Annual Revisions to the SUDAS Standard Specifications
2019 Edition

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

Please replace the following: the small business card on the spine with the card titled "2019 Edition," the Contributors and Acknowledgments page, and the general Table of Contents. You might also find it helpful to keep this sheet behind the information contained within the Overview tab.

Division	***Section***	***pg #***	***Summary of Revision(s)***
1	Table of Contents	ii	Minor correction.
	1080, 1.01, A	1	Modified the limitation that the prime contractor had to be responsible for 50% of the contract.
2	2010, 1.08, E, 3, e	3	Deleted letter e since it is already covered in another bid item (L).
3	3010, 1.08, A, 6	2	Clarified what work activities are encompassed by dewatering.
	3010, 2.06 and 3.05	7-11	Added foamed cellular concrete as an option for special pipe embedment and encasement material, backfill for abandoned tunnels, annular space grouting, and sewer abandonment fill.
	Figure 3010.102	1-2	(Begins on the back of Figure 3010.101). Minor revision.
	Figure 3010.103	1	Removed column for ASTM F 2736; standard no longer exists.
	3020, 2.04, 2.05, and 3.04	3-6	Added foamed cellular concrete as an option for special pipe embedment and encasement material, backfill for abandoned tunnels, annular space grouting, and sewer abandonment fill.
4	Table of Contents	ALL	Updated to reflect changes made in Division 4.
	4010, 1.08	3-4	Added "furnishing and placing backfill material" to H, 3. Split the sewer abandonment bid items (K and L).
	4010, 2.01, I, 1	7	Updated ASTM reference.
	4010, 3.08, B	13	Added foamed cellular concrete.
	4020	ALL	Replace ENTIRE SECTION with enclosed pages (EXCLUDING figures). Updated/added bid items, added pipe apron information, and added foamed cellular concrete.
	4030	ALL	Replace ENTIRE SECTION with enclosed pages (EXCLUDING figures). Added a reference to the apron footing figure. Clarified dewatering language.
	4050, 2.05	5-6	Minor formatting correction.
5	Table of Contents	i-ii	Updated to reflect changes made in Division 5.
	5010, 2.05, B	6-12	Modified tracer wire requirements for trenchless installations (affected pages that followed).
6	6010, 2.10, D	7	Fixed incorrect numbering.
7	Table of Contents	ALL	Updated to reflect changes made in Division 7.
	7010, 1.08, H and M	1-3	Added a bid item for railroad crossing approaches.
	7010, 2.01, L, 3	5	Error correction.
	7010, 3.02, H	15-18	Added execution language for railroad crossing approaches.
	7010, Table 7010.02	23	Updated a reference and deleted the 6 inch requirement from the plastic concrete cylinders.

7 (con't)	Figure 7010.101	ALL	Modified to identify an option for tie bar and to add tubular dowels. (Figure 7010.102, sheet 1 starts on the back of Figure 7010.101, sheet 8).
	7011, 2.01, I	3	Revised incorrect reference.
	7020, 1.08, E	3-4	Added a bid item for railroad crossing approaches; renumbered items that followed.
	7020, 3.01, E	6	Added execution language for railroad crossing approaches.
	7021	ALL	Replace ENTIRE SECTION with enclosed pages. Modified binder grades per new climate information. Voids in the mineral aggregate is no longer used as a mix design parameter. Clarified sample locations due to thin applications.
	7030	ALL	Replace ENTIRE SECTION with enclosed pages (EXCLUDING figures). Deleted sand bedding and modified brick/paver requirements to meet ADA.
	Figure 7030.203	1	Deleted sand bedding and modified brick/paver requirements to meet ADA and changed the figure title.
	7040, 2.01, B	5	Updated to correct asphalt binder grade.
	7040, 3.02, C, 4, a	8	Removed old method no longer performed.
	7090 (new)	ALL	Add NEW SECTION for cold-in-place recycling projects.
	7091 (new)	ALL	Add NEW SECTION for full depth reclamation projects.
8	8010, 2.01, C, 1	4	Updated Iowa DOT reference.
	Figure 8010.102	1-4	(Begins on the back of Figure 8010.101). Added option for placement of traffic signal pole foundation in rock, which created two additional sheets.
9	9040, 3.21, B, 5	23	Revised hydromulching requirements to match the changes previously made in Section 9010.
	9080, 2.05, A, 1	5	Corrected the dimensions of the anchor plate for safety rail to be consistent with what is actually used.
	Figure 9080.101	1	Corrected the dimensions of the anchor plate for safety rail to be consistent with what is actually used.
	Figure 9080.102	1	Corrected the dimensions of the anchor plate for safety rail to be consistent with what is actually used.
	Figure 9080.103	1	Corrected the dimensions of the anchor plate for safety rail to be consistent with what is actually used.

Contributors and Acknowledgments

In 2018, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2019 versions of the SUDAS manuals. These revisions would not have been possible without the efforts of the SUDAS technical committee members. The SUDAS program's success is also due to the dedication of the district committees and Board of Directors. Keeping the SUDAS manuals current is an ongoing, cooperative effort, involving hundreds of people who volunteer their time and expertise. It is not possible to acknowledge each of these volunteers individually, but we appreciate them all.

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General Table of Contents

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Section 1050 - Control of Work

Section 1060 - Control of Materials

PROSECUTION AND PROGRESS

1.01 SUBLETTING OR ASSIGNMENT OF CONTRACT

A. Work by Contractor:

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

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

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

B. Permission to Sublet:

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

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

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

C. Subcontracts:

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

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

1.02 CONTRACT TIME

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

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

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

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

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

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

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

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

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Topsoil:

1. On-site Topsoil:

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

b. Payment:

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

2. Compost-amended Topsoil:

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

b. Payment: Payment will be the unit price per cubic yard.

c. Includes: This work includes, but is not limited to, furnishing and incorporating compost.

3. Off-site Topsoil:

a. Measurement: Measurement will be in cubic yards for furnishing, excavating, hauling, and incorporating the material.

b. Payment: Payment will be at the unit price per cubic yard.

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

1. Measurement:

a. Measurement for Class 10, Class 12, and Class 13 material excavated from the project site and borrow areas will be the plan quantity in cubic yards, without final field measurement. Adjustments may be made to the plan quantities if agreed to by both the Engineer and the Contractor.
b. If either the Contractor or the Engineer desires actual measurements rather than using contract document quantities, that party must provide written notice to the other party prior to starting work.
    1) If actual measurements are used, use cross-section surveys by the Engineer before and after work for the basis of computing the cubic yards of excavation. The extra survey cost will be paid by the party requesting the survey.
    2) When the Engineer determines it is impractical to make cross-section surveys, use the truck count method, with a shrinkage factor, resulting in volume per truck type and size determined by the Engineer. Unless otherwise specified, use a shrinkage factor of 1.35 for Class 10 and Class 13 excavation. No shrinkage factor will be used for Class 12.

2. Payment:

a. Payment will be at the unit price per cubic yard.
b. Payment will not be made for excavation work done prior to the staking and, if necessary, cross-sectioning.

3. Includes, but is not limited to:

a. Site preparation for, and the construction of, embankment, fills, shoulder backfill, and backfill behind curbs.
b. Overhaul.
c. Finishing the soil surface, including roadways, shoulders, behind curbs, side ditches, slopes, and borrow pits.
d. Repair or replacement of any fences that have been unnecessarily damaged or removed.

1.08 MEASUREMENT AND PAYMENT (Continued)

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

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

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

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

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

G. Subgrade Preparation:

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

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

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

H. Subgrade Treatment:

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

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

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

I. Subbase:

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

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

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

TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trench Excavation for Pipe Systems

B. Trench Foundation Stabilization

C. Pipe Bedding and Backfill

1.02 DESCRIPTION OF WORK

A. Excavate trench for pipe installation.

B. Stabilize trench and install pipe bedding materials.

C. Place backfill material in trench.

1.03 SUBMITTALS

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

A. Gradation reports for bedding materials.

B. Results of required testing.

C. Dewatering plan.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

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

1. Standard trench excavation.
2. Removal and disposal of 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 including, but not limited to, all equipment such as generators, pumps, rock for sump pits, discharge piping, and any extra excavation needed to facilitate dewatering according to stormwater regulations, as applicable.
7. Sheeting, shoring, and bracing.
8. Adjusting the moisture content of excavated backfill material to the range specified for placement and compaction.
9. Temporary support for existing water, sewer, gas, telephone, electric, and other utilities or services that cross the trench.

B. Rock Excavation:

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

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

C. Trench Foundation:

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

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

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

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 per cubic yard for the quantity of backfill material furnished.

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

2.05 STABILIZATION (FOUNDATION) MATERIALS

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

Table 3010.06: Stabilization Materials

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

B. If specified, meet Iowa DOT Section 4128 for Gradation No. 13 screened over a 1 inch screen or the Engineer may authorize a change in gradation depending on materials available locally at time of construction.

C. Crushed concrete may be used, if approved by the Engineer, if it is within ± 5% of the gradation for each size of material.

2.06 SPECIAL PIPE EMBEDMENT AND ENCASEMENT MATERIAL

A. Concrete Cradle, Arch, or Encasement: Use Iowa DOT Class C concrete.

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

C. CLSM:

1. Approximate quantities per cubic yard:
   a. Cement: 50 pounds
   b. Fly ash: 250 pounds
   c. Fine aggregate: 2,910 pounds
   d. Water: 60 gallons

2. A compressive strength of at least 50 psi compressive strength at 28 calendar days can be expected.

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

D. Foamed Cellular Concrete:

1. If specified or approved by the Engineer, foamed cellular concrete may be substituted for flowable mortar.

2. Comply with Iowa DOT Article 2506.02.

3. Submit mix design to the Engineer. Include base cement slurry mix per cubic yard, expansion factor from the foaming agent, and wet density.

PART 3 - EXECUTION

3.01 TRENCH EXCAVATION

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

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

C. Excavate trench to required elevations and dimensions. Comply with Figure 3010.101.

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

2. Place excavated material away from trench.

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

D. Unsuitable Backfill Material:

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

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

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

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

3.02 ROCK OR UNSTABLE SOILS IN TRENCH BOTTOM

A. Notify the Engineer prior to over-excavation.

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

C. Comply with Figure 3010.101 for over-excavation of rock and wet or soft foundations.

3.03 TRENCH PROTECTION

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

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

3.04 DEWATERING

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

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

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

D. Discharged Water:

1. Do not discharge water into sanitary sewers.

2. Discharging water into storm sewers requires Engineer's approval.

3.04 DEWATERING (Continued)

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

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

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

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

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

3.05 PIPE BEDDING AND BACKFILL

A. General: Comply with Figures 3010.101, 3010.102, 3010.103, 3010.104, and 3010.105, as appropriate.

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

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

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

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

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

6. Special Pipe Embedment and Encasement Materials:
   a. If specified, use concrete, flowable mortar, CLSM, or foamed cellular concrete as a substitute for pipe bedding, haunch support, or primary and secondary backfill.
   b. Secure pipe against displacement or flotation prior to placing special pipe embedment and encasement material.
   c. Place Class IV clay material for a waterstop and compacted to 90% of Standard Proctor Density. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content. If trench stabilization material is used, extend waterstop through stabilization material to the bottom of the trench.

B. Pipe Bedding:

1. Granular Material:
   a. Class I granular bedding material is required for all gravity mains. Use when specified for pressure pipes.
   b. Comply with Figures 3010.101, 3010.102, 3010.103, 3010.104, and 3010.105.

3.05 PIPE BEDDING AND BACKFILL (Continued)

c. Place bedding material in the bottom of the trench in lifts no greater than 6 inches thick. Consolidate and moderately compact bedding material.
d. Shape bedding material to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.
e. Install pipe and system components.
f. Place, consolidate, and moderately compact additional bedding material adjacent to the pipe to a depth equal to 1/6 the outside diameter of the pipe.

2. Suitable Backfill Material:
a. Only use with pressure pipe. Comply with Figure 3010.104.
b. Use suitable backfill material to shape trench bottom to evenly support pipe at the proper line and grade, with full contact under the bottom of the pipe. Excavate for pipe bells.

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

1. Granular Material:
a. Place Class I material in lifts no greater than 6 inches thick.
b. Consolidate and moderately compact by slicing with a shovel or using other approved techniques.

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

D. Primary and Secondary Backfill:

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

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

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

E. Final Trench Backfill:

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

3.05 PIPE BEDDING AND BACKFILL (Continued)

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

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

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

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

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

3.06 TRENCH COMPACTION TESTING

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

B. Soil Testing:

1. Cohesive Soils:
   a. Determine moisture-density relationships by ASTM D 698 (Standard Proctor). Perform at least one test for each type of cohesive soil used.
   b. Determine in-place density and moisture content. Use ASTM D 1556 (sand-cone method) and ASTM D 2216 (laboratory moisture content), or use ASTM D 6938 (nuclear methods for density and moisture content).

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

C. Field Testing:

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

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

END OF SECTION

Refer to the contract documents for specific material and placement requirements.

(1) Required only when specified in the contract documents or when directed by the Engineer.

