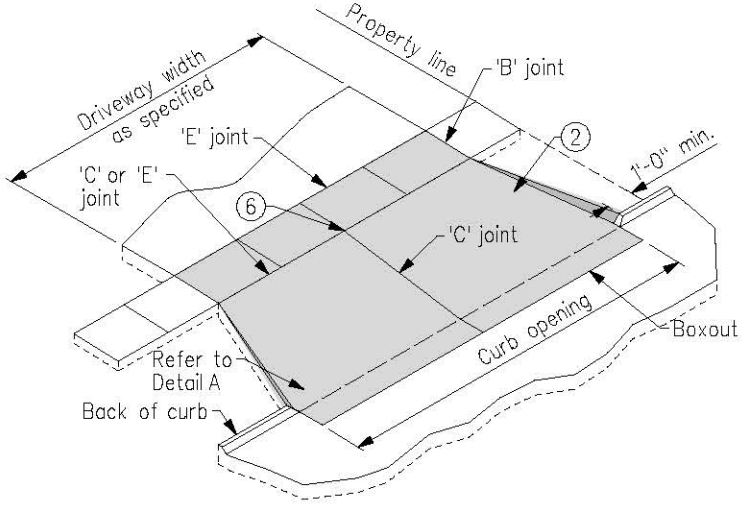
| REVISION DATE |
| 10/21/08 |
| SHEET 1 OF 1 |

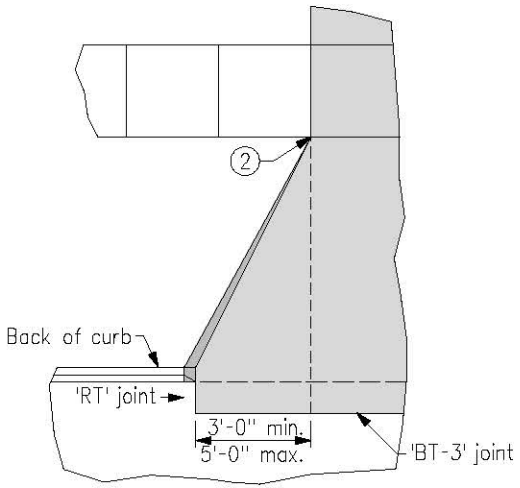
FIGURE: 7030.101

# CONCRETE DRIVEWAY, TYPE A

FIGURE: 7030.101 | SHEET 1 OF 1

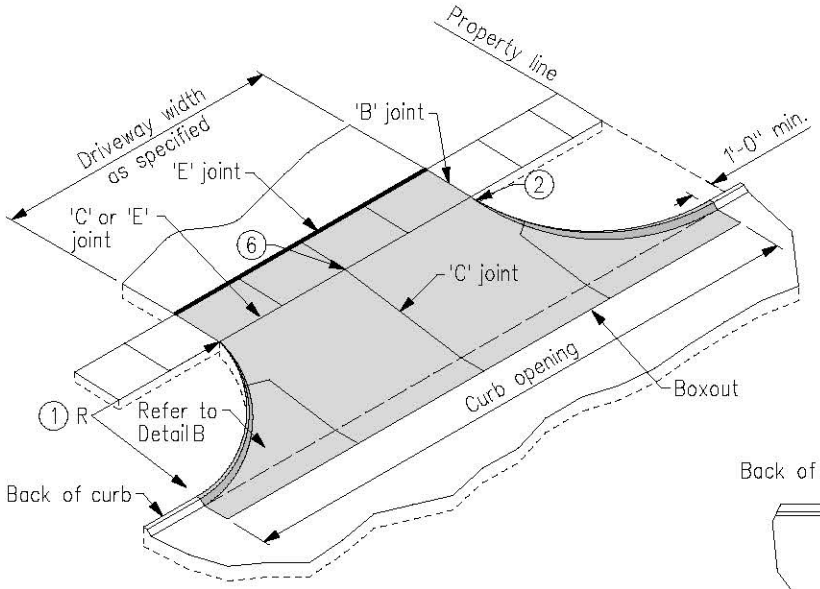



TYPE B WITH FLARES

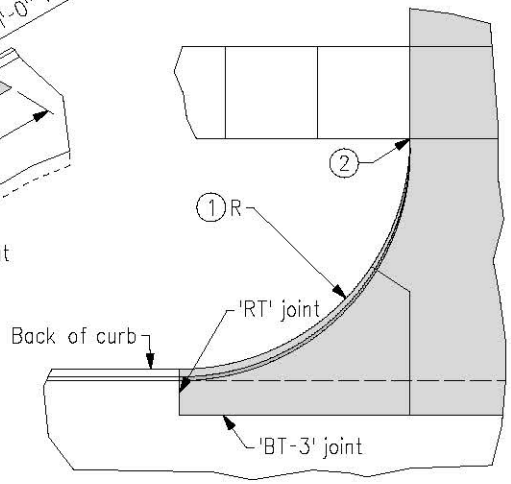



DETAIL A

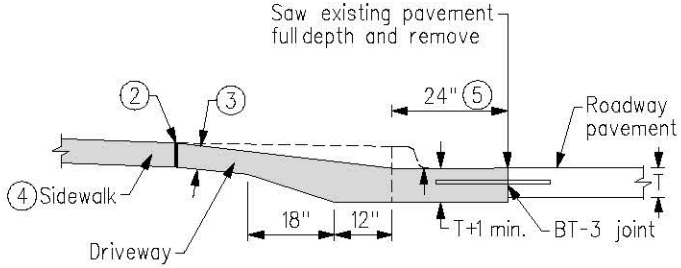
1. Driveway radius (R).
   Residential: 10 foot minimum, 15 foot maximum.
   Commercial and industrial: as specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb across sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. If longitudinal joint is located 48 inches or less from the back of curb, extend boxout to joint line. Full depth saw cut is still required.
6. For alleys, invert the pavement crown 2% toward the center of the alley.




TYPE B WITH RADII




DETAIL B



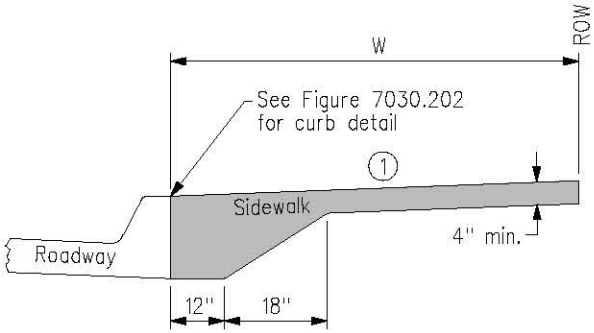

SECTION A-A

SUDAS

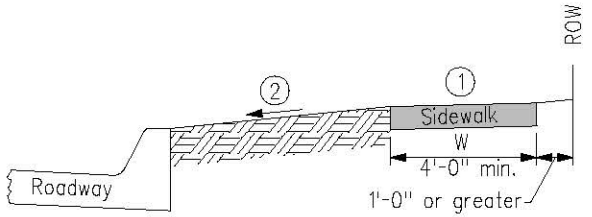
| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 7030.102 | SHEET 1 OF 1 |

# CONCRETE DRIVEWAY, TYPE B

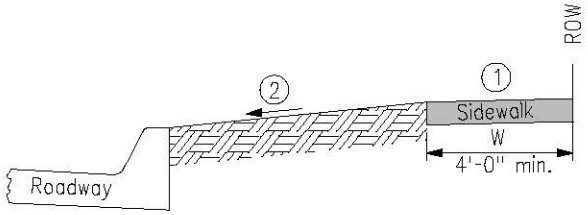
FIGURE: 7030.102 | SHEET 1 OF 1




CLASS A SIDEWALK
(Sidewalk extends from back of curb to ROW)




CLASS B SIDEWALK




CLASS C SIDEWALK

① Maximum cross slope of sidewalk (including sidewalk through driveway) is 2%.

② Parking slopes:
Less than 10 feet wide: 1/4 inch per foot
Over 10 feet wide: 1/2 inch per foot.

Special grade may be specified in the contract documents.

W = Sidewalk width as specified in the contract documents.

SUDAS

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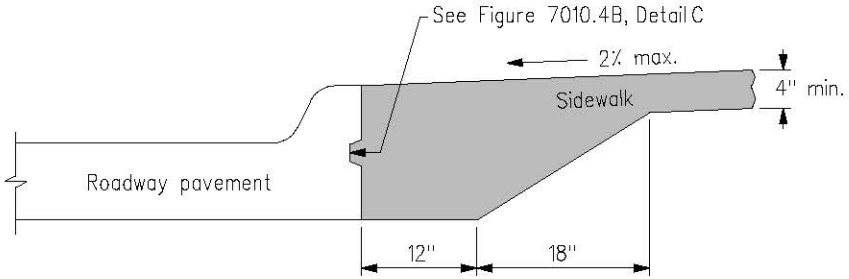
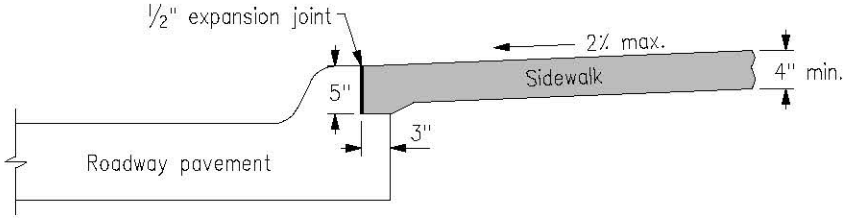
FIGURE: 7030.201

# CLASSES OF SIDEWALKS

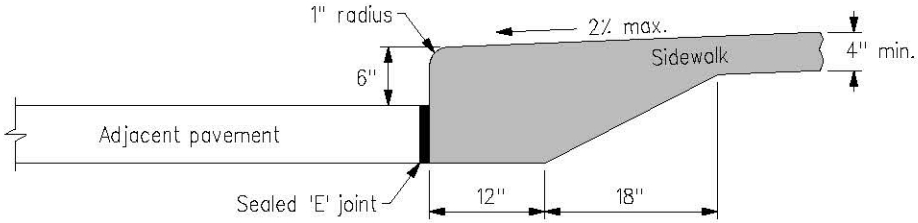
FIGURE: 7030.201 SHEET 1 OF 1




DETAIL 1




DETAIL 2




DETAIL 3

For new sidewalk with new curb and gutter, comply with Detail 1 or Detail 2. Comply with Detail 3 for new sidewalk adjacent to existing pavement or when specified in the contract documents.

FIGURE: 7030.202 SHEET 1 OF 1

SUDAS

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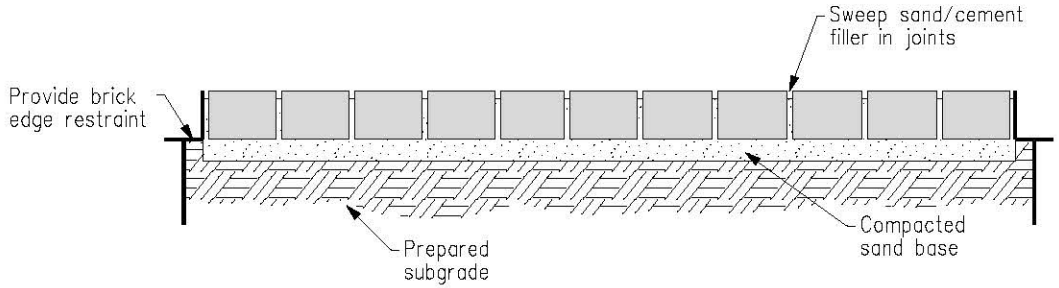
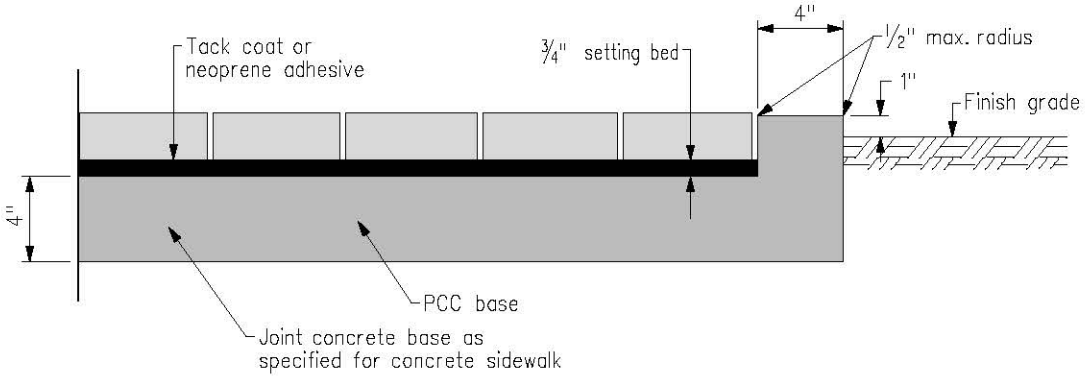
FIGURE: 7030.202

# CURB DETAILS FOR CLASS A SIDEWALK

Install brick sidewalk with pattern specified in the contract documents.




BRICK SIDEWALK WITH SAND BASE



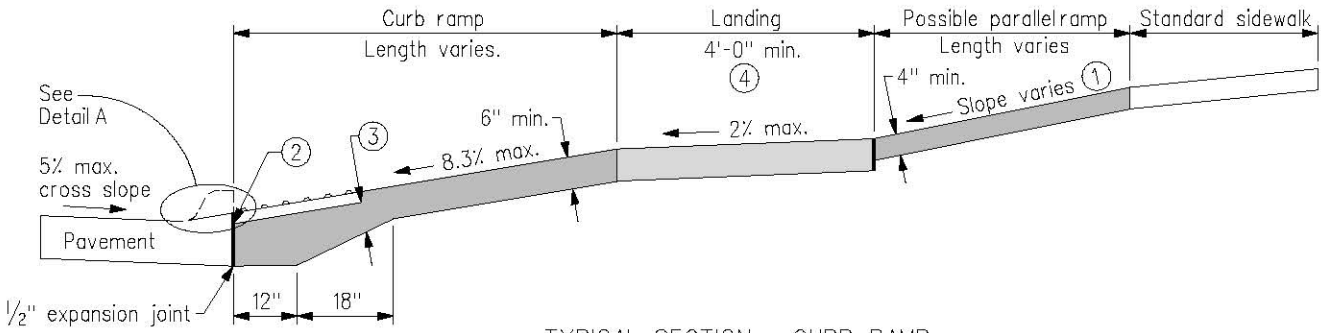

BRICK SIDEWALK WITH CONCRETE BASE

FIGURE: 7030.203 SHEET 1 OF 1

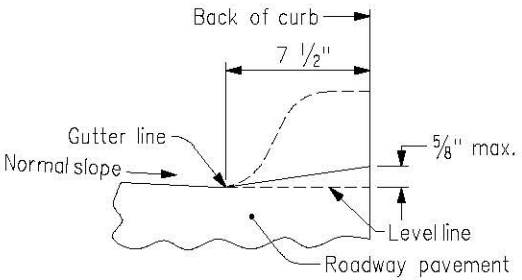
SUDAS

| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 7030.203 | SHEET 1 OF 1 |

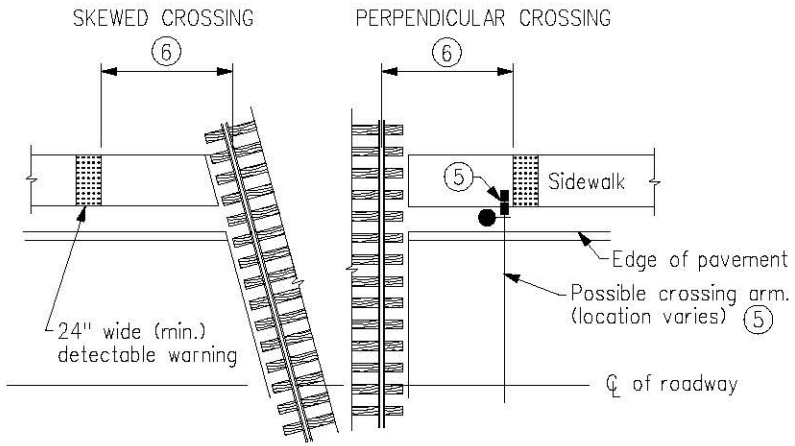
# BRICK SIDEWALK



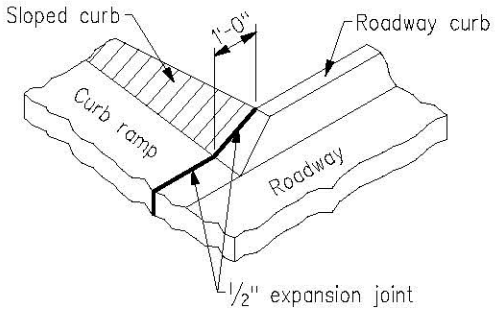

TYPICAL SECTION - CURB RAMP




DETAIL A




DETECTABLE WARNING LOCATION AT RAILROAD CROSSING




DETAIL B
(Curb return)

If crosswalks are marked, locate ramps, exclusive of flares, within the crosswalk markings.