Key

OD = Outside diameter of pipe

D = Inside diameter of pipe

TW = Trench width at top of pipe

d = Depth of bedding material below pipe

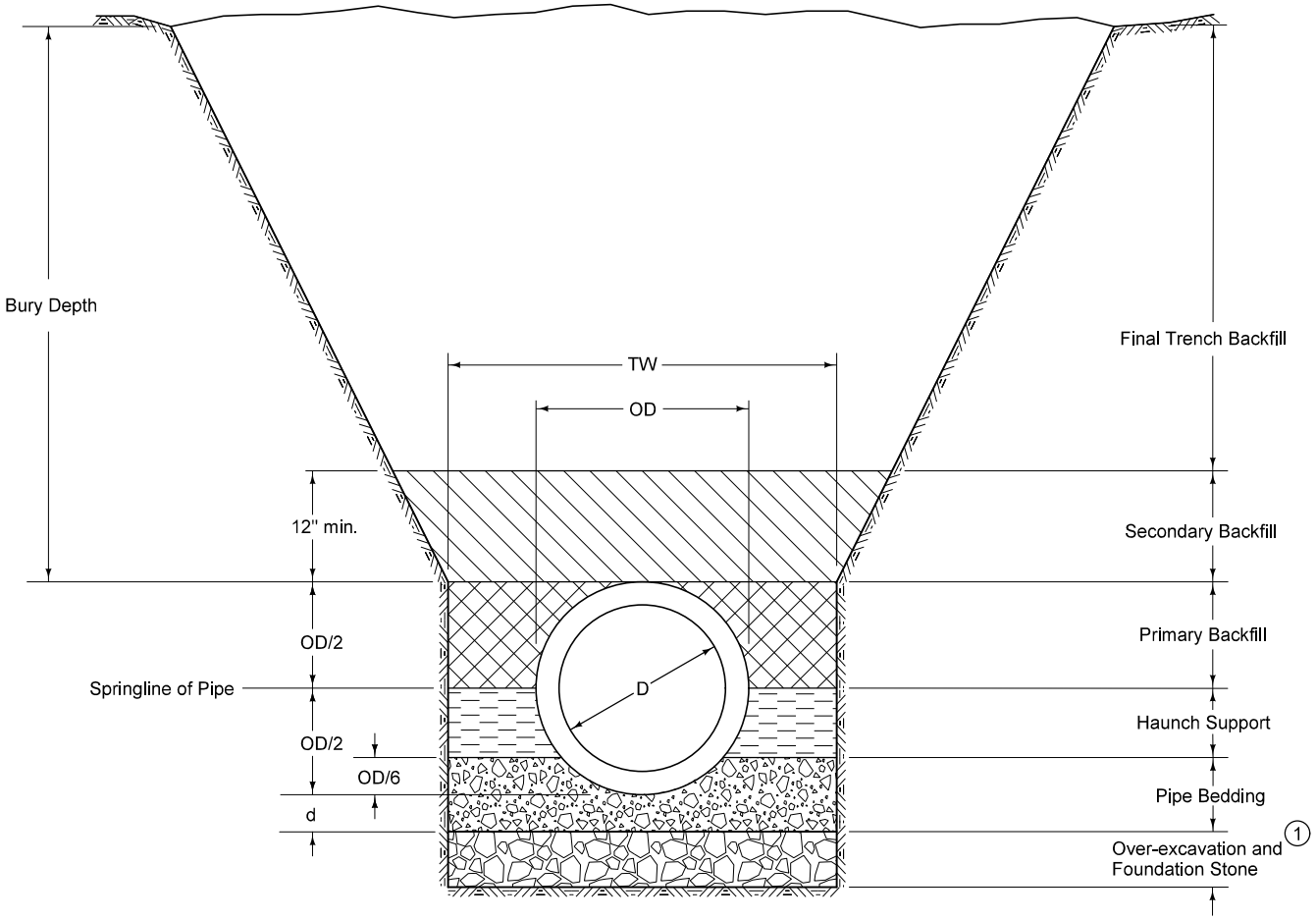


FIGURE 3010.101 SHEET 1 OF 1

SUDAS | IOWADOT | REVISION 1 04-17-18

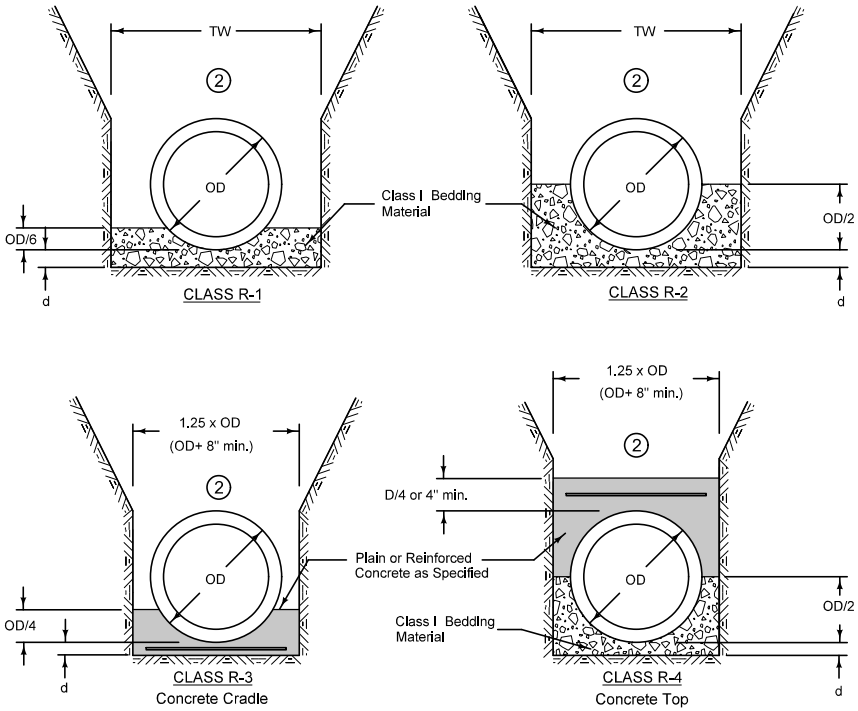
FIGURE 3010.101 | STANDARD ROAD PLAN | SW-101 | SHEET 1 of 1

REVISIONS: Replaced Iowa DOT and SUDAS logos.

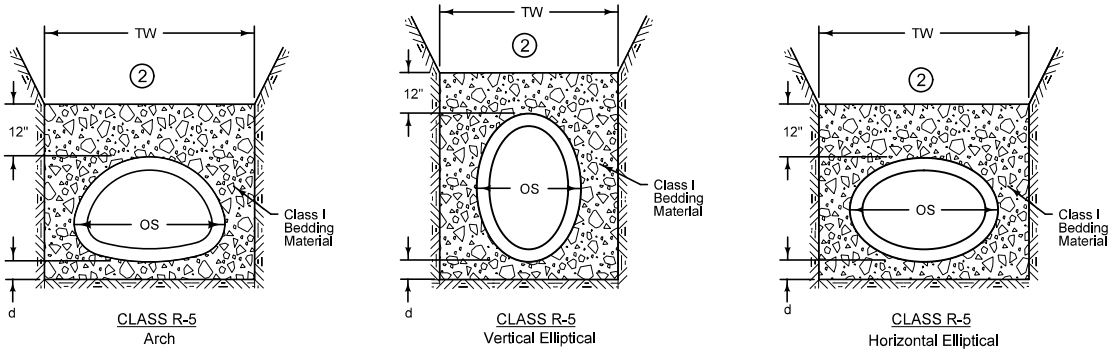
Paul D. Wigand, SUDAS DIRECTOR — Brian Smith, DESIGN METHODS ENGINEER

TRENCH BEDDING AND BACKFILL ZONES

RCP AND VCP CIRCULAR PIPE BEDDING ①



REINFORCED CONCRETE ARCH AND ELLIPTICAL PIPE BEDDING



Refer to sheet 2 for bury depth restrictions.

① Use Bedding Class R-1 or R-2 unless specified otherwise.

② Place remainder of bedding and backfill materials as specified in the contract documents.

Key

OD = Outside diameter of pipe

OS = Outside span of pipe

TW = Trench width at top of pipe:
Min. = OD+18 inches
Max.= 1.25xOD+12 inches OR
54 inches (whichever is greater)

d = Depth of bedding material below pipe:
OD/8 or OS/8, OR 4 inches
(whichever is greater)

FIGURE 3010.102 SHEET 1 OF 2

SUDAS | IOWA DOT

REVISION 3 04-16-19

FIGURE 3010.102 | STANDARD ROAD PLAN | SW-102

SHEET 1 of 2

REVISIONS: Changed Class 1 to Class I in CLASS R-5 Vertical Elliptical detail.

Paul D. Wigard
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

RIGID GRAVITY PIPE TRENCH BEDDING

ALLOWABLE BURY DEPTH

CLASS III RCP

Pipe Diameter (in)	Class R-1 Bedding	Class R-2 Bedding	Class R-3 & R-4 Bedding		
			No Steel	As=0.4%	As=1.0%
12	7'	10'	15'	19'	27'
15	8'	10'	16'	19'	27'
18	8'	11'	16'	20'	40'
21	8'	11'	18'	26'	40'
24	8'	12'	23'	36'	40'
27	10'	15'	30'	40'	40'
30	11'	15'	29'	40'	40'
33	11'	15'	28'	40'	40'
36	11'	15'	27'	40'	40'
42	11'	15'	26'	38'	40'
48	11'	15'	26'	36'	40'
54	11'	15'	25'	34'	40'
60	11'	15'	25'	33'	40'
66	11'	15'	24'	32'	40'
72	11'	15'	24'	32'	40'

As = Area of Steel Reinforcing

CLASS IV RCP

Pipe Diameter (in)	Class R-1 Bedding	Class R-2 Bedding	Class R-3 & R-4 Bedding		
			No Steel	As=0.4%	As=1.0%
12	12'	15'	23'	28'	40'
15	12'	16'	23'	30'	40'
18	13'	16'	29'	40'	40'
21	13'	18'	40'	40'	40'
24	16'	23'	40'	40'	40'
27	19'	30'	40'	40'	40'
30	19'	29'	40'	40'	40'
33	19'	28'	40'	40'	40'
36	19'	28'	40'	40'	40'
42	18'	27'	40'	40'	40'
48	18'	26'	40'	40'	40'
54	18'	25'	40'	40'	40'
60	18'	25'	40'	40'	40'
66	18'	25'	40'	40'	40'
72	18'	24'	40'	40'	40'

As = Area of Steel Reinforcing

CLASS V RCP

Pipe Diameter (in)	Class R-1 Bedding	Class R-2 Bedding	Class R-3 & R-4 Bedding		
			No Steel	As=0.4%	As=1.0%
12	18'	23'	35'	40'	40'
15	19'	24'	40'	40'	40'
18	19'	30'	40'	40'	40'
21	25'	40'	40'	40'	40'
24	34'	40'	40'	40'	40'
27	40'	40'	40'	40'	40'
30	40'	40'	40'	40'	40'
33	40'	40'	40'	40'	40'
36	40'	40'	40'	40'	40'
42	37'	40'	40'	40'	40'
48	35'	40'	40'	40'	40'
54	33'	40'	40'	40'	40'
60	32'	40'	40'	40'	40'
66	31'	40'	40'	40'	40'
72	31'	40'	40'	40'	40'

As = Area of Steel Reinforcing

EXTRA STRENGTH VCP

Pipe Dia. (in)	Bedding Class				
	R-1	R-2	R-3 & R-4		
			No Steel	As=0.4%	As=1.0%
6	25'	30'	30'	30'	30'
8	20'	26'	30'	30'	30'
10	18'	23'	30'	30'	30'
12	16'	20'	30'	30'	30'
15	15'	19'	28'	30'	30'
18	14'	18'	30'	30'	30'
21	15'	22'	30'	30'	30'
24	18'	28'	30'	30'	30'
27	20'	30'	30'	30'	30'
30	19'	29'	30'	30'	30'
33	20'	30'	30'	30'	30'
36	20'	30'	30'	30'	30'
39	19'	29'	30'	30'	30'
42	18'	26'	30'	30'	30'

As = Area of Steel Reinforcing

CONCRETE ARCH PIPE

Pipe Size (in x in)	Equiv. Dia. (in)	Pipe Class	
		A-III	A-IV
18 x 11	15	6'	11'
22 x 13	18	6'	11'
26 x 15	21	6'	13'
29 x 18	24	7'	15'
36 x 22	30	8'	15'
44 x 27	36	8'	14'
51 x 31	42	8'	15'
58 x 36	48	8'	15'
65 x 40	54	8'	15'
73 x 45	60	8'	14'
88 x 54	72	9'	14'

Based on Class R-5 bedding

HORIZONTAL ELLIPTICAL RCP

Pipe Size (in x in)	Equiv. Dia. (in)	Pipe Class	
		HE-III	HE-IV
14 x 23	18	12'	22'
19 x 30	24	15'	29'
22 x 34	27	15'	28'
24 x 38	30	15'	27'
27 x 42	33	15'	27'
29 x 45	36	15'	26'
32 x 49	39	15'	26'
34 x 54	42	15'	25'
38 x 60	48	15'	25'
43 x 68	54	15'	24'
48 x 76	60	15'	24'
53 x 83	66	15'	24'
58 x 91	72	15'	24'
63 x 98	78	15'	23'
68 x 106	84	15'	23'

Based on Class R-5 bedding

VERTICAL ELLIPTICAL RCP

Pipe Size (in x in)	Equiv. Dia. (In)	Pipe Class			
		VE-III	VE-IV	VE-V	VE-VI
23 x 14	18	10'	15'	22'	33'
30 x 19	24	10'	16'	34'	40'
34 x 22	27	11'	20'	40'	40'
38 x 24	30	12'	23'	40'	40'
42 x 27	33	15'	30'	40'	40'
45 x 29	36	15'	29'	40'	40'
49 x 32	39	15'	29'	40'	40'
54 x 34	42	15'	28'	40'	40'
60 x 38	48	15'	27'	40'	40'
68 x 43	54	15'	27'	40'	40'
76 x 48	60	15'	26'	40'	40'
83 x 53	66	15'	25'	40'	40'
91 x 58	72	15'	25'	40'	40'
98 x 63	78	15'	25'	40'	40'
106 x 68	84	15'	24'	40'	40'

Based on Class R-5 bedding

FIGURE 3010.102 SHEET 2 OF 2

SUDAS | IOWADOT

REVISION 3 04-16-19

FIGURE 3010.102 | STANDARD ROAD PLAN | SW-102

SHEET 2 of 2

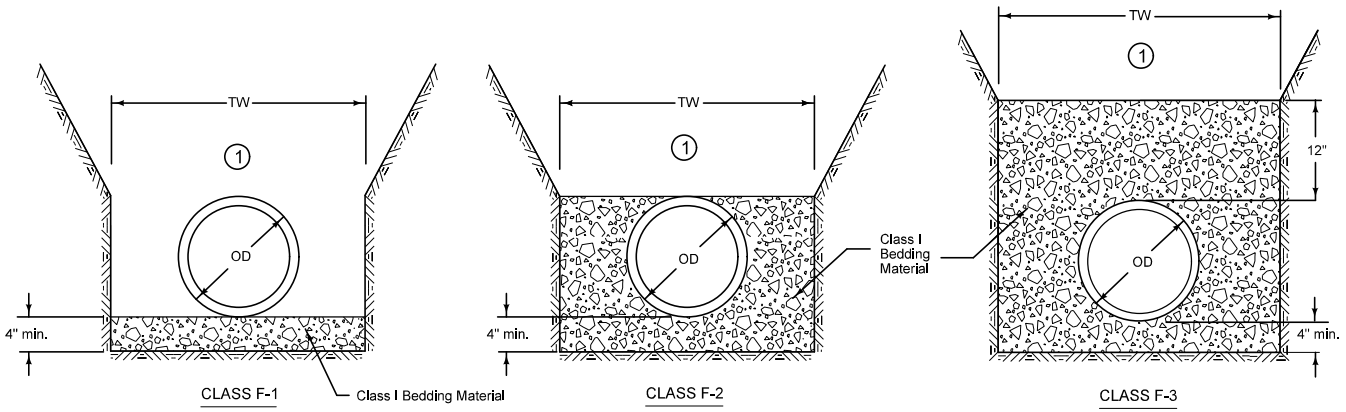
REVISIONS: Changed Class 1 to Class I In CLASS R-5 Vertical Elliptical detail.

Paul D. Wigand, SUDAS DIRECTOR

Stuart Nicholson, DESIGN METHODS ENGINEER

RIGID GRAVITY PIPE TRENCH BEDDING

BEDDING CLASSES



1. Place remainder of bedding and backfill materials as specified in the contract documents.
2. Minimum depth of bury 12 inches or as specified by the manufacturer.

ALLOWABLE BEDDING CLASSES

PIPE MATERIAL	STORM SEWER	SANITARY SEWER
Ductile Iron	F-1, F-2, F-3	F-1, F-2, F-3
HDPE	F-2, F-3	Not allowed
Polypropylene	F-2, F-3	F-3
PVC	F-2, F-3	F-3

Key

OD = Outside diameter of pipe

TW = Trench width at top of pipe:
Min. = OD+18 Inches OR 1.25xOD+12 Inches
(whichever is greater)

ALLOWABLE BURY DEPTH (2)

PVC PIPE

Pipe Diameter (in)	ASTM D 3034			ASTM F 679	ASTM F 949	ASTM F 1803	ASTM D 2680
	Solid Wall			Solid Wall	Corrug. Exterior	Closed Profile	Composite (Truss Type)
	SDR 23.5	SDR 26	SDR 35	SDR 35			
8	30'	28'	24'	---	24'	---	32'
10	30'	28'	24'	---	24'	---	32'
12	30'	28'	24'	---	24'	---	32'
15	30'	28'	24'	---	24'	---	32'
18	---	---	---	24'	24'	---	---
21	---	---	---	24'	24'	24'	---
24	---	---	---	24'	24'	24'	---
27	---	---	---	24'	---	24'	---
30	---	---	---	24'	24'	24'	---
33	---	---	---	24'	---	---	---
36	---	---	---	24'	24'	24'	---
42	---	---	---	24'	---	24'	---
48	---	---	---	24'	---	24'	---
54	---	---	---	---	---	24'	---
60	---	---	---	---	---	24'	---

DUCTILE IRON, AWWA C151, CLASS 52

Pipe Diameter (in)	Class F-1 Bedding	Class F-2 Bedding	Class F-3 Bedding
4	40'	40'	40'
6	40'	40'	40'
8	40'	40'	40'
10	40'	40'	40'
12	37'	40'	40'
14	31'	40'	40'
16	28'	37'	40'
18	25'	34'	40'
20	23'	32'	40'
24	20'	29'	38'
30	18'	23'	31'
36	18'	22'	30'
42	17'	21'	29'
48	16'	19'	27'
54	16'	19'	27'

HDPE PIPE

Pipe Diameter (in)	AASHTO M 294
12	8'
15	9'
18	9'
24	9'
30	9'
36	9'
42	8'
48	8'
54	8'
60	8'

POLYPROPYLENE PIPE

Pipe Diameter (In)	ASTM F 2764
12	24'
15	25'
18	22'
24	20'
30	22'
36	21'
42	22'
48	23'
54	21'
60	21'

FIGURE 3010.103 | SHEET 1 OF 1

SUDAS | IOWADOT

REVISION: 3 | 04-16-19

FIGURE 3010.103 | STANDARD ROAD PLAN | SW-103

SHEET 1 of 1

REVISIONS: Removed ASTM F 2736 from Polypropylene Pipe table. Changed Class 1 to Class I in the CLASS F-2 and CLASS F-3 details.

Paul D. Wigant — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

FLEXIBLE GRAVITY PIPE TRENCH BEDDING

2.02 CASING PIPE (Continued)

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

2.03 CASING SPACERS

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

B. Meet the following material requirements:

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

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

2.04 BACKFILL FOR ABANDONED TUNNELS

A. Use Iowa DOT Class C concrete, approximately 4 inch slump.

B. Flowable mortar, foamed cellular concrete, or CLSM according to Section 3010, 2.06.

2.05 BACKFILL MATERIAL

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

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

1. PCC: Use Iowa DOT Class C concrete, approximately 4 inch slump.

2. Flowable Mortar: Comply with Section 3010, 2.06.

3. CLSM: Comply with Section 3010, 2.06.

4. Foamed Cellular Concrete: Comply with Section 3010, 2.06

2.06 CASING END SEAL

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

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

PART 3 - EXECUTION

3.01 EXCAVATION

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

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

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

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

2. Place excavated material away from trench.

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

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

3.02 SHEETING, SHORING, AND BRACING

Comply with Section 3010, 3.03.

3.03 DEWATERING

Comply with Section 3010, 3.04.

3.04 TRENCHLESS INSTALLATION

A. General: Select a method of installation that is appropriate for the soil conditions anticipated and will 1) allow the pipe to be installed to the desired line and grade within the specified tolerances; 2) prevent heaving or settlement of the ground surface or damage to nearby facilities; and 3) prevent damage to the carrier pipe and any lining materials within the carrier pipe.

1. Installation Methods:

- **a. Auger Boring:** A method that utilizes a rotating cutting head to form the bore hole and a series of rotating augers inside a casing pipe to remove the spoil.
- **b. Directional Drilling:** A method for installing pipe from a surface-launched drilling rig. A pilot bore is formed and then enlarged by back reaming and removing the spoil material. The pipe is then pulled in place.
- **c. Open-ended Pipe Ramming:** A method that involves driving a steel casing pipe with a percussive hammer. The front end of the casing pipe is open-ended. Spoils are removed from the pipe.
- **d. Pipe Jacking:** A method in which pipe is pushed into the ground with hydraulic jacks while soil is simultaneously excavated. Excavation is normally completed with a tunnel boring machine.
- **e. Microtunneling:** A method of pipe jacking using a remote controlled tunnel boring machine.
- **f. Utility Tunneling:** A method of forming large diameter tunnels. As excavation takes place at the front of the tunnel, a liner is constructed to temporarily support the tunnel. Upon completion of the tunnel, the pipe is pushed in place.
- **g. Other:** Other methods may be allowed with the Engineer's approval.

3.04 TRENCHLESS INSTALLATION (Continued)

2. Line and Grade:

a. Install pipe at line and grade that will allow the carrier pipe to be installed at its true starting elevation and grade within the specified maximum alignment deviation of the pipe centerline.

b. When no deviation tolerances are specified in the contract documents, apply the following maximum deviations to the carrier pipe.

1) Gravity Pipe:

a) Horizontally: $\pm$ 1.0 foot per 100 feet;

b) Vertically: $\pm$ 0.2 feet up to 100 feet; an additional $\pm$ 0.1 foot per 100 feet thereafter. Backfall in pipe is not allowed.

2) Pressurized Pipe:

a) Horizontally: ± 2.0 feet

b) Vertically: ± 1.0 foot. Maintain the minimum depth specified in the contract documents.

c. Greater deviation or interference with other identified facilities may be cause for rejection.

3. Deviation from Line and Grade:

a. Provided adequate clearance remains for proper installation of the carrier pipe, the Contractor will be allowed to correct deviations in grade of a casing pipe in order to achieve design grade of the carrier pipe by:

- Pouring an invert in the casing pipe, or
- Shimming the carrier pipe with casing spacers to a uniform grade.

b. Installations deviating from the specified tolerances that cannot be adjusted to conform to the specified tolerances may be rejected by the Engineer. If non-conforming installation is not rejected, provide all additional fittings, manholes, or appurtenances needed to accommodate horizontal or vertical misalignment, at no additional cost to the Jurisdiction.

c. Abandon rejected installation and place special fill materials, at no additional cost to the Jurisdiction. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required to replace rejected installations.

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

1. Install pipe by approved methods.

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

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

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

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

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

C. Carrier Pipe Installation through Casing:

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

3.04 TRENCHLESS INSTALLATION (Continued)

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

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

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

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

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

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

D. Annular Space Grouting: If specified, fill the annular space between the carrier pipe and the casing pipe with flowable mortar, foamed cellular concrete, or CLSM according to Section 3010. Batching, mixing, and placing may be started when the temperature is 34°F and rising. Cease mixing and placing when temperature is 38° F or less and falling.

1. Flowable Mortar and CLSM: Fill voids by staged grouting. Construct bulkheads at each end of the pipe. Ensure all voids are filled with flowable mortar by providing 2 feet of head when filling.

2. Foamed Cellular Concrete:
   a. Construct bulkheads sufficient to withstand pressure of grouting operation at each end of the pipe.
   b. Use sufficient grouting pressures to ensure all voids between the inner pipe and the casing pipe have been filled without collapsing or deforming the inner pipe by more than 5% of the diameter. Multiple grout lifts may be necessary. Follow manufacturer’s recommendations.
   c. Check wet density at the beginning of the placement and a minimum of every 2 hours thereafter. Provide test results to the Engineer.
   d. If grout holes are utilized, insert cylindrical wood plugs or other approved plugs until grout has set. Fill holes with concrete after plugs have been removed.

3.05 PIT RESTORATION

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

B. When the carrier pipe extends beyond the limits of trenchless installation and into the bore pit, place bedding and backfill material according to Section 3010, 3.05.

C. Place suitable backfill material in the pit. Apply the testing requirements of Section 3010, 3.06.

D. Restore the site to original condition or better.

END OF SECTION

Table of Contents

Section 4050 - Pipe Rehabilitation **Page No.**

1.08 MEASUREMENT AND PAYMENT (Continued)

2. **Trenchless:**
   a. **Measurement:** Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe.
   b. **Payment:** Payment will be made at the unit price per linear foot for each type and size of carrier pipe.
   c. **Includes:** Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, 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 the centerline of the pipe from the end of the pipe to the centerline of the sewer main.

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

3. **Includes:** Unit price includes, but is not limited to, trench excavation, furnishing 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.

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.

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 per linear foot for each type and size of pipe.

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

1.08 MEASUREMENT AND PAYMENT (Continued)

I. Sanitary Sewer Cleanout:

1. Measurement: Each sanitary sewer cleanout will be counted.

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

3. Includes: Unit price includes, but is not limited to, plug at the end of the main, fittings, riser pipe, cap with screw plug, casting, and concrete casting encasement.

J. Connection to Existing Manhole: Comply with Section 6010, 1.08, G.

K. Sanitary Sewer Abandonment, Plug:

1. Measurement: Each plug will be counted.

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

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

L. Sanitary Sewer Abandonment, Fill and Plug:

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

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

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

2.01 SANITARY SEWER (Gravity Mains) (Continued)

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

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

1. Pipe and fittings complying with ASTM C 700.

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

3. Test according to ASTM C 301.

I. Double Walled Polypropylene Pipe 12 inch to 30 inch:

1. Comply with ASTM F 2764.

2. Minimum pipe stiffness per ASTM D 2412, 46 psi.

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

J. Triple Walled Polypropylene Pipe 30 inch to 36 inch:

1. Comply with ASTM F 2764.

2. Minimum pipe stiffness per ASTM D 2412, 46 psi.

3. Integral bell and spigot joint complying with ASTM D 3212 and ASTM F477.

2.02 SANITARY SEWER FORCE MAINS

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

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

C. Sewage Air Release Valve:

1. General: Consists of an elongated tapered or conical body and a float to operate (open and close) under pressure without spillage. Provide valves suitable for pressures up to 150 psi. Use a float with a linkage connection to the seal plug assembly to prevent irregular air release and protect the connecting rod. Ensure the bottom of the valve body is sloped or funnel-shaped to encourage the accumulated sewage and solids to drain from the valve. Preserve a volume of air at all times between the liquid sewage and the seal plug assembly. Provide a flushing port with attachments for backwashing.

2. Materials:
a. Body and Cover:
1) Stainless Steel: ASTM A 351.
2) Cast Iron: ASTM A 126, Grade B.
3) Ductile Iron: ASTM A 536, Grade 65-45-12.
4) Other corrosion resistant materials.
b. Internal Metal Components: Stainless steel.

2.02 SANITARY SEWER FORCE MAINS (Continued)

c. Float: Stainless steel, ASTM A 240, Type 304 or Type 316, or foamed polypropylene.

d. Seal Plug Assembly: Stainless steel, foamed polypropylene, EPDM rubber, Nitrile (Buna-N) rubber, and reinforced nylon.

3. Tapping Saddle: Stainless steel or nylon.

4. Pit: Construct according to Figure 4010.202.

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

E. Tracer Wire Station:

1. Two internal terminals with shunt.

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

3. Removable top cap with lock.

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

2.03 CASING PIPE

Comply with Section 3020, 2.02 for casing pipe requirements.

2.04 SANITARY SEWER SERVICES

A. Connection to Main:

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

2. 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.

3.08 SANITARY SEWER ABANDONMENT

A. Plug:

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

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

B. Fill:

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

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

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

3.09 CONNECTION TO EXISTING MANHOLE

Comply with Section 6010, 3.05.

3.10 SANITARY SEWER CLEANOUT

Provide cleanouts where specified in the contract documents. Comply with Figure 4010.203.

3.11 TOLERANCES

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

A. Gravity Main:

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

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

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

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

* Measured to the nearest 1/2”

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

3.12 CONFLICTS

A. Horizontal Separation of Gravity Sewers from Water Mains: Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet unless:

1. The top of a sewer main is at least 18 inches below the bottom of the water main, and

2. The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

3. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Section 5010, 2.01. However, provide a linear separation of at least 2 feet.

B. Separation of Sewer Force Mains from Water Mains: Separate sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

1. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of Section 5010, 2.01 and
2. The sewer force main is laid at least 4 linear feet from the water main.

C. Separation of Sewer and Water Main Crossovers:

1. Vertical separation of sanitary 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.

2. 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.

3.13 CLEANING, INSPECTION, AND TESTING

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

END OF SECTION

STORM SEWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Storm Sewers

B. Abandonment of Storm Sewers

1.02 DESCRIPTION OF WORK

A. Construct storm sewers.

B. Abandon storm sewers.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Storm Sewer:

1. Trenched:

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

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

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

1.08 MEASUREMENT AND PAYMENT (Continued)

2. Trenchless:

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

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

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

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

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe, trench excavation, dewatering, furnishing 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.