① Parallel ramp: If normal sidewalk elevation cannot be achieved with the perpendicular ramp between the street and landing due to limited ramp length, provide a parallel ramp to make up the elevation difference between the landing and the standard sidewalk.

The length of the parallel ramp is not required to exceed 15 feet, regardless of the resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.

② Install a 24 inch wide (min.) strip of detectable warnings at the back of curb. Extend the detectable warnings across the full width of the ramp.

③ Provide a minimum of 6 inches of concrete below the detectable warning panel.

④ Landing: maximum slope of 2% in any direction.

⑤ If crossing gate conflicts with location of detectable warning or if pedestrian crossing gate is provided, place detectable warning panel in advance of the crossing gate.

⑥ Install detectable warning panel with truncated domes oriented parallel to the direction of pedestrian travel. Locate front edge of detectable warning panel 6 to 15 feet from centerline of nearest rail.

Key

= Ramp

= Landing

= Detectable warning

SUDAS

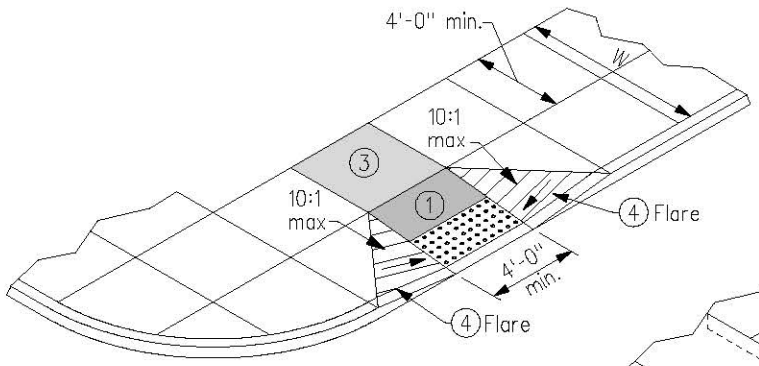
| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 7030.204 | SHEET 1 OF 1 |

# GENERAL CURB RAMP DETAILS

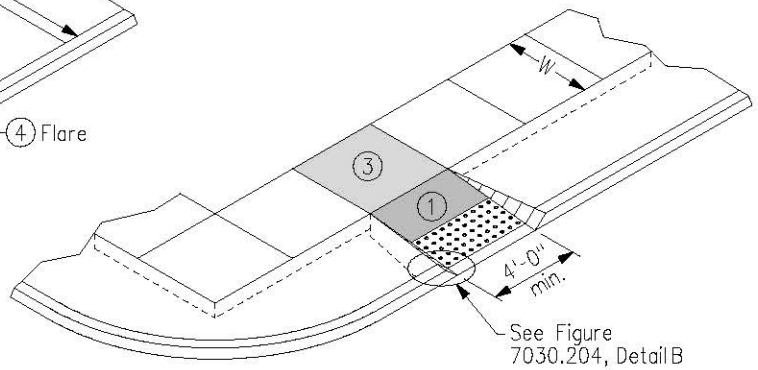
FIGURE: 7030.204 SHEET 1 OF 1

If crosswalks are marked, locate ramps, exclusive of flares, within the crosswalk markings.

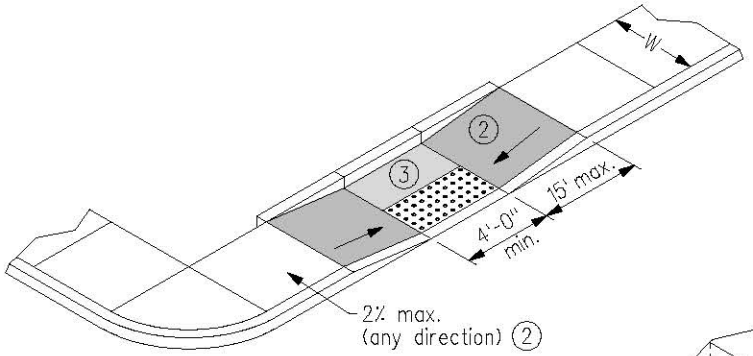
1. Perpendicular ramp: Maximum running slope of 8.3%. Maximum cross slope of 2%. At mid-block crossings, cross slope may exceed 2% to match roadway grade.
2. Parallel ramp: Maximum cross slope of 2%. The length of the parallel ramp is not required to exceed 15 feet, regardless of resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.
3. Landing: Maximum slope of 2% in any direction. At mid-block crossings, cross slope of landing may exceed 2% to match roadway grade.
4. Flare required if ramp is contiguous with sidewalk.
5. Provide 2% cross slope across median for drainage. For wide medians (12 feet or greater), curb ramps may be used at both sides with a 48 inch by 48 inch minimum landing in between.
6. For crossings controlled by signals and timed for full crossing, detectable warnings are not required at medians.



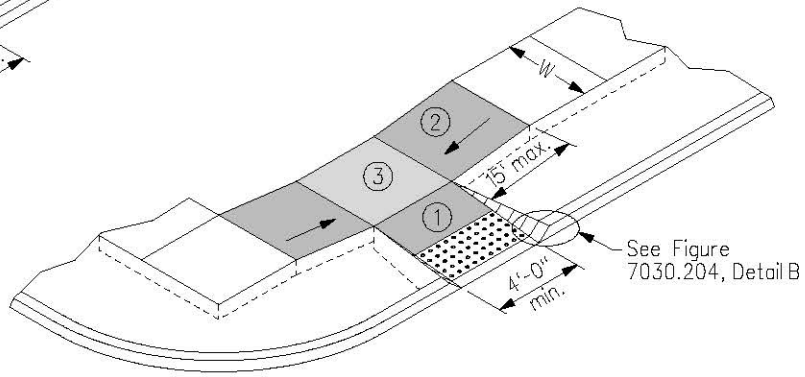

PERPENDICULAR RAMP
(For Class A Sidewalk)




PERPENDICULAR RAMP
(For Class B Sidewalk)




PARALLEL RAMP
(For Class A Sidewalk)
(For use with restricted right-of-way)
(All ramp slope within sidewalk)




COMBINATION RAMP
(For Class B Sidewalk)

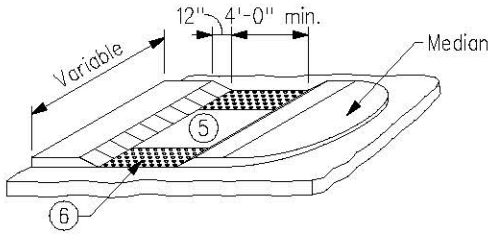
Key

W = Sidewalk width as specified in the contract documents.

= Ramp

= Landing

= Detectable warning




ACCESS AT CURBED MEDIANS

SUDAS

REVISION NO. ---

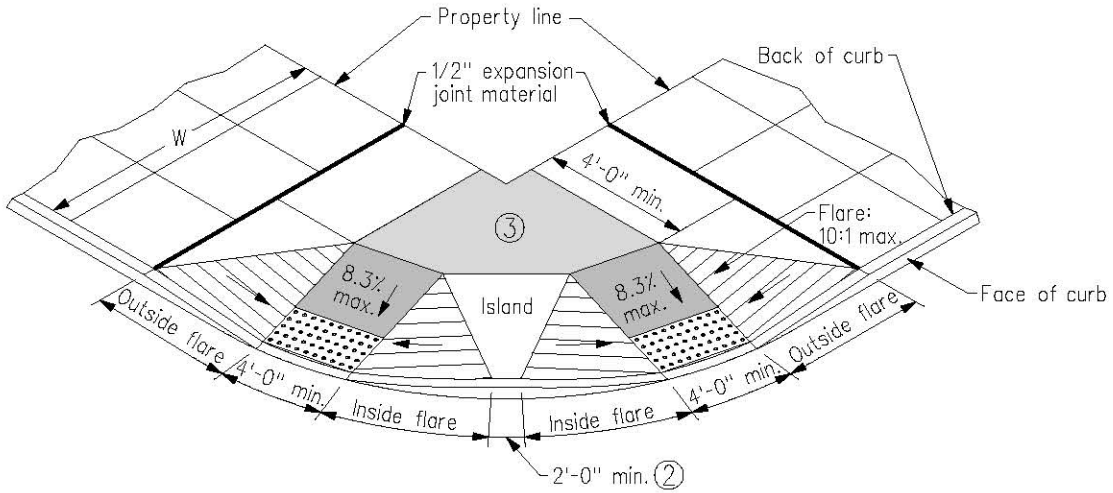
REVISION DATE 10/21/08

FIGURE: 7030.205

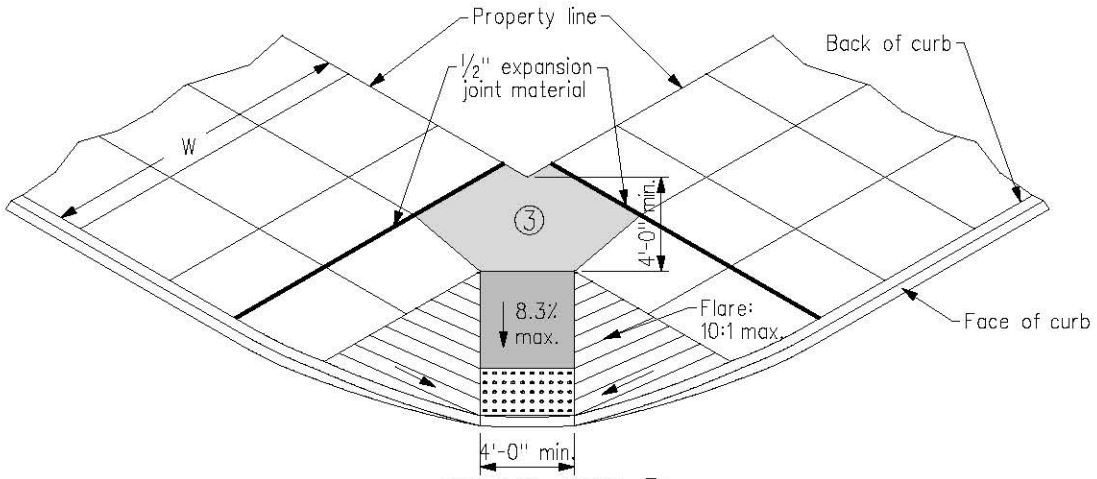
SHEET 1 OF 1

# CURB RAMPS OUTSIDE OF INTERSECTION RADIUS

FIGURE: 7030.205 SHEET 1 OF 1




PREFERRED RAMP ①




OPTIONAL RAMP ②

Refer to Figure 7030.204 for general ramp details.

① Construct preferred ramp when sufficient right-of-way is available.

② Optional ramp is acceptable if center island cannot be constructed at a minimum width of 2 feet and height of 3 inches.

③ Landing: Maximum slope of 2% in any direction.

Key

W = Sidewalk width as specified in the contract documents.

= Ramp

= Landing

= Detectable warning

FIGURE: 7030.206 SHEET 1 OF 1

SUDAS

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| 10/21/08 |
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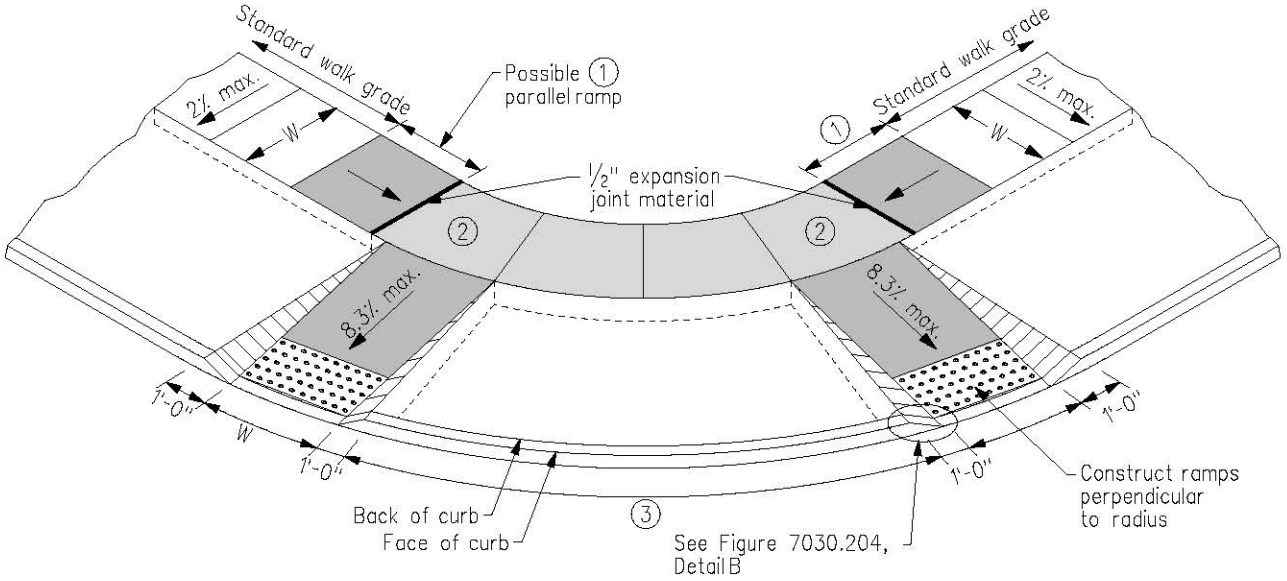
FIGURE: 7030.206

# CURB RAMPS WITHIN INTERSECTION RADIUS FOR CLASS A SIDEWALK




PREFERRED RAMP

Refer to Figure 7030.204 for general ramp details.

(1) Parallel ramp: If normal sidewalk elevation cannot be achieved with the perpendicular ramp between the street and landing due to limited ramp length, provide a parallel ramp to make up the elevation difference between the landing and the standard sidewalk.

The length of the parallel ramp is not required to exceed 15 feet, regardless of the resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.

(2) Landing: maximum slope of 2% in any direction.

(3) Island width: 5 foot minimum. If island is less than 5 feet, eliminate island and provide Alternate 2.

(4) Unless curb ramp is aligned perpendicular to the street radius, provide an area of special shaping at the bottom of the ramp to provide a smooth transition to the gutterline. 2% maximum slope in any direction.

Key

W = Sidewalk width as specified in the contract documents.

= Ramp

= Landing

= Detectable warning

FIGURE: 7030.207 SHEET 1 OF 2

SUDAS

| REVISION NO. |
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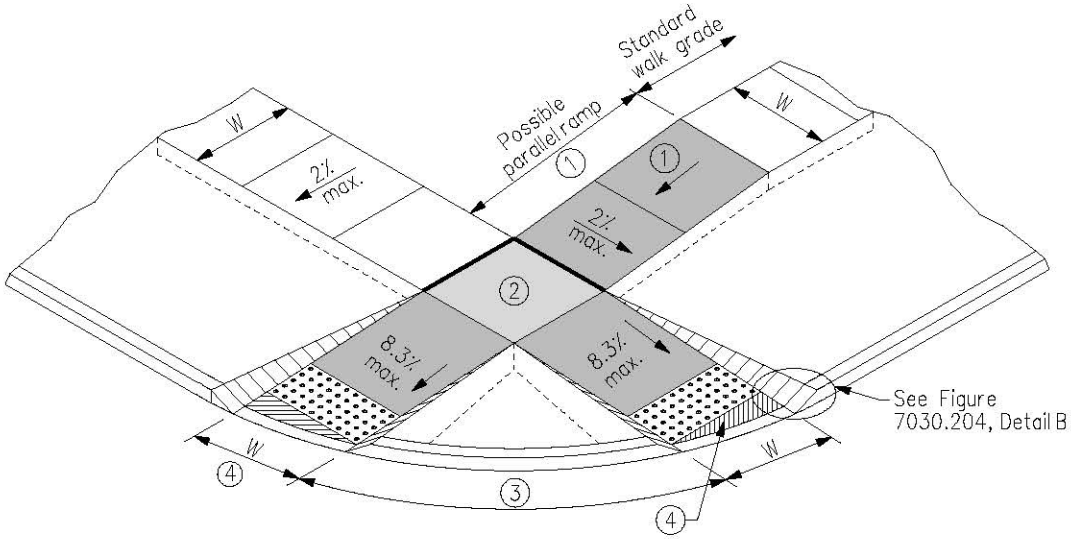
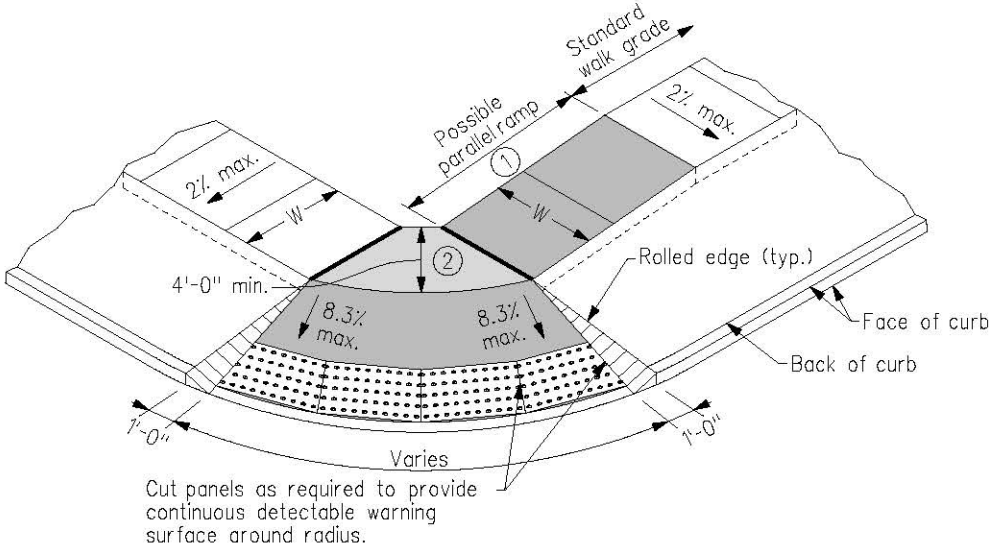
| --- |
| REVISION DATE |
| 10/21/08 |
| SHEET 1 OF 2 |