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

c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing 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 made at the unit price per linear foot for each type and size of pipe removed.

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

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

E. Storm Sewer Abandonment, Plug:

1. Measurement: Each plug will be counted.

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

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

1.08 MEASUREMENT AND PAYMENT (Continued)

F. Storm Sewer Abandonment, Fill and Plug:

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

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

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

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

PART 2 - PRODUCTS

2.01 STORM SEWERS

A. Reinforced Concrete Pipe (RCP):

1. Comply with ASTM C 76.

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

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

B. Reinforced Concrete Arch Pipe (RCAP):

1. Comply with ASTM C 506.

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

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

C. Reinforced Concrete Elliptical Pipe (RCEP):

1. Comply with ASTM C 507.

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

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

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

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

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

E. Polyvinyl Chloride Pipe (PVC):

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

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

2.01 STORM SEWERS (Continued)

F. High Density Polyethylene Pipe (HDPE):

1. Use pipe complying with the following:
   a. AASHTO M 294, Type S corrugated exterior and smooth interior.
   b. 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 complying with ASTM F 477.
   e. Maximum 5% deflection of the average inside diameter by testing after installation according to Section 4060, 3.05.

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

G. Corrugated Metal Pipe (CMP):

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

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

H. Spiral Rib Pipe:

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

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

I. Coated Corrugated Metal Pipe:

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

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

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

J. Corrugated Metal Arch Pipe (CMAP):

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

2.01 STORM SEWERS (Continued)

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

K. Spiral Rib Arch Pipe:

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

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

L. Polypropylene Pipe:

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

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

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

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

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

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

2.02 CASING PIPE

Comply with Section 3020, 2.02 for casing pipe requirements.

2.03 PIPE APRONS

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

2.04 APRON FOOTINGS

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

2.05 APRON GUARD

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

PART 3 - EXECUTION

3.01 EXAMINATION

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

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

3.02 PIPE INSTALLATION

A. General:

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

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

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

4. Assemble joints as specified by the pipe manufacturer.

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

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

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

B. Trenched:

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

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

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

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

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

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

C. Trenchless: Comply with Section 3020.

3.03 STORM SEWER INSTALLED WITHIN A CASING PIPE

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

3.04 PIPE JOINTING

A. General:

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

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

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

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

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

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

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

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

E. Connections between Dissimilar Pipes:

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

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

3.05 APRONS

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

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

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

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

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

3.06 TOLERANCES

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

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

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

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

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

* Measured to the nearest 1/2”

3.07 CONFLICTS

A. Horizontal Separation of Gravity Sewers from Water Mains:

1. Separate gravity storm sewer mains from water mains by a horizontal distance of at least 10 feet unless:
   - The top of a sewer main is at least 18 inches below the bottom of the water main, and
   - The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

2. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Section 5010, 2.01. However, provide a linear separation of at least 2 feet.

B. Separation of Sewer Force Mains from Water Mains: Separate storm sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

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

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

C. Separation of Sewer and Water Main Crossovers:

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

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

3.08 STORM SEWER ABANDONMENT

A. Plug:

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

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

B. Fill:

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

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

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

3.09 CONNECTION TO EXISTING MANHOLE OR INTAKE

Comply with Section 6010, 3.05.

3.10 CLEANING, INSPECTION, AND TESTING

Clean, inspect, and test according to Section 4060.

END OF SECTION

PIPE CULVERTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe Culverts

B. Pipe Aprons and Beveled Ends

C. Footings for Concrete Pipe Aprons

D. Pipe Apron Guards

1.02 DESCRIPTION OF WORK

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

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Pipe Culverts:

1. Trenched:

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

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

c. Includes: Unit price includes, but is not limited to, trench excavation, dewatering, furnishing 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.

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.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Pipe Aprons:

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

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

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

D. Pipe Apron Guards:

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

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

PART 2 - PRODUCTS

2.01 PIPE CULVERTS

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

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

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

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

1. Use a galvanized steel structural plate complying with AASHTO M 167.
2. Use bolts and nuts complying with ASTM A 449 and galvanized per ASTM A 153, Class C.
3. Assemble the structure according to the manufacturer's recommendations. Tighten the bolts using an applied torque of between 100 and 300 foot-pounds.
4. Install the structure according to the contract documents, the manufacturer′s recommendations, and AASHTO Standard Specifications for Highway Bridges, Division II, Section 26.
5. Conform the gage of the structure to Iowa DOT Standard Road Plan DR-104 or as specified in the contract documents.

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

1. Comply with AASHTO M 219.
2. Use a corrugation profile of 9 inches by 2 1/2 inches.
3. Use aluminum complying with ASTM B 209.
4. Use a minimum thickness of 0.100 inch. Gage of structure complying with manufacturer's requirements.
5. Use bolts and nuts meeting ASTM A 307 or ASTM A 449 and galvanize per ASTM A 153.

2.01 PIPE CULVERTS (Continued)

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

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

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

2.02 PIPE APRONS

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

2.03 APRON FOOTINGS

Comply with the requirements of Figure 4030.221 and Section 6010 for reinforcing steel and structural concrete used in apron footings.

2.04 APRON GUARD

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

PART 3 - EXECUTION

3.01 PIPE CULVERT INSTALLATION

A. Trenched:

1. Install pipe in a trench per Section 4020.

2. For culvert pipe installed in embankment, pipe may be installed at the Contractor's option per the contract documents and the following Iowa DOT Specifications sections:
   a. Reinforced Concrete Pipe (circular, arched, and elliptical): Section 2416.
   b. Corrugated Metal and Corrugated Plastic Pipe: Section 2417.
   c. Structural Plate Culverts: Section 2420.

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

3.02 APRONS

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

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

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

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

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

3.03 CLEANING, INSPECTION, AND TESTING

Clean, inspect, and test culverts per Section 4060.

END OF SECTION

PART 2 - PRODUCTS

2.01 POLYETHYLENE AND POLYOLEFIN MANUFACTURED PIPE FOR SLIPLINING

A. Pipe:

1. Comply with ASTM D 3035, minimum pipe stiffness of 46 psi.
2. Polyethylene complying with ASTM D 1248, Type III, Class C, Category 5, Grade P 34 or ASTM D 3350 Cell Classification PE 335434C.
3. Maximum outside diameter 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 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 complying with ASTM D 4161.

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

A. Pipe Lining:

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.

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

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 with the inversion process.

2. Cures in the presence of water with temperature greater than 150°F and less than 180°F.

3. Initial structural properties complying with ASTM F 1216. Also comply with the following table.

Table 4050.01: CIPP Lining 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. CIPP Lining Dimensions:

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

2. Field verify diameter and length.

3. Use one continuous length without joints.

2.06 DEFORMED/REFORMED HIGH DENSITY POLYETHYLENE PIPE LINING (DRP-HDPE)

A. Pipe Lining:

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 DRP lining structural standards.

Table 4050.02: DRP-HDPE Lining Properties

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

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2.01 WATER MAIN (Continued)

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

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

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

2.02 BOLTS FOR WATER MAIN AND FITTINGS

Use corrosion resistant bolts.

A. Tee-bolts and Hexagonal Nuts for Mechanical Joints:

1. High-strength, low-alloy steel manufactured according to AWWA C111.

2. Provide ceramic-filled, baked-on, fluorocarbon resin coating for bolts and nuts.

3. Include factory-applied lubricant that produces low coefficient of friction for ease of installation.

B. Other Bolts and Nuts:

1. Stainless steel.

2. Ductile iron.

3. Zinc, zinc chromate, or cadmium plated.

2.03 FITTINGS

A. For DIP and PVC Pipe: Comply with AWWA C110 (ductile iron or gray iron) or AWWA C153 (ductile iron).

1. Joint Type:
- a. For pipe sizes 16 inches and less, use mechanical joint complying with AWWA C111.
- b. For pipe sizes greater than 16 inches, use restrained mechanical joint system. Provide follower gland using breakaway torque bolts to engage thrust restraint.
  - 1) Minimum pressure rating same as connecting pipe. For fittings between dissimilar pipes, the minimum pressure rating is the lesser of the two pipes.
  - 2) Suitable for buried service.
  - 3) Joint restraint system to be field installable, field removable, and re-installable.
- c. Use of alternate restraint systems must be approved by the Engineer.

2. Lined: Cement mortar lined according to AWWA C104 with asphalt coating.

2.03 FITTINGS (Continued)

3. Wall Thickness: Comply with AWWA C153.

4. Gaskets: Comply with AWWA C111.

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

C. Flange Adapter:

1. Body: Ductile iron complying with ASTM A 536.

2. End Rings (Follower Rings): Ductile iron complying with ASTM A 536.

3. Gaskets: New rubber compounded for water service and resistant to permanent set.

4. Bolts and Nuts: High strength, low alloy corrosion resistant steel or carbon steel bolts complying with ASTM A 307.

D. Pipe Coupling:

1. Center Sleeve (Center Ring): Steel pipe or tubing complying with ASTM A 53 or ASTM A 512, or formed carbon steel with a minimum yield of 30,000 psi.

2. End Ring (Follower Ring): Ductile iron complying with ASTM A 536, or steel meeting or exceeding the requirements of ASTM A 576, grade 1010-1020.

3. Gaskets: New rubber compounded for water service and resistant to permanent set.

4. Bolts and Nuts: High strength, low alloy corrosion resistant steel.

2.04 CONCRETE THRUST BLOCKS

A. Use Iowa DOT Class C concrete.

B. Comply with the contract documents for dimensions and installation of thrust blocks. Comply with Figure 5010.101.

C. Use for all pipe sizes 16 inches in diameter or smaller or when specified.

2.05 PIPELINE ACCESSORIES

A. Polyethylene Wrap:

1. Comply with AWWA C105.

2. Provide tubes or sheets with 8 mil minimum thickness.

B. Tracer System: Comply with Figure 5010.102.

1. Tracer Wire:
a. Open Cut:
1) Solid Single Copper Conductor:
a) Size: #12 AWG
b) Insulation Material: Linear low-density polyethylene (LLDPE) installation suitable for direct burial applications

2.05 PIPELINE ACCESSORIES (Continued)

c) Insulation Thickness: 0.030 inches, minimum
d) Tensile Strength: 150 pounds, minimum
e) Operating Voltage: Rated for 30 volts

2) Bimetallic Copper Clad Steel Conductor:
a) Size: #14 AWG
b) Rating: Direct burial
c) Operating Voltage: Rated for 30 volts
d) Conductivity: 21%
e) Copper Cladding: 3% of conductor diameter, minimum
f) Insulation Material: High density, high molecular weight polyethylene
g) Insulation Thickness: 0.030 inches, minimum
h) Tensile Strength: 175 pounds, minimum

b. Directional Drilling/Boring:

1) Bimetallic Copper Clad Steel Conductor:
a) Size: #12 AWG
b) Rating: Direct burial
c) Operating Voltage: Rated for 30 volts
d) Conductivity: 21%
e) Copper Cladding: 3% of conductor diameter, minimum
f) Insulation Material: High density, high molecular weight polyethylene
g) Insulation Thickness: 0.045 inches, minimum
h) Tensile Strength: 1,100 pounds, minimum

2. Ground Rod: 3/8 inch diameter, 60 inch steel rod uniformly coated with metallically bonded electrolytic copper.

3. Ground-rod Clamp: High-strength, corrosion-resistant copper alloy.

4. Splice Kit: Inline resin splice kit with split bolt (1 kV and 5 kV) for use with single conductor and unshielded cable splices in direct bury and submersible applications.

5. Tracer Wire Station: Comply with the contract documents.

2.06 SPECIAL GASKETS

A. For soils contaminated with gasoline, use neoprene or nitrile gaskets.

B. For soils contaminated with volatile organic compounds, use nitrile or fluorocarbon gaskets.

C. For other soil contaminants, contact the Engineer for the required gasket.

2.07 WATER SERVICE PIPE AND APPURTENANCES

A. Controlling Standards: Local plumbing and fire codes.

B. Materials (as allowed by Jurisdiction or specified in contract documents)**:**

1. Copper Pipe:
a. Comply with ASTM B 88.
b. Wall Thickness: Type K.

2. DIP: As specified in Section 5010, 2.01. Polyethylene wrap is required.

3. PVC Pipe: ASTM D 1785, Schedule 80 or ASTM D 2241, SDR 21. Provide solvent weld joints for all pipes.

2.07 WATER SERVICE PIPE AND APPURTENANCES (CONTINUED)

4. Brass Pipe: Red, seamless, according to ASTM B 43.

5. Polyethylene Pipe: Class 200, according to AWWA C901.

C. Corporations, Stops, and Stop Boxes: Contact the Jurisdiction for requirements.

2.08 NON-SHRINK GROUT

Comply with Iowa DOT Materials I.M. 491.13.

2.09 CASING PIPE

Comply with Section 3020.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

A. General:

1. Do not use deformed, defective, gouged, or otherwise damaged pipes or fittings.
2. Keep trench free of water. Clean pipe interior prior to placement in the trench.
3. Install pipe with fittings and valves to the lines and grades specified in the contract documents.
4. Clean joint surfaces thoroughly and apply lubricant approved for use with potable water and recommended by the manufacturer.
5. Push pipe joint to the indication line on the spigot end of the pipe before making any joint deflections.
6. Limit joint deflections to one degree less than pipe manufacturer′s recommended maximum limit.
7. Tighten bolts in a joint evenly around the pipe.
8. Install concrete thrust blocks on all fittings 16 inches in diameter or smaller (comply with Figure 5010.101). For fittings larger than 16 inches, install restrained joints, and when specified in the contract documents, also install concrete thrust blocks.
9. Keep exposed pipe ends closed with rodent-proof end gates at all times when pipe installation is not occurring.
10. Close the ends of the installed pipe with watertight plugs during nights and non-working days.
11. Do not allow any water from the new pipeline to enter the existing distribution system piping until testing and disinfection are successfully completed.

B. Trenched:

1. Excavate trench and place pipe bedding and backfill material as specified in Section 3010.
2. Provide uniform bearing along the full length of the pipe barrel. Provide bell holes.

C. Trenchless: Comply with Section 3020.

3.02 ADDITIONAL REQUIREMENTS FOR DIP INSTALLATION

A. Utilize full-length gauged pipe for field cuts. Alternatively, field-gauge pipe selected for cutting to verify the outside diameter is within allowable tolerances.

B. Cut the pipe perpendicular to the pipe barrel. Do not damage the cement lining. Bevel cut the ends for push-on joints according to the manufacturer's recommendations.

C. Encase all pipe, valves, and fittings with polyethylene wrap according to Section 5010, 3.05.

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 polyethylene encasement to buried ductile iron pipe and to buried fittings, fire hydrants, and appurtenances. The polyethylene encasement is used to prevent contact between the pipe and the bedding material, but need not be airtight or watertight.

B. Install polyethylene encasement according to AWWA C105, using tubes or flat sheets, and pipe manufacturer's recommendations.

C. Do not expose the polyethylene encasement to sunlight for long periods before installation.

D. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before encasing the pipe. Take care to prevent soil or bedding material from becoming trapped between the pipe and polyethylene.

E. Lift polyethylene-encased pipe with a fabric-type sling or padded cable.

F. Secure and repair encasement material using polyethylene tape, or replace as necessary.

3.06 TRACER SYSTEM INSTALLATION

A. Install with all buried water main piping. Comply with Figure 5010.102 for tracer wire installation.

B. Begin and terminate the system at all connections to existing mains.

C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 2 inch wide, 10 mil thickness polyethylene pressure sensitive tape.

D. Install splices only as authorized by the Engineer. Allow the Engineer to inspect all below-grade splices of tracer wire prior to placing the backfill material.

E. Install ground rods adjacent to connections to existing piping and at locations specified in the contract documents or as directed by the Engineer.

3.06 TRACER SYSTEM INSTALLATION (Continued)

F. Bring two wires to the surface at each fire hydrant location and terminate with a tracer wire station (comply with Figure 5010.102).

G. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair discontinuities.

3.07 CONFLICTS

A. Horizontal Separation of Gravity Sewers from Water Mains:

1. Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet unless:
   - The top of a sewer main is at least 18 inches below the bottom of the water main, and
   - The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

2. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Section 5010, 2.01. However, provide a linear separation of at least 2 feet.

B. Separation of Sewer Force Mains from Water Mains: Separate sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

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

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

C. Separation of Sewer and Water Main Crossovers:

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

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

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

D. Surface Water Crossings: Comply with the Recommended Standards for Water Works, 2007 Edition.

3.07 CONFLICTS (Continued)

1. **Above-water Crossings:** Ensure the pipe is adequately supported and anchored; protected from vandalism, damage, and freezing; and accessible for repair or replacement.

2. **Underwater Crossings:** Provide a minimum cover of 5 feet over the pipe unless otherwise specified in the contract documents. When crossing water courses that are greater than 15 feet in width, provide the following.
   a. pipe with flexible, restrained, or welded watertight joints,
   b. valves at both ends of water crossings so the section can be isolated for testing or repair; ensure the valves are easily accessible and not subject to flooding, and
   c. permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples on each side of the valve closest to the supply source.

3.08 TRANSITIONS IN PIPING SYSTEMS

Where the specified material of a piping system entering or exiting a structure changes, make the change at the outside of the structure wall, beyond any wall pipe or wall fitting required, unless otherwise specified.

3.09 STRUCTURE PENETRATIONS

A. Wall Pipes:

1. Install where pipes penetrate and terminate at a wall or floor surface of a concrete structure, or where the pipe protrudes through the concrete wall or floor and the protrusion is otherwise unsupported.

2. Provide a waterstop flange near the center of the embedment length. The waterstop is to be cast integrally with the wall pipe, or fully welded to it around the pipe circumference.

B. Wall Sleeves:

1. Install where a pipe passes through a structure wall.

2. Sleeves in concrete walls are to be supplied with a waterstop collar, fully welded, and cast-in-place in the concrete.

3.10 WATER SERVICE STUB

A. Install water service pipe, corporations, stops, and stop boxes according to local Jurisdiction requirements.

B. Install 1 inch and smaller corporation valves tapped at 45 degrees above horizontal at a minimum distance of 18 inches from pipe bell or other corporation. Install 1 1/2 inch and 2 inch corporation valves tapped horizontal a minimum distance of 24 inches from pipe bell or other corporation.

C. Construct trench and place backfill material according to Section 3010.

3.11 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

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

D. Casting Types:

1. Manholes: The following table lists the manhole casting types.

Table 6010.03: Manhole Casting Types

	Figure No.	Casting Type	Number of Pieces	Ring/ Cover	Bolted Frame	Bolted Cover (Floodable)	Gasket
Sanitary Sewer	6010.601	SW-601, A	2	Fixed[2]	Yes	No	Yes[1]
	6010.601	SW-601, B	3	Adjustable[3]	No	No	Yes[1]
	6010.601	SW-601, C	2	Fixed[2]	Yes	Yes	Yes[1]
	6010.601	SW-601, D	3	Adjustable[3]	No	Yes	Yes[1]
Storm Sewer	6010.602	SW-602, E[4]	2	Fixed[2]	Yes	No	No
	6010.602	SW-602, F[4]	3	Adjustable[3]	No	No	No
	6010.602	SW-602, G[4]	2	Fixed	No	No	No

[1] Machine bearing surfaces required.
[2] Typically used with non-paved or flexible surfaces, including HMA, seal coat, gravel, and brick.
[3] Typically used with PCC surfaces, including castings in concrete boxouts.
[4] Storm sewer casting may include environmental symbols and/or messages such as “DUMP NO WASTE, DRAINS TO RIVER.”

2. Intakes:
a. Comply with Figures 6010.602, 6010.603, 6010.604, and the contract documents.
b. Castings may include environmental symbols and/or messages such as “DUMP NO WASTE, DRAINS TO RIVER.”

3. Manhole Casting Extension Ring:
a. Match the dimensions of the existing ring and cover with an allowable diameter tolerance of -1/4 inch for the frame ridge and +1/4 inch for the cover recess.
b. Provide extension ring with height as required to raise the top of the casting to make it level or no more than 1/4 inch below the finished pavement surface. Maximum ring height is 3 inches.

2.11 ADDITIONAL MATERIALS FOR SANITARY SEWER MANHOLES

A. Infiltration Barrier:

1. External Chimney Seal:
a. Rubber Sleeve and Extension:
1) Corrugated; minimum thickness of 3/16 inches, according to ASTM C 923.
2) Minimum allowable vertical expansion of at least 2 inches.
b. Compression Bands:
1) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces.
2) 16 gauge ASTM C 923, Type 304 stainless steel, minimum 1 inch width, minimum adjustment range of 4 inches more than the manhole outside diameter.
3) For standard two-piece castings, shape top band to lock sleeve to manhole frame's base flange. For three-piece adjustable castings, shape top band to lock sleeve to upper piece of adjustable frame.
4) Stainless steel fasteners complying with ASTM F 593 and 594, Type 304.

2.11 ADDITIONAL MATERIALS FOR SANITARY SEWER MANHOLES (Continued)

2. Internal Chimney Seal:

a. Rubber Sleeve and Extension:

1) Double pleated, minimum thickness 1/8 inch thick, according to ASTM C 923.
2) Minimum allowable vertical expansion of at least 2 inches.
3) Integrally formed expansion band recess top and bottom with multiple sealing fins.

b. Expansion Bands:

1) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces to make a watertight seal.
2) 16 gauge ASTM C 923, Type 304 stainless steel, minimum 1 inch width, minimum adjustment range of 2 inches more than the manhole inside diameter.
3) Positive stainless steel locking mechanism permanently securing the band in its expanded position after tightening.

3. Molded Shield:

a. Barrier Shield:

1) Medium density polyethylene, according to ASTM D 1248.
2) Certified for 40,000 pound proof-load according to AASHTO M 306.
3) Diameter to match cone section and internal dimension of casting.

b. Sealant: Butyl material meeting ASTM C 990.

4. Heat Shrink Sleeve: Heat-shrinkable wrap around sleeve designed for protection of buried and exposed sanitary sewer manholes. Do not use with polypropylene or polyethylene adjustment rings.

a. Primer: Compatible with concrete, ductile and cast iron, and sleeve material.

b. Sleeve and Backing:

Property	Standard	Value
Water Absorption	ASTM D 570	0.05% maximum
Low Temperature Flexibility	ASTM D 2671	-40° F
Tensile Strength	ASTM D 638	2,900 psi minimum
Elongation	ASTM D 638	600% minimum
Hardness	ASTM D 2240	Shore D: 46
Shrink Factor	---	40% minimum
Thickness	---	0.1 inch minimum

c. Adhesive: Softening point of 212° F maximum meeting ASTM E 28.

B. Riser Section Coating:

1. Exterior: When exterior waterproof coating is specified, provide bituminous or coal tar coating.

2. Interior: When interior manhole lining is specified, provide lining according to Section 4010, 2.01 (lined, reinforced concrete pipe).

2.12 CONCRETE FILLET

A. Cast-in-place Base: Provide a cast-in-place concrete fillet with concrete complying with the requirements of Section 6010, 2.03.

B. Precast Base Section:

1. For sanitary sewers, provide a precast concrete fillet, unless otherwise allowed by the Engineer. Comply with Section 6010, 3.01.

2. For storm sewers, provide a cast-in-place concrete fillet with concrete complying with the requirements of Section 6010, 2.03.

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PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pavement

B. Curb and Gutter

1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of full depth PCC pavement and curb and gutter.

1.03 SUBMITTALS

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

A. Two weeks prior to commencing any PCC pavement placement, submit a paving mix design for each different source of aggregate to be used for review and approval by the Engineer. Submit mixes or mix designs approved by the Iowa Department of Transportation or an independent testing laboratory.

B. Maturity curves for paving mixes and maturity reading results.

C. Submit all testing and certifications according to Section 7010, 3.07.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

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

A. Aggregate Storage: Comply with Iowa DOT Article 2301.02, C.

B. Cement and Fly Ash: Comply with Iowa DOT Article 2301.02, C.

C. Admixtures: Store in suitable weather tight enclosures which will preserve quality.

D. Reinforcing Steel: Store off ground on timbers or other supports.

1.06 SCHEDULING AND CONFLICTS

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

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

1.07 SPECIAL REQUIREMENTS

None

1.08 MEASUREMENT AND PAYMENT

A. PCC Pavement:

1. Measurement: Measurement will be in square yards for each different thickness of PCC pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. Payment: Payment will be at the unit price per square yard for each thickness of PCC pavement.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. **Includes:** Unit price includes, but is not limited to, final trimming of subgrade or subbase, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, pavement smoothness testing, and quality control for stringless paving.

B. Air Content Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement subject to a unit price reduction for air content deficiency according to Section 7010, 3.07.

2. **Payment:** Payment will be at the reduced unit price according to Table 7010.03 for each thickness of PCC pavement. If there is an air content deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

C. Pavement Smoothness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement subject to a unit price reduction for pavement smoothness according to Section 7010, 3.07.

2. **Payment:** Payment will be at the reduced unit price according to Table 7010.04 for each thickness of PCC pavement. If there is a pavement smoothness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

D. PCC Pavement Thickness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement that has deficient pavement thickness as determined in Table 7010.05.

2. **Payment:** Payment will be at the percentage of the unit price indicated in Table 7010.05 for each different thickness of PCC pavement. If there is a pavement thickness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

E. Curb and Gutter:

1. **Measurement:** Measurement will be in linear feet measured along the face of the curb for each different width and thickness of curb and gutter.

2. **Payment:** Payment will be at the unit price per linear feet of curb and gutter.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.

F. Beam Curb:

1. **Measurement:** Measurement will be in linear feet measured along the face of the curb.

2. **Payment:** Payment will be at the unit price per linear feet of beam curb.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.

1.08 MEASUREMENT AND PAYMENT (Continued)

G. Concrete Median:

1. **Measurement:** Measurement will be in square yards of concrete median. When the curb is integral with the pavement, the width will be measured from back of curb to back of curb.

2. **Payment:** Payment will be at the unit price per square yard of concrete median.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.

H. PCC Railroad Crossing Approach:

1. **Measurement:** Measurement will be in square yards of railroad crossing approach.

2. **Payment:** Payment will be at the unit price per square yard of railroad crossing approach.

3. **Includes:** Unit price includes, but is not limited to, excavation for modified subbase and subdrain, furnishing and installing subdrain, furnishing and installing subdrain outlet or connection to storm sewer, furnishing and installing porous backfill material, furnishing and installing fiber board barrier, furnishing and placing modified subbase material, furnishing and installing reinforcing steel and tie bars, furnishing and placing concrete, furnishing, placing, and compacting HMA.

I. PCC Pavement Samples and Testing:

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

2. **Payment:** Payment will be at the lump sum price for PCC pavement samples and testing.

3. **Includes:** Lump sum price includes, but is not limited to, certified plant inspection, pavement thickness cores, profilograph pavement smoothness measurement (when required by the contract documents), and maturity testing.

J. Granular Surfacing: Comply with Section 7030 for granular surfacing material placed at intersecting roads, driveways, and turnouts.

K. PCC Pavement Widening:

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement widening. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement widening area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of PCC pavement widening.

3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness.

L. Pavement Removal: Comply with Section 7040.

M. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: Meet the requirements of Iowa DOT Section 4101 and Materials I.M. 401, including Type I and Type II cements and blended hydraulic cements Type 1P, Type 1S, and Type 1L.

B. Supplementary Cementitious Materials (SCM):

1. Fly Ash: Comply with Iowa DOT Section 4108.

2. Ground Granulated Blast Furnace Slag (GGBFS): Comply with Iowa DOT Section 4108.

3. Limestone: Comply with Iowa DOT Materials I.M. 401.

C. Fine Aggregate for Concrete:

1. Meet the requirements of Iowa DOT Section 4110 and Materials I.M. 409, Source Approvals for Aggregates.

2. Comply with the following gradation:

Sieve Size	Percent Passing
3/8”	100
No. 4	90 to 100
No. 8	70 to 100
No. 30	10 to 60
No. 200	0 to 1.5
Iowa DOT Article 4109.02, Gradation No. 1 in the Aggregate Gradation Table.	

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

D. Coarse Aggregate for Concrete:

1. Crushed stone particles with Class 2 durability complying with Iowa DOT Section 4115 and Materials I.M. 409, Source Approvals for Aggregates.

2. Comply with one of the following gradations:

Sieve Size	Gradation No. 3 Percent Passing	Gradation No. 4 Percent Passing	Gradation No. 5 Percent Passing
1 1/2”	100	100	-----
1”	95 to 100	50 to 100	100
3/4”	-----	30 to 100	90 to 100
1/2”	25 to 60	20 to 75	-----
3/8”	-----	5 to 55	20 to 55
No. 4	0 to 10	0 to 10	0 to 10
No. 8	0 to 5	0 to 5	0 to 5
No. 200	0 to 1.5	0 to 1.5	0 to 1.5
Iowa DOT Article 4109.02, Gradation No. 3, 4, and 5 in the Aggregate Gradation Table.			