FIGURE: 7030.207

# CURB RAMPS WITHIN INTERSECTION RADIUS FOR CLASS B OR C SIDEWALK




ALTERNATE RAMP 1



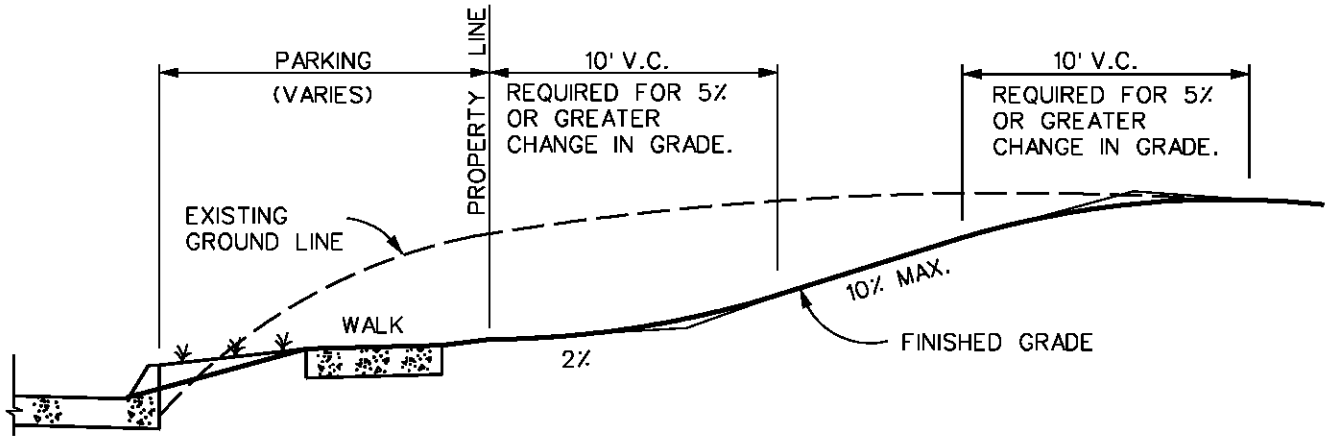

ALTERNATE RAMP 2

FIGURE: 7030.207 SHEET 2 OF 2

SUDAS

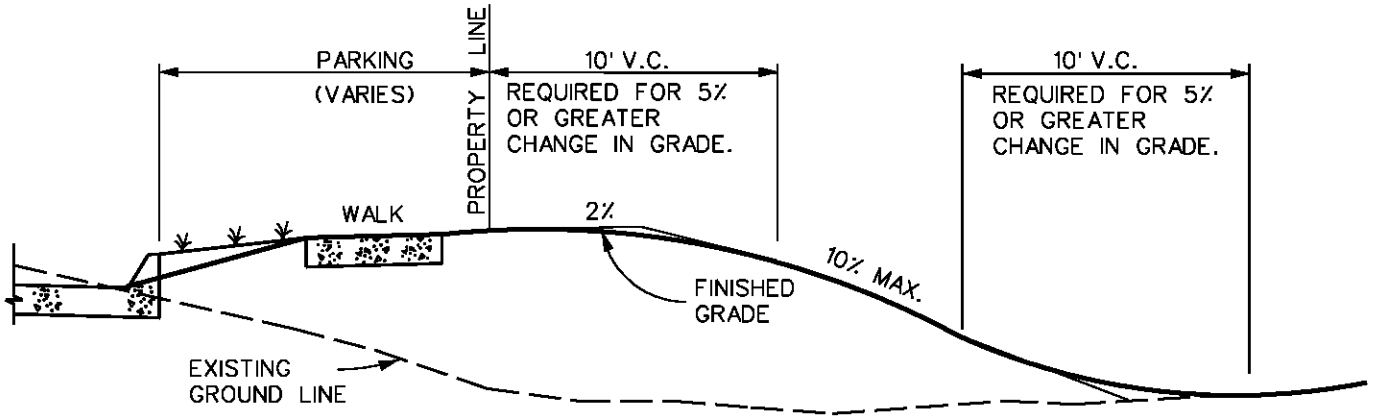
| REVISION NO. | --- |
|---|---|
| REVISION DATE | 10/21/08 |
| FIGURE: 7030.207 | SHEET 2 OF 2 |

# CURB RAMPS WITHIN INTERSECTION RADIUS FOR CLASS B OR C SIDEWALK




## DRIVEWAY GRADING DETAIL IN CUT SECTION

(℄ PROFILE SHOWN)