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

2.01 MATERIALS (Continued)

E. Intermediate Aggregate for Concrete: Use if specified in contract documents.

1. Meet the requirements of Iowa DOT Section 4112 and Materials I.M. 409, Source Approvals for Aggregates.

2. For crushed limestone or dolomite, meet the durability class required for the coarse aggregate. When gravel durability is lower than the coarse aggregate durability requirements, pea gravel is not to exceed 15% of the total aggregate mix.

3. Comply with the following aggregate gradation:

Sieve Size	Percent Passing
1/2”	95 to 100
3/8”	-----
No. 4	-----
No. 8	0 to 10
Iowa DOT Article 4109.02, Gradation No. 2 in the Aggregate Gradation Table	

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

F. Water Requirements: Comply with Iowa DOT Section 4102. Potable water obtained from a municipal supply, suitable for drinking, may be accepted without testing.

G. Admixtures: Meet the requirements for the liquid admixtures shown below. Other admixtures may be used subject to the approval of the Engineer.

1. Air Entrainment Admixture: Comply with Iowa DOT Section 4103.

2. Retarding and Water Reducing Admixtures: Comply with Iowa DOT Section 4103.

3. Accelerating admixtures (calcium chloride): Comply with Iowa DOT Article 2529.02.

H. Bars: Comply with Iowa DOT Section 4151 for tie bars and dowel bars. Meet the tie bar requirements for bar mats. All bars must be epoxy coated.

I. Expansion Tubes: Comply with Iowa DOT Section 4191.

J. Metal Keyways: Comply with Iowa DOT Section 4191.

K. Supports for Bars: Comply with Iowa DOT Materials I.M. 451.01.

L. Joint Fillers and Sealers:

1. Joint Sealers: Comply with Iowa DOT Article 4136.02.

2. Preformed Expansion Joint Fillers and Sealers: Use the following types of preformed materials for filling expansion joints that comply with Iowa DOT Article 4136.03. When the type is not specified, use a resilient filler.
- Resilient filler
- Flexible foam expansion joint filler
- Tire buffings expansion joint filler
- Elastomeric joint seals

2.01 MATERIALS (Continued)

M. Liquid Curing Compound: Comply with Iowa DOT Section 4105.

N. Covering:

1. Burlap: Comply with Iowa DOT Section 4104.

2. Plastic Film: Comply with Iowa DOT Section 4106.

3. Insulating Cover: Comply with Iowa DOT Section 4106.

O. Grout Systems: Use polymer grouts that comply with Iowa DOT Materials I.M. 491.11.

2.02 CONCRETE MIXES

A. Mix Design:

1. Comply with Iowa DOT Class C or Class M mix meeting the requirements of Materials I.M. 529. If higher durability mixes are specified, use C-SUD or CV-SUD mixes.

2. Ensure compatibility of all material combinations. If the concrete materials are not producing a workable concrete mixture, a change in the material may be required. Changes will be at no additional cost to the Contracting Authority.

B. Consistency and Workability:

1. Slump:
a. Use an amount of mixing water that will produce workable concrete of uniform consistency. Unless specifically modified by the Engineer, ensure slump, measured according to Iowa DOT Materials I.M. 317, is no less than 1/2 inch or no more than 2 1/2 inches for machine finish and no less than 1/2 inch and no more than 4 inches for hand finish.
b. If it is not possible to produce concrete having the required consistency without exceeding the maximum allowable water to cement ratio specified, the cement content may be increased or water reducing admixture may be added. Obtain the Engineer's approval. Do not exceed the maximum water to cement ratio. Additional cement or water reducer will be added with no additional cost to the Contracting Authority.
c. The basic absolute volume of water per unit volume of concrete is based on average conditions. If material characteristics require that the total quantity of water used to secure the required consistency reduces the batch yield (computed on the basis of absolute volumes of the batch quantities used) by more than 2.0%, the Engineer may adjust the proportions to correct the yield. This adjustment will not be a basis for adjustment of the contract unit price.

2. Air Content: Use an approved air entraining agent.
a. For machine-placed pavement, use a target air content of 8% with a tolerance of plus or minus 2% when measured on the grade just prior to consolidation, as determined by Iowa DOT Materials I.M. 318. The target air content may be adjusted by the Engineer based on random tests of the consolidated concrete behind the paving machine. These additional tests will be used to consider the need for a target value change and will not be used in the acceptance decision.
b. For hand-placed pavement, use a target content for hand finish of 7% with a tolerance of plus or minus 1.5% when measured on the grade and just prior to consolidation, as determined by Iowa DOT Materials I.M. 318.

3.02 PAVEMENT CONSTRUCTION (Continued)

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

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

I. Finishing:

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

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

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

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

5. Surface Treatment:
a. Drag Surface Treatment: Unless otherwise specified, texture the finished surface with an artificial turf or burlap drag treatment.
1) Pull the artificial turf or burlap drag longitudinally over the finished surface to produce a tight, uniform, textured surface, and round the edges in a workmanlike manner.
2) Remove the artificial turf or burlap drag from the pavement surface at regular intervals and clean with water to remove accumulated concrete from the fabric in order to maintain a consistent finished texture.
3) When the desired texture is not attained, the Engineer may require the final finish be a broom finish.
b. Surface Tining: When surface tining is specified, use a longitudinal tining. Under special circumstances, when specified in the contract documents, transverse tining may be required.
1) Longitudinal:
a) Complete longitudinal surface tining using a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and uniformly spaced at 3/4 inch intervals. The depth of the grooves must be a minimum of 1/8 inch to a maximum of 3/16 inch in the plastic concrete.
b) Use equipment with horizontal and vertical string line controls to ensure straight grooves.
c) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.
d) At longitudinal joints, leave a 2 to 3 inch wide strip of pavement surface (centered along the joint) that is not grooved for the length of the joint.

3.02 PAVEMENT CONSTRUCTION (Continued)

2) Transverse:

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

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

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

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

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

J. Surface Curing:

1. Apply liquid curing compound in a fine spray to form a continuous, uniform film on the horizontal surface and vertical edges of pavement, curbs, and back of curbs immediately after surface moisture has disappeared, but no later than 30 minutes after finishing. With approval of the Engineer, the timing of cure application may be adjusted due to varying weather conditions and concrete mix properties to ensure acceptable macrotexture is achieved.
   a. Use a white pigment liquid curing compound for concrete not receiving an asphalt overlay. When specified in the contract documents, use a linseed oil solution.
   b. Use a dark-colored curing compound for concrete receiving an asphalt overlay.

2. Apply compound with power sprayer; rate of application not less than 15 square yards per gallon (0.067 gallon per square yard); do not dilute compound. For concrete receiving an asphalt overlay, use a minimum rate for dark-colored cure of 12.5 square yards per gallon (0.08 gallon per square yards).

3. Ensure liquid curing materials are well agitated in the supply drum or tank immediately before transfer to the sprayer. Keep curing materials well agitated during application.

4. Hand operated sprayers may be used for small and irregular areas.

5. If forms are used, apply to pavement edges and back of curbs within 30 minutes after forms are removed.

6. If, due to other operations, the coating is damaged within 72 hours after being applied, immediately re-coat the affected areas. Coating of the sawed surface with curing compound will not be allowed on joints that are to be sealed. When pavement is opened to traffic prior to 72 hours after application of the curing coating, a re-coating will not be required.

K. Construction of Joints:

1. General:
   a. Construct joints of the type, dimensions, and at the locations specified in the contract documents. See the 7010 figures.
   b. Place longitudinal joints coincident with or parallel to the pavement centerline.

3.02 PAVEMENT CONSTRUCTION (Continued)

c. Place all transverse joints at right angles to the centerline and extend the full width of the pavement.
d. Place all joints perpendicular to the finished grade of the pavement and do not allow the alignment across the joint to vary from a straight line by more than 1 inch.
e. Exercise care in placing, consolidating, and finishing the concrete at all joints.

2. Saw Joints:

a. Mark joint locations with a string line before sawing.
b. Begin transverse joint sawing as soon as the concrete has hardened sufficiently to allow sawing without raveling or moving of aggregate. Saw joints before uncontrolled cracking takes place.
c. Saw all joints in a single cutting operation for a specific joint. Make saw cuts true to line and to the dimensions specified in the contract documents.
d. Discontinue sawing a joint if a crack develops ahead of the saw.
e. Saw longitudinal joints within 24 hours of the concrete being placed.
f. If necessary, continue the sawing operations both day and night.
g. The concrete must be capable of supporting the sawing operations to allow the use of an early green concrete saw.
h. Repair or replace pavement with uncontrolled or random cracking at no additional cost to the Contracting Authority. Use repair methods approved by the Engineer. Repair or replace at the direction of the Engineer.
i. Use wet sawing for dust control when specified in the contract documents.
j. Where boxouts occur in pavement, construct joints as shown on Figures 7010.103 and 7010.904.

3. Construction Joints:

a. Place longitudinal and transverse construction joints where specified in the contract documents, at boxouts, and at headers.
b. Locate and place forms for boxouts on grade prior to paving as shown on Figures 7010.103 and 7010.904.
c. Construct a Days Work (DW) or a Rigid Tie (RT) transverse construction joint no closer than 5 feet of an existing or planned transverse contraction joint. Construct the DW or RT transverse construction joint if concrete placement is delayed for more than 30 minutes, at planned pavement gaps, or at the end of each day.
d. Finish the edges of the pavement at construction joints with a 1/8 inch radius edging tool.

4. Expansion Joints:

a. Install expansion joints as specified in the contract documents.
b. Prevent movement of or damage to joint assembly when placing concrete; set joint material low enough to clear the finish machine.
c. Construct double width expansion joint in curb over expansion joint in pavement. The backside of the joint must be clear of concrete.
d. Align the expansion joint straight and true. After the mechanical finishing equipment has passed over the joint, check the joint for movement. If movement in excess of 1/2 inch has occurred, immediately correct the installation to its intended position.
e. If joint fillers are assembled in sections, or if joints as a whole are constructed in sections, do not allow offsets between adjacent fillers.
f. Where more than one section is used in a joint, securely lace or clip the sections together.
g. Supplemental vibration equipment is required for proper consolidation of the concrete.
h. After the surface finishing has been completed, finish the edge of the joint with a 1/8 inch edging tool.

3.02 PAVEMENT CONSTRUCTION (Continued)

L. Joint Sealing:

1. Timing:
a. Unless otherwise allowed or approved by the Engineer, before any portion of the pavement is opened to the Contractor's equipment or to general traffic, clean and seal joints that require sealing.
b. The Engineer may limit the wheel loads and axle loads of equipment operating on the pavement during this operation, if prior to the age and strength specified in Section 7010, 3.05. Additional tests to determine the pavement strength may be required.

2. Cleaning:
a. For those joints that are not to be sealed, cleaning is not required.
b. Within 3 hours after a joint has been wet sawed to the finished dimension, flush the wet sawing residue away from the sawed faces using a high pressure water blast operating with a minimum pressure of 1,000 pounds per square inch. Within 3 hours after a joint has been dry sawed to the finished dimension, blow the dry sawing residue from the joint using air compressors that provide moisture and oil free compressed air.
c. Immediately prior to installation of sealant, clean joints with an air blast. Do not perform sealing until visual examination verifies the joint surfaces appear dry, in addition to being clear of dust and contamination.

3. Sealing:
a. Prepare and install joint sealer in the joint and to the proper level specified in the contract documents and as recommended by the manufacturer.
b. Heat hot-poured sealers in a thermostatically controlled heating kettle; heat the material to the temperature required for use, but not above that recommended by the manufacturer. After sealing, remove excess sealer from the pavement surface.
c. Seal joints the same day they are cleaned. Apply sealant only when the joint surfaces appear dry by visual examination.
d. Place joint sealer only when the pavement and ambient air temperatures are 40°F or above. When near this minimum, additional air blasting or drying time, or both, may be necessary to ensure a satisfactory bond to the joint faces. When this sealer cannot be properly placed due to late fall work, submit a joint construction plan and sealing details to the Engineer for approval before commencing paving. Delay the cleaning, sealing, and, if required, resawing of joints until the following spring. This delay requires the Engineer's approval.
e. When surface correction is required, repair seals damaged from the corrective work. Joint preparation, cleaning, and sealing may be delayed until after corrective work, provided the pavement is not opened to traffic before corrective work is performed.

M. Pavement Backfill: Following slipform paving operations, place backfill material along the pavement within 48 hours of pavement attaining opening strength or as directed by the Engineer to prevent flow of water and any subsequent damage caused by undermining of the pavement. Prior to placement of full backfill material, construct check dams or other protection as appropriate to ensure no damage to the subgrade and/or subbase occurs.

N. Form Removal:

1. Timing:
a. Remove forms after the initial set of the concrete has taken place.
b. Remove stakes and forms with care to prevent cracking, spalling, or over stressing concrete. If damage does occur, repairs will be made as required by the Engineer.

2. Honeycomb Repair:
a. When the forms are removed, fill honeycombs with mortar composed of 1 part cement and 2 parts fine aggregate by weight.

3.07 QUALITY CONTROL

A. Testing: Provide the following material certifications and testing required to be performed by Supplier or Contractor.

Table 7010.02: Material Certifications and Testing

Material or Construction Item	Tests	Applicable Standard[1]	Methods of Acceptance of Sampling and Testing	Field Sampling and Testing	
				Frequency (minimum)	Responsible Party
Fine Aggregates	Gradation	I.M. 302, 306, 336	Cert. Plant Insp.[2]	1/250 CY or min 1/day	Supplier/ Contractor
	Moisture	I.M. 308, 527	Cert. Plant Insp.[2]	1 per 1/2 day	
	Specific Gravity	I.M. 307	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Quality	I.M. 209	Approved Source	Prior to use	
Coarse Aggregates	Gradation	I.M. 302, 306, 336	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Moisture	I.M. 308, 527	Cert. Plant Insp.[2]	1 per 1/2 day	
	Specific Gravity	I.M. 307	Cert. Plant Insp.[2]	1/250 CY or min 1/day	
	Quality	I.M. 209	Approved Source	Prior to use	
Portland Cement	Quality	I.M. 401	Approved Source	Prior to use	
Fly Ash	Quality	I.M. 491.17	Approved Source	Prior to use	
GGBFS	Quality	I.M. 491.14	Approved Source	Prior to use	
Curing Compound	Quality	Iowa DOT Section 4105	Approved Source	Prior to use	
Joint Sealer	Quality	I.M. 436.01	Approved Source	Prior to use	
Epoxy Dowel Bars and Assemblies	Quality	I.M. 451.03B	Approved Source	Prior to use	
Tie Bars	Quality	I.M. 451	Approved Source	Prior to use	
Plastic Concrete	Air Content	I.M 318, 327	Field Test	1/200 CY or min. 1/day	Engineer
	Slump	I.M. 317	Field Test	1/200 CY or min. 1/day	
	Cylinders	I.M. 315	Field Test	Set of 3/500 CY or two sets/day	
	Beams	I.M. 316, 327, 328	Field Test	Set of 3/500 CY or two sets/day	
	Thickness	----------	Field Test	1/200 CY	
Hardened Concrete	Smoothness	SUDAS 7010, 3.07	Field Test - Straightedge	Project length	
	Smoothness	SUDAS 7010, 3.07	Field Test - Profilograph	Project length	Contractor
	Thickness	SUDAS 7010, 3.07	Field Test	1 core/1000 SY or 3 cores/project	
	Strength	I.M. 383	Maturity Tests[3]	Prior to placement	

[1] Refers to the Iowa DOT Materials I.M.s, Iowa DOT Standard Specifications, or SUDAS Standard Specifications.
[2] Certified plant inspection per Iowa DOT Materials I.M. 527.
[3] The Contractor is responsible for developing the maturity curve for the specified mix, taking maturity readings, and delivering a copy of the results to the Engineer.

3.07 QUALITY CONTROL (Continued)

B. Air Content:

1. Air content of the concrete will be evaluated according to Iowa DOT Materials I.M. 318 and 327.

2. When a test result is outside the tolerance for the target air content, the contractor will be notified immediately. An air test will then be immediately run behind the paver to aid in identifying the limits of the non-complying air. A test result between 5% and 8% behind the paver will be considered complying. This test will represent all concrete from the back of the paver back to the last documented complying test. Make immediate adjustments to the mix production and placement process to bring the air content back within tolerance. Do not use succeeding loads below the lower target air content tolerance by more than 0.5%. Each subsequent load will be tested until air content is within tolerance for two consecutive loads. For all incorporated, non-complying concrete that is out of tolerance, the Engineer will determine if removal and replacement is required or if a price adjustment, according to Table 7010.03, will be applied.

Table 7010.03: Concrete Air Content Price Adjustments

Air Content Range			% Payment of Unit Price
Minimum		**Maximum**	
1.1*	and	below	0%
0.6	to	1.0*	50%
0.1	to	0.5*	75%
Low air tolerance limit			100%
Target			100%
High air tolerance limit			100%
0.1	to	0.5**	95%
0.6	to	1.0**	85%
1.1	to	1.5**	75%
1.6	to	2.0**	60%
2.1**	and	above	0%

*Air content deviation below the acceptable limits
** Air content deviation above the acceptable limits

C. Pavement Smoothness: Evaluate pavement smoothness for all PCC pavement and overlay surfaces.

1. Straightedge: The Engineer will check PCC pavement surfaces with a 10 foot straightedge placed parallel to the centerline. Areas showing high spots of more than 1/4 of an inch in 10 feet will be marked. Complete surface corrections according to the procedures in Iowa DOT Section 2316 to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straightedge. Surface corrections will be completed at the direction of the Engineer with no additional cost to the Contracting Authority.

2. Profilograph:

a. If specified in the contract documents, comply with Iowa DOT Section 2316 to measure pavement smoothness with a profilograph.
b. Evaluate according to the smoothness requirements of Table 7010.04 and make surface corrections and price reductions. Surface corrections will be completed with no additional cost to the Contracting Authority. No incentive for pavement smoothness will be made.

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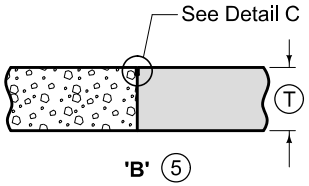
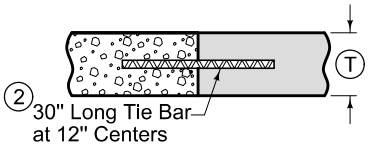
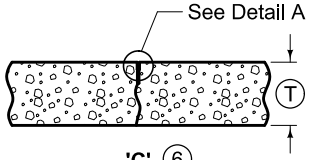


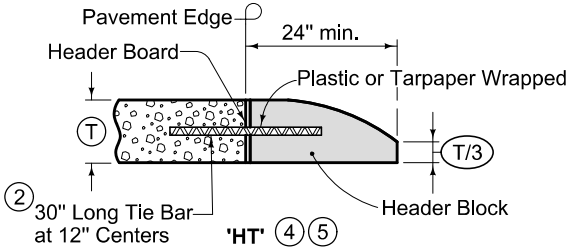
'B' (5)
PLAIN JOINT
(Abutting Pavement Slabs)



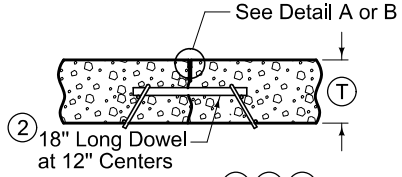
'DW' (3)(4)(7)
DAY'S WORK JOINT(Non-working)



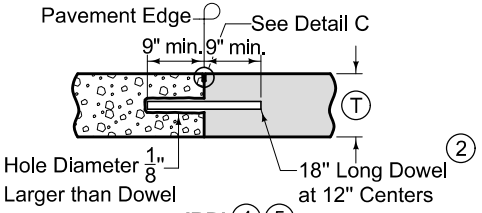
'C' (6)
CONTRACTION JOINT



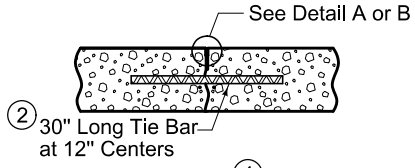
'HT' (4)(5)
HEADER JOINT
(End Rigid Pavement)



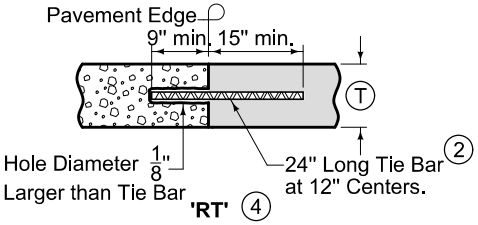
'CD' (1)(4)(6)
DOWELED CONTRACTION JOINT



'RD' (4)(5)
ABUTTING PAVEMENT JOINT

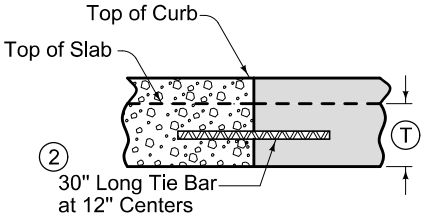


'CT' (4)
TIED CONTRACTION JOINT

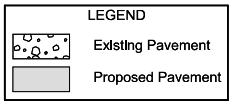


'RT' (4)
ABUTTING PAVEMENT JOINT
RIGID TIE

1. See dowel assemblies for fabrication details.
2. See Bar Size Table for Contraction Joints on Sheet 2.
3. Locate 'DW' joint at a mid-panel location between future 'C' or 'CD' joints. Place no closer than 5 feet to a 'C' or 'CD' joint.
4. Place bars within the limits shown under dowel assemblies.
5. Edge with 1/8 inch tool for length of joint. For HT joint, remove header block and board when second slab is placed.
6. Unless specified otherwise, use 'CD' transverse contraction joints in mainline pavement when (T) is greater or equal to 8 inches. Use 'C' joints when (T) is less than 8 inches.
7. 'RT' joint may be used in lieu of 'DW' joint at the end of the days work. Remove any pavement damaged due to the drilling at no additional cost to the Contracting Authority.



'DW - CG' (3)(4)
DAY'S WORK JOINT
CURB AND GUTTER UNIT



SUDAS | IOWA DOT | REVISION 9 | 04-16-19

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 1 of 8

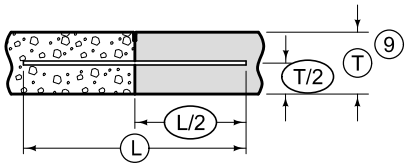
REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

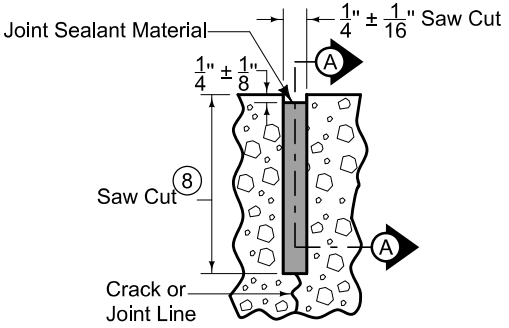
JOINTS

TRANSVERSE CONTRACTION

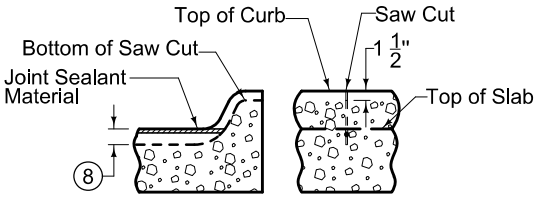
FIGURE 7010.101 SHEET 1 OF 8



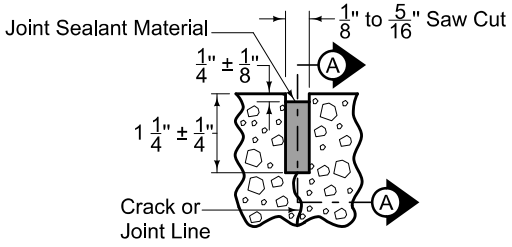
BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



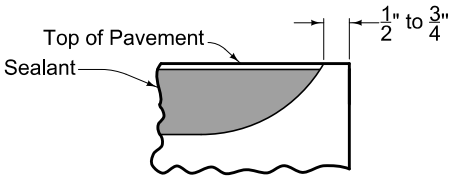
DETAIL A
(Saw cut formed by conventional concrete sawing equipment.)



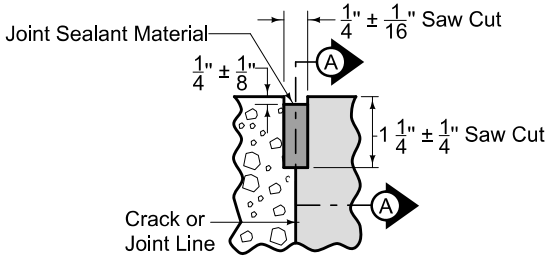
'C' JOINT IN CURB
(Match 'CT', 'CD', or 'C' joint in pavement.)



DETAIL B
(Saw cut formed by approved early concrete sawing equipment.)



SECTION A-A
(Detail at Edge of Pavement)

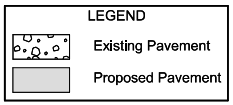


DETAIL C

8 Saw 'CD' joint to a depth of T/3 ± 1/4"; saw 'C' joint to a depth of T/4 ± 1/4".

9 When tying into old pavement, (T) represents the depth of sound PCC.

BAR SIZE TABLE FOR CONTRACTION JOINTS			
(T)	Solid Dowel Diameter	Tubular Dowel Diameter	Tie Bar Size
< 8"	3/4"	7/8"	#6
≥ 8" but < 10"	1 1/4"	1 3/8"	#10
≥ 10"	1 1/2"	1 5/8"	#11
Tubular Dowel Bars will not be allowed for RD joints.			



SUDAS | IOWADOT | REVISION 9 04-16-19

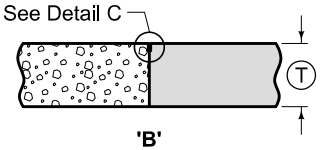
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 2 of 8

REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

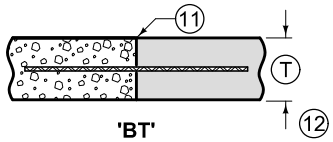
Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

TRANSVERSE CONTRACTION JOINTS

FIGURE 7010.101 | SHEET 2 OF 8

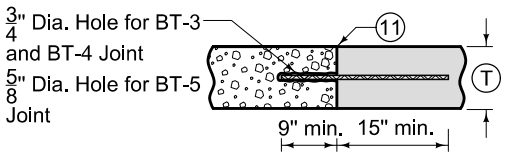


'B'
PLAIN JOINT
(Abutting Pavement Slabs)



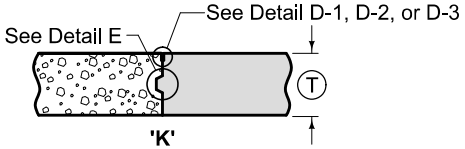
'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE

T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-1'	#4	36" Long at 30" Centers
		#5	30" Long at 30" Centers
≥ 8"	'BT-2'	#5	36" Long at 30" Centers

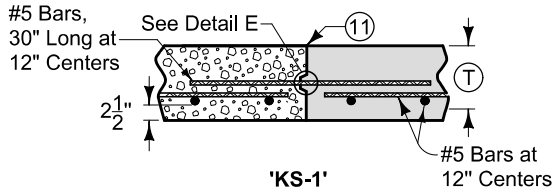


'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE (Drilled)

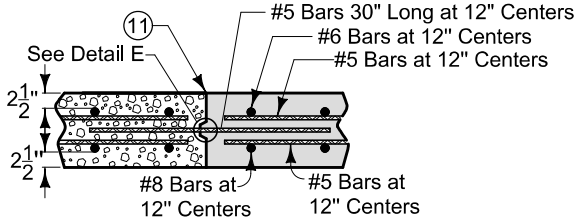
T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-5'	#4	24" Long at 30" Centers
≥ 8"	'BT-3'	#5	24" Long at 30" Centers
	'BT-4'		24" Long at 15" Centers



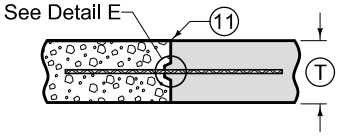
'K'
KEYED JOINT FOR ADJACENT SLABS
(Where T is 8" or more)



'KS-1'
[Single Reinforced Pavement (Bridge Approach)]



'KS-2'
[Double Reinforced Pavement (Bridge Approach)]



'KT' (10)(12)
ABUTTING PAVEMENT JOINT - KEYWAY TIE

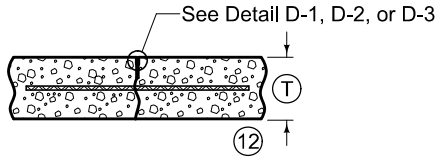
T	Joint	Bars	Bar Length and Spacing
< 8"	'KT-1'	#4	30" Long at 30" Centers
≥ 8"	'KT-2'	#5	30" Long at 30" Centers
	'KT-3'		30" Long at 15" Centers

LONGITUDINAL CONTRACTION

(10) Bar supports may be necessary for fixed form paving to ensure the bar remains in a horizontal position in the plastic concrete.