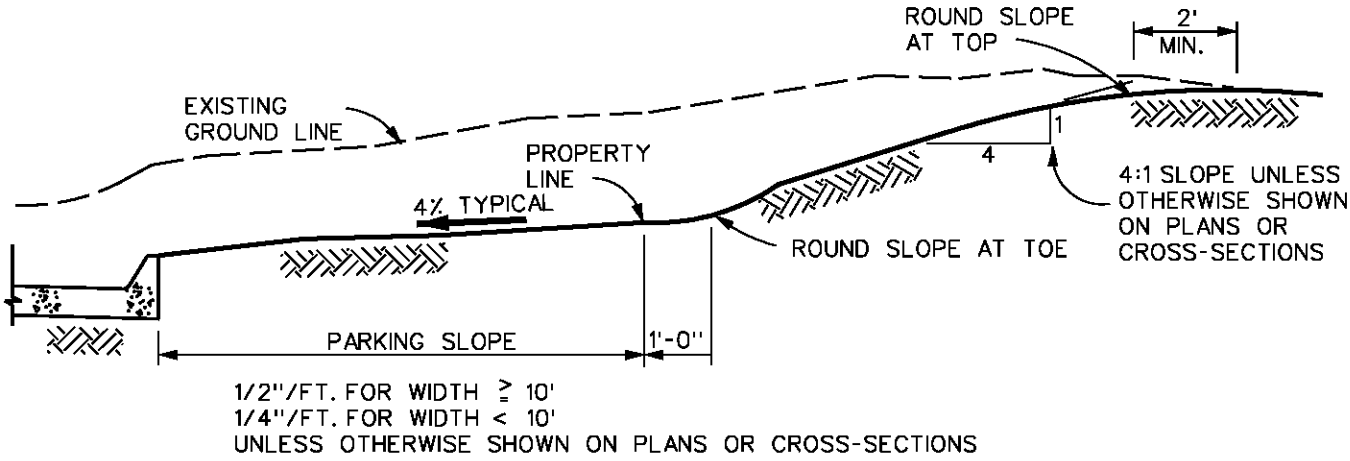



## DRIVEWAY GRADING DETAIL IN FILL SECTION

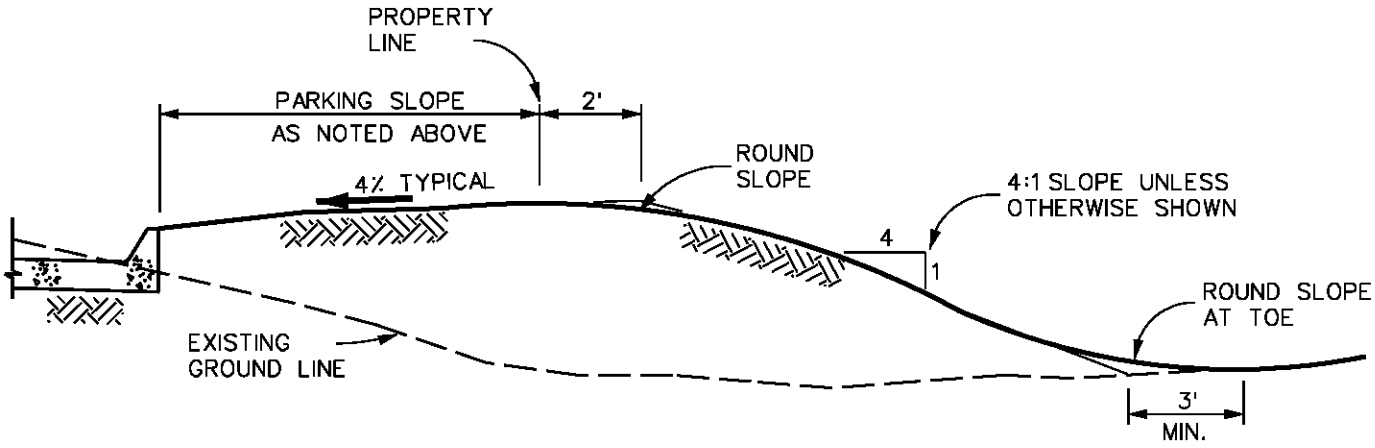
(℄ PROFILE SHOWN)



| REV. | DATE | BY | DRIVEWAY GRADING DETAIL | FIGURE: 7030.1 |
|---|---|---|---|---|
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |




TYPICAL CUT SECTION




TYPICAL FILL SECTION



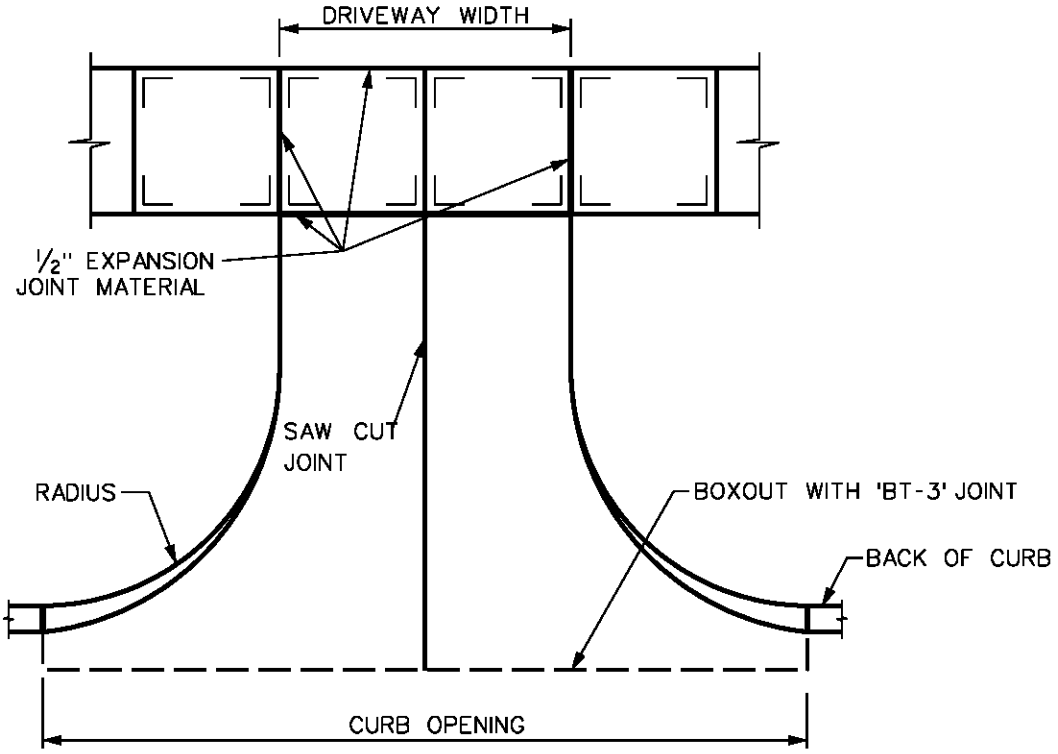
| REV. | DATE | BY |
|---|---|---|
| 2 | 01/25/01 | |
| 1 | 01/25/99 | |

DATE: 01-01-98

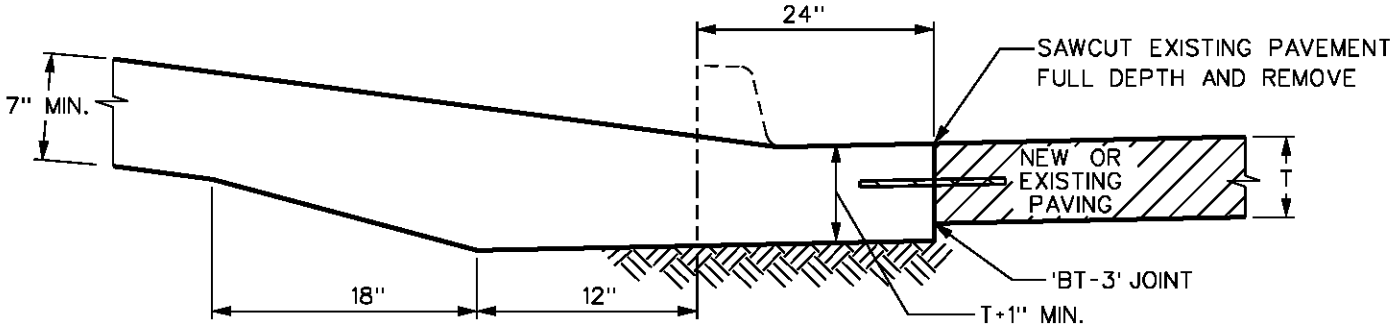
PARKING AND BACKSLOPES

FIGURE: 7030.2

SHEET 1 OF 1




COMMERCIAL/INDUSTRIAL DRIVEWAY




NOTE: IF A LONGITUDINAL JOINT LINE IS LOCATED 36" OR LESS FROM THE BACK OF CURB, EXTEND BOXOUT TO JOINT LINE. FULL DEPTH SAWCUT SHALL STILL BE REQUIRED.

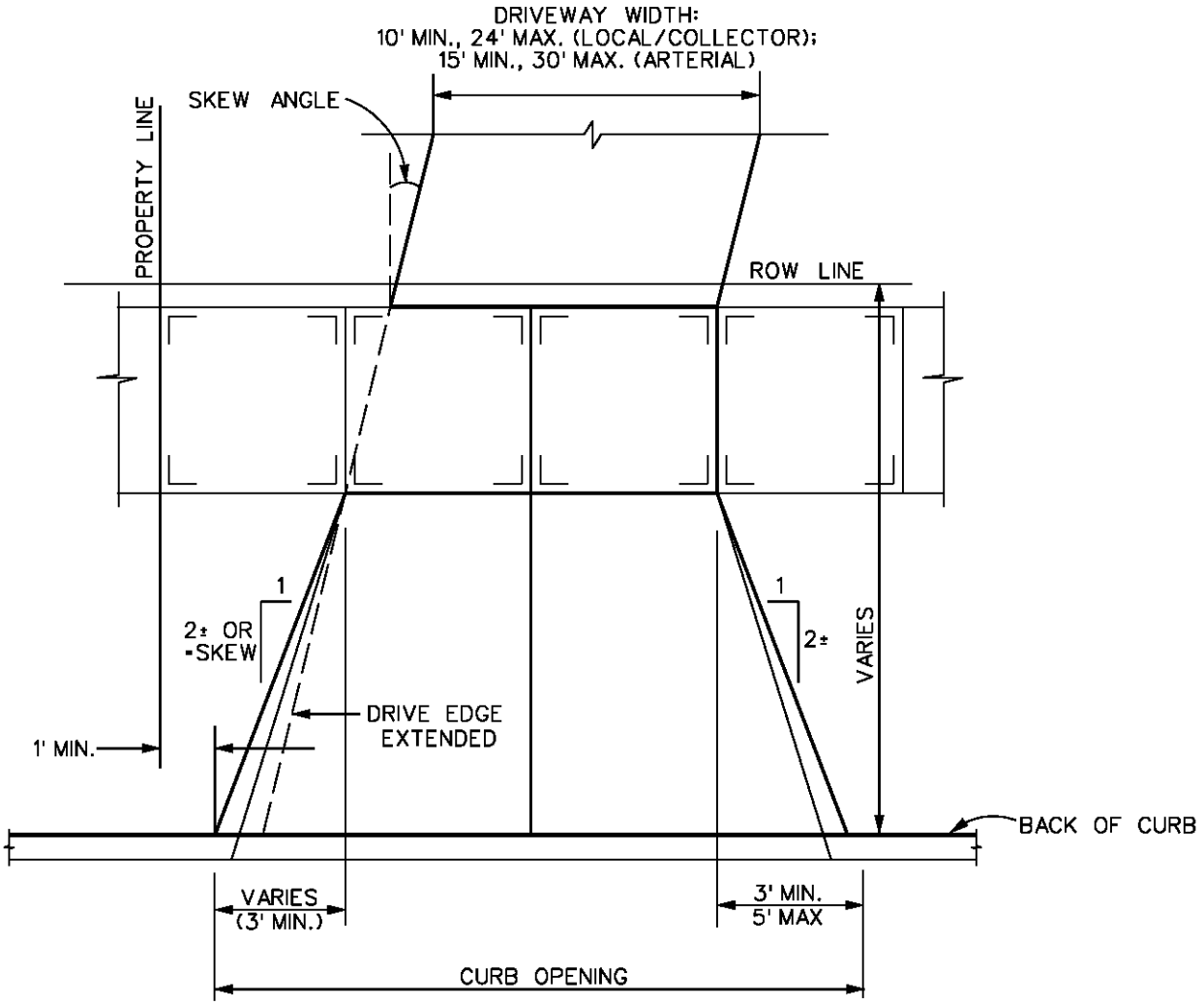
TYPE C

(TYPICAL COMMERCIAL/INDUSTRIAL DRIVEWAY)

| | LOCAL STREET | | COLLECTOR | | MAJOR/MINOR ARTERIAL | |
|---|---|---|---|---|---|---|
| | RADIUS | WIDTH | RADIUS | WIDTH | RADIUS | WIDTH |
| COMMERCIAL | 10'-20' | 24'-32' | 10'-35' | 24'-40' | 10'-35' | 24'-45' |
| INDUSTRIAL | 10'-30' | 24'-40' | 25'-50' | 24'-45' | 25'-50' | 24'-45' |



| REV. | DATE | BY | COMMERCIAL/INDUSTRIAL DRIVEWAY | FIGURE: 7030.4 |
|---|---|---|---|---|
| 3 | 01/29/03 | | | SHEET 1 OF 1 |
| DATE: 03-03-98 | | | | |




**NOTES:**

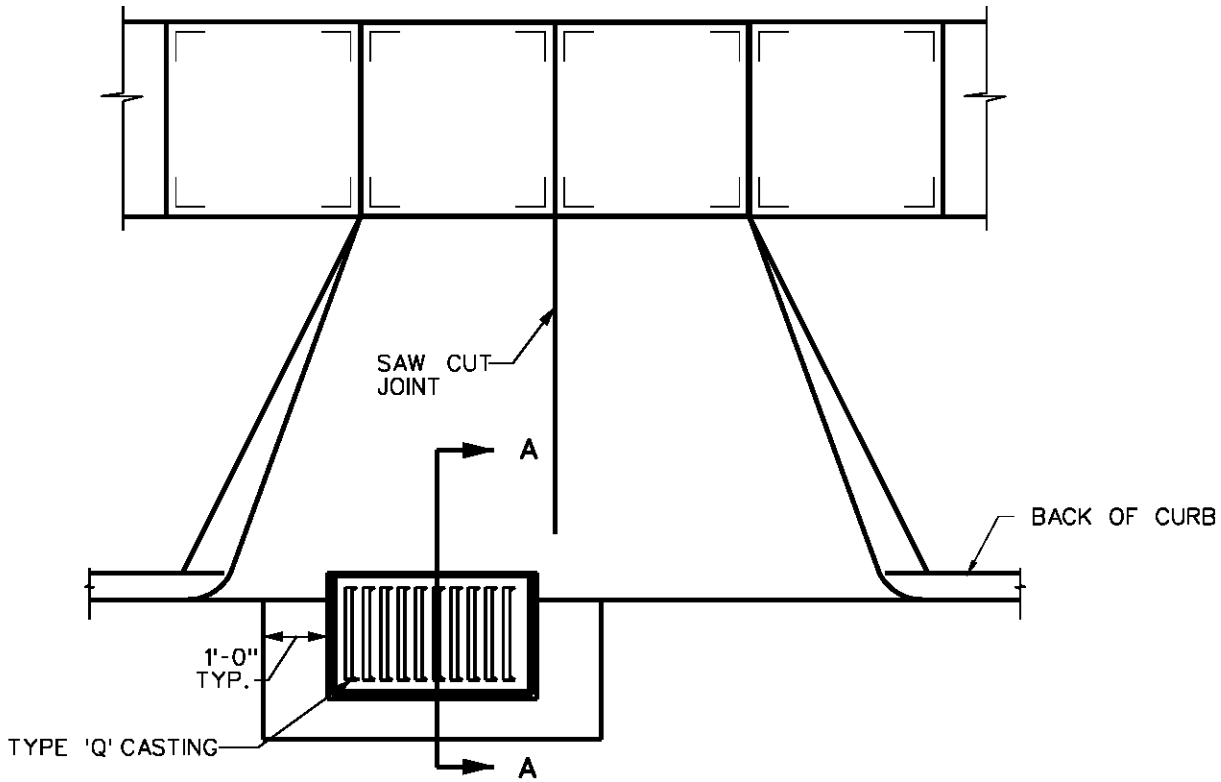
DRIVES WITH SKEWS GREATER THAN 20° REQUIRE SPECIAL DESIGN

REFER TO FIGURES 7030.3A AND 7030.3B FOR DRIVEWAY JOINTING AND CROSS SECTION REQUIREMENTS.

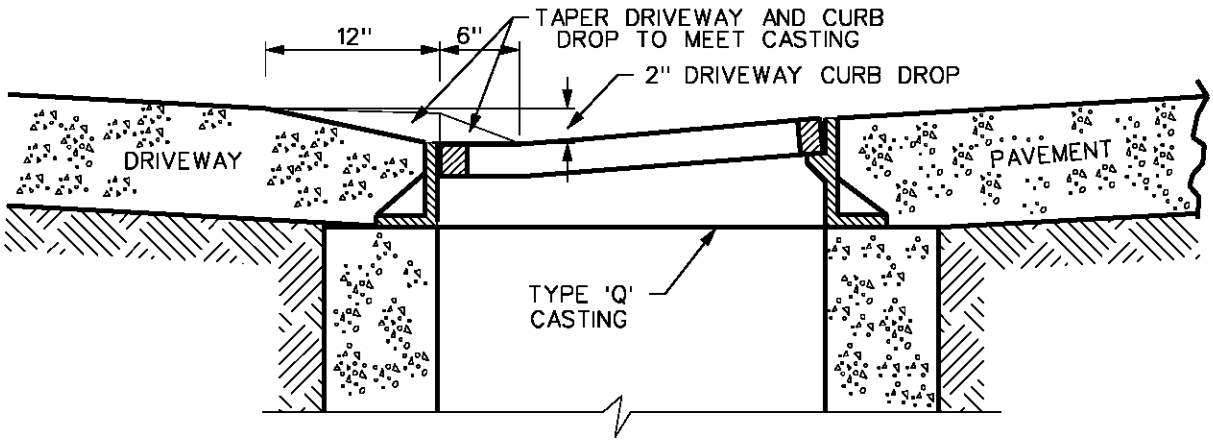
IF SIDEWALK IS LOCATED AT, OR NEAR, BACK OF CURB, SEE FIGURE 7030.9 FOR PARALLEL RAMP REQUIREMENTS



| REV. | DATE | BY | | |
|---|---|---|---|---|
| 3 | 10/18/05 | | SKEWED DRIVEWAY LAYOUT FOR NEW PAVEMENT | FIGURE: 7030.5 |
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |




PLAN VIEW




SECTION A-A



| REV. | DATE | BY | | |
|---|---|---|---|---|
| 1 | 01/25/01 | | SPECIAL SHAPING FOR DRIVEWAY INTAKE | FIGURE: 7030.6 |
| DATE: 01-01-98 | | | | SHEET 1 OF 1 |

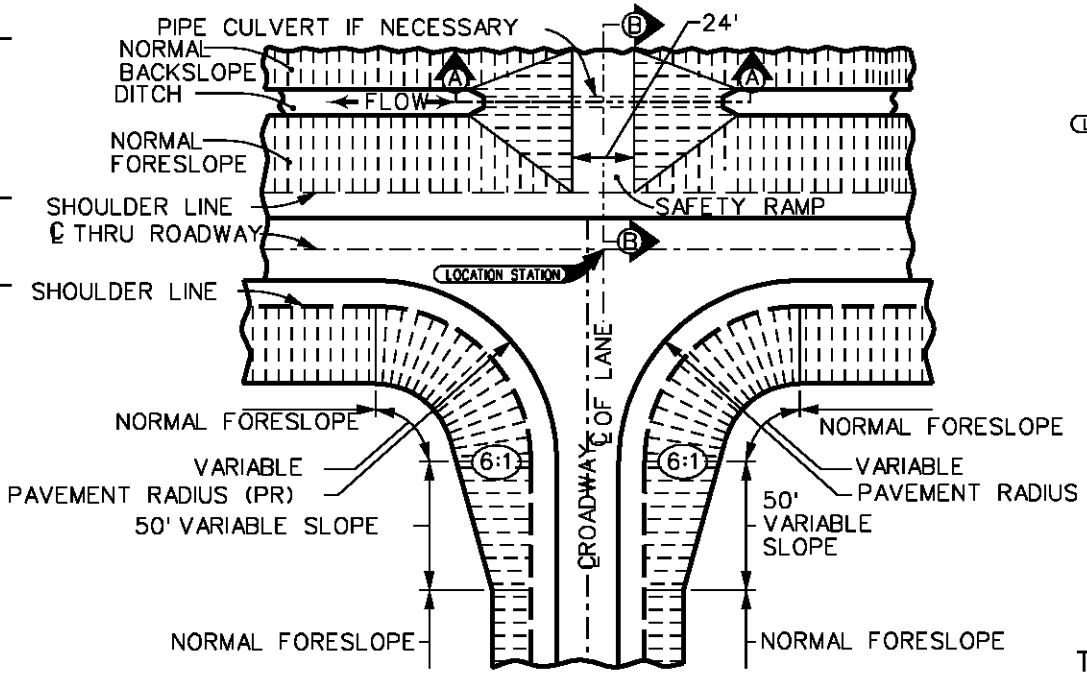
REV. | DATE | BY

DATE: 01-01-98

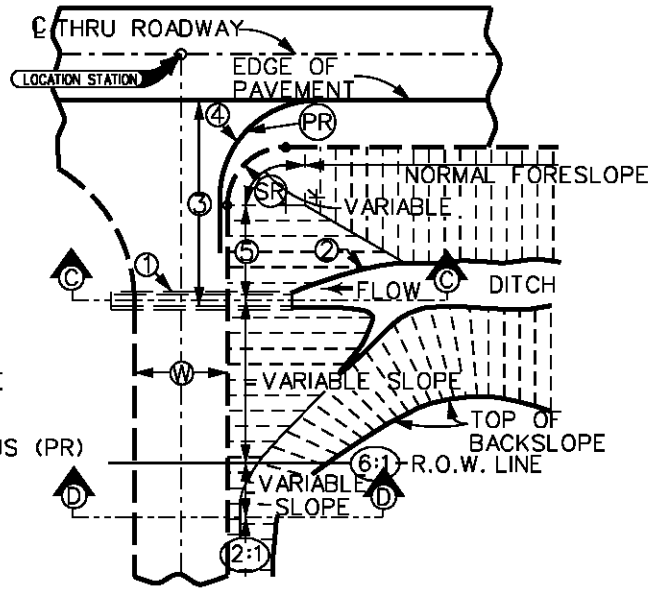
# DETAILS OF TYPICAL RURAL ENTRANCE AND SAFETY RAMP

FIGURE: 7030.7

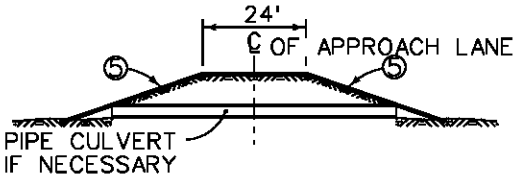
SHEET 1 OF 2



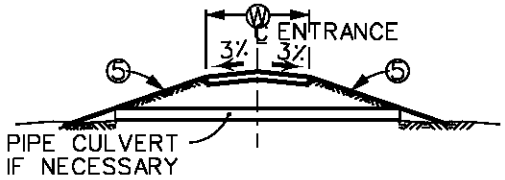

TYPICAL TEE INTERSECTION WITH SAFETY RAMP



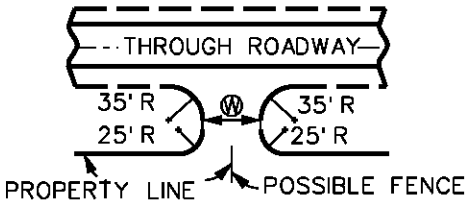

TYPICAL FIELD, FARM, RESIDENTIAL OR LIGHT COMMERCIAL ENTRANCE



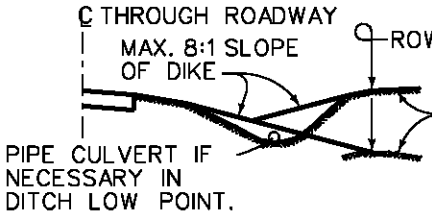

SECTION A-A



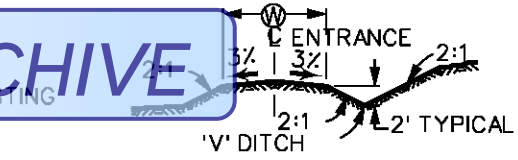

SECTION C-C




TYPE "B"

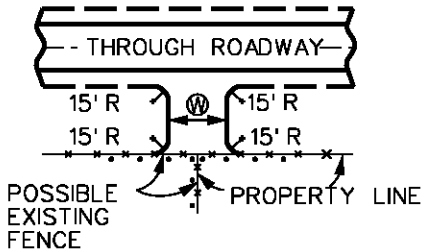



SECTION B-B




SECTION D-D






TYPE "C"

TYPICAL JOINT ENTRANCE (NON-PAVED)

SEE SHEET 2 FOR NOTES AND RADIUS CHART.

NOTES:

1. NORMAL LOCATIONS FOR ENTRANCE PIPE CULVERTS SHALL COINCIDE WITH THE LINE OF THE TOE OF BACKSLOPE AS SHOWN. REFER TO TABULATION OF ENTRANCE PIPE CULVERTS AND CROSS SECTIONS FOR DETAILS OF INSTALLATION.
2. SOME SPECIAL SHAPING OF DITCH MAY BE REQUIRED TO FIT CULVERT.
3. 8:1 SLOPE SHALL END AT THE ENTRANCE PIPE. 10:1 SLOPE SHALL END 50 FEET FROM THE EDGE OF PAVEMENT.
4. ENTRANCE WILL ONLY BE PAVED AS STATED ELSEWHERE IN THIS PLAN.
5. SLOPE 10:1 OR FLATTER WITHOUT PIPE. 8:1 OR FLATTER WITH PIPE. SLOPES SHOULD BE CONSTRUCTED RELATIVE TO THE ROADWAY GRADE.

## ENTRANCE RADIUS CHART

| TYPE OF ENTRANCE | PAVED | | NON-PAVED |
|---|---|---|---|
| | SHOULDER RADIUS (SR) | PAVEMENT RADIUS (PR) | SHOULDER RADIUS (SR) |
| TYPE "B" LIGHT COMMERCIAL | 35' | 45' | 35' |
| TYPE "C" FIELD, FARM OR RESIDENTIAL | 15' | 20' | 15' |



| REV. | DATE | BY | DETAILS OF TYPICAL RURAL ENTRANCE AND SAFETY RAMP | FIGURE: 7030.7 |
|---|---|---|---|---|
| DATE: 01-01-98 | | | | SHEET 2 OF 2 |