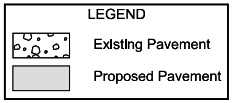
(11) Sawing or sealing of joint not required.

(12) The following joints are interchangeable, subject to the pouring sequence:
'BT-1', 'L-1', and 'KT-1'
'KT-2' and 'L-2'
'KT-3' and 'L-3'



'L'
CONTRACTION JOINT

T	Joint	Bars	Bar Length and Spacing
< 8"	'L-1'	#4	36" Long at 30" Centers
≥ 8"	'L-2'	#5	36" Long at 30" Centers
	'L-3'		36" Long at 15" Centers



SUDAS | IOWA DOT

REVISION
9 | 04-16-19

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101

SHEET 3 of 8

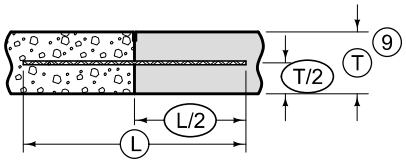
REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

Paul D. Wigand
SUDAS DIRECTOR

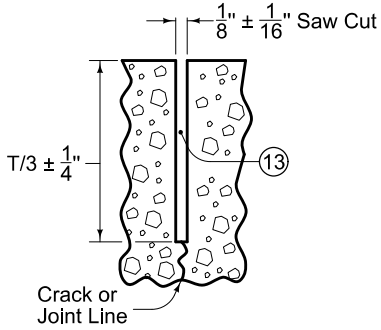
DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 SHEET 3 OF 8



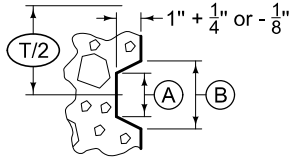
TIE BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



DETAIL D-1
(Required when specified in the contract documents.)

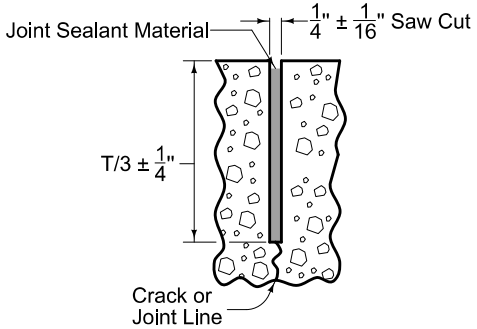
9 When tying into old pavement, T represents the depth of sound PCC.

13 Sealant or cleaning not required.

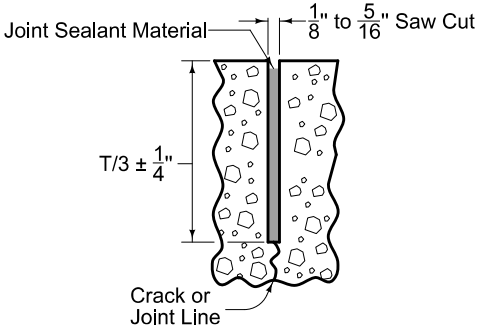


DETAIL E

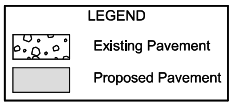
KEYWAY DIMENSIONS			
Keyway Type	Pavement Thickness (T)	(A)	(B)
Standard	8" or greater	1 3/4"	2 3/4"
Narrow	Less than 8"	1"	2"



DETAIL D-2
(Required when the Department of Transportation is not the Contracting Authority, or when specified in the contract documents)



DETAIL D-3
(Required when the Department of Transportation is the Contracting Authority, or when specified in the contract documents)



SUDAS | IOWADOT | REVISION 9 04-16-19

FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 4 of 8

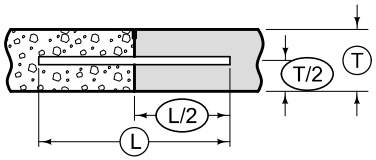
REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

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

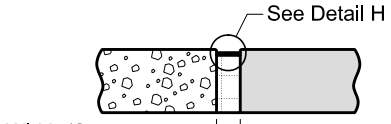
LONGITUDINAL CONTRACTION

JOINTS

FIGURE 7010.101 | SHEET 4 OF 8

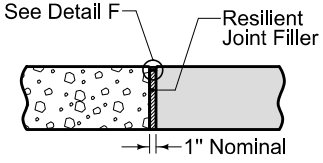


DOWEL PLACEMENT
(Applies to all joints unless otherwise detailed.)

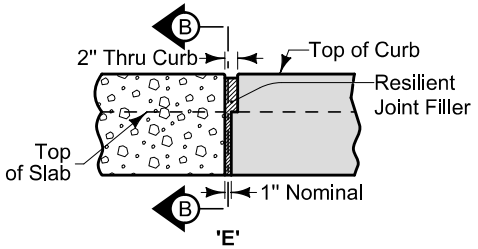


'CF' JOINT

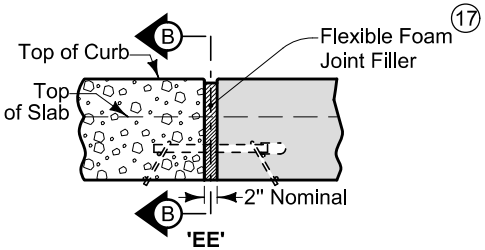
TYPE	WIDTH
CF-1	2"
CF-2	$2\frac{1}{2}$"
CF-3	3"
CF-4	$3\frac{1}{2}$"



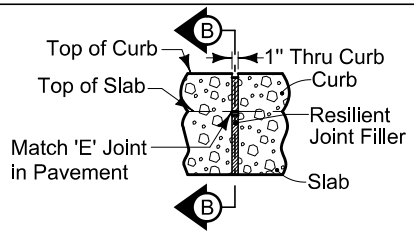
'E'
1" EXPANSION JOINT



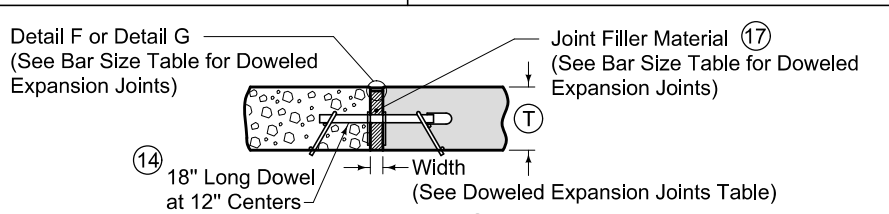
'E'
JOINT IN CURB
(View at Back of Curb)



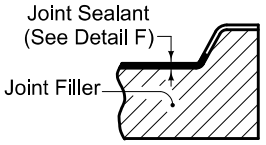
'EE'
JOINT IN CURB
(View at Back of Curb)



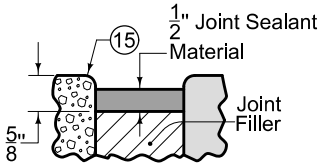
'ES'
JOINT IN CURB
(View at Back of Curb)



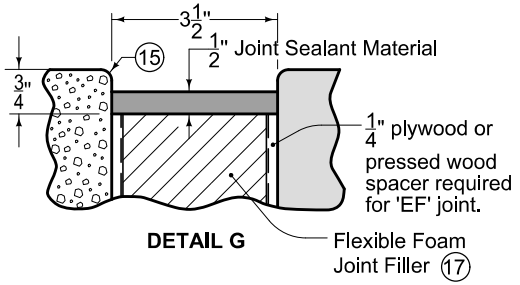
'ED', 'EE', 'EF' 16
DOWELED EXPANSION JOINT



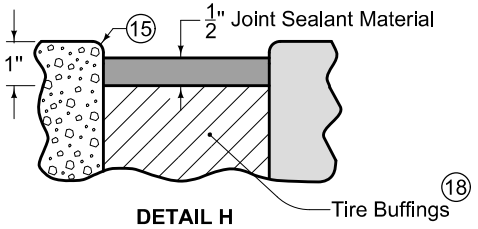
SECTION B-B



DETAIL F



DETAIL G



DETAIL H

EXPANSION

14 See Bar Size Table for Doweled Expansion Joints.

15 Edge with 1/4 inch tool for length of joint indicated if formed; edging not required when cut with diamond blade saw.

16 See Dowel Assemblies for fabrication details and placement limits. Coat the free end of dowel bar to prevent bond with pavement. At intake locations, dowel bars may be cast-in-place.

17 Predrill or preform holes in joint material for appropriate dowel size.

18 Compact tire buffings by spading with a square-nose shovel.

DOWELED EXPANSION JOINTS		
TYPE	WIDTH	FILLER MATERIAL 17
ED	1"	Resilient (Detail F)
EE	2"	Flexible Foam (Detail F)
EF	$3\frac{1}{2}$"	Flexible Foam (Detail G)

BAR SIZE TABLE FOR DOWELED EXPANSION JOINTS			
T	< 8"	≥ 8" but < 10"	≥ 10"
Dowel Diameter	$\frac{3}{4}$"	$1\frac{1}{4}$"	$1\frac{1}{2}$"
Tubular Dowel Bars will not be allowed for expansion joints.			

LEGEND
Existing Pavement
Proposed Pavement

FIGURE 7010.101 SHEET 5 OF 8

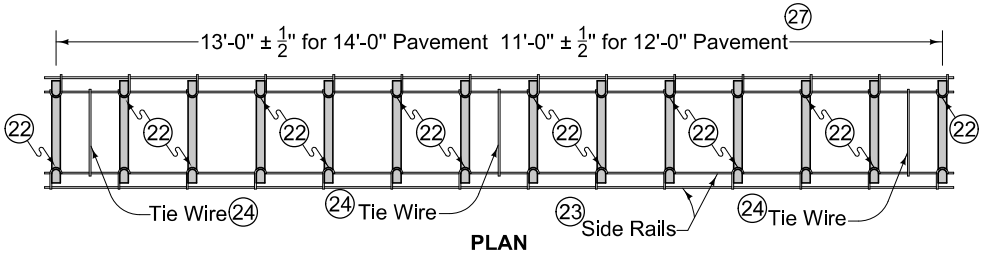
SUDAS | IOWA DOT | REVISION 9 04-16-19
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101
SHEET 5 of 8

REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

Paul D. Wigard, SUDAS DIRECTOR
DESIGN METHODS ENGINEER

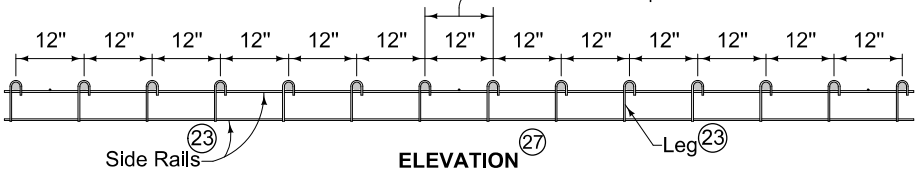
JOINTS

CONTRACTION JOINTS

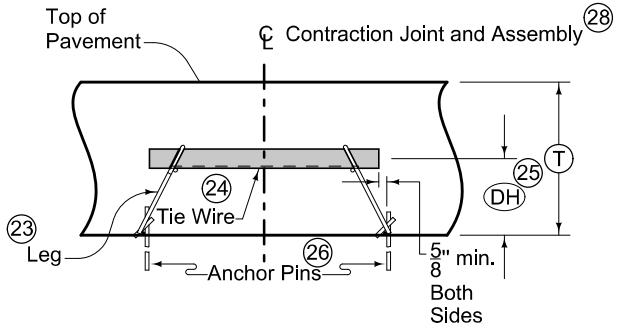


PLAN

Spaces between dowel bars are nominal dimensions with a $\frac{1}{4}$" allowable tolerance.



ELEVATION



LONGITUDINAL SECTION

DOWEL ASSEMBLIES (19) (20) (21)

DOWEL HEIGHT AND DIAMETER FOR DOWELED CONTRACTION JOINTS			
(T)	(DH) (25)	Diameter (Solid)	Diameter (Tubular)
7" to 7 1/2"	3 1/2"	3/4"	7/8"
8" to 9 1/2"	4 1/4"	1 1/4"	1 3/8"
10" to 11 1/2"	5 1/4"	1 1/2"	1 5/8"
12" to 13"	6 1/4"	1 1/2"	1 5/8"
Tubular Dowel Bars will not be allowed for RD joints.			

(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

(21) Details apply to both transverse contraction and expansion joints.

(22) Weld alternately throughout.

(23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.

(24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.

(25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

(26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

(27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

(28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

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FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 6 of 8

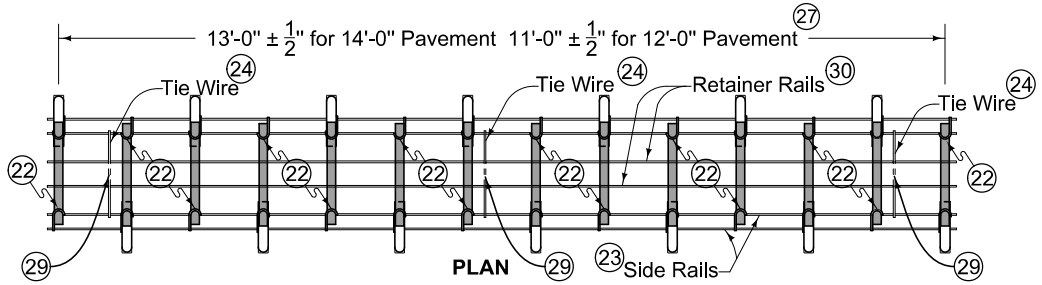
REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

Paul D. Wigand, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

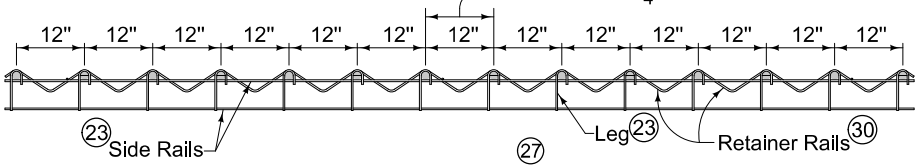
JOINTS

FIGURE 7010.101 | SHEET 6 OF 8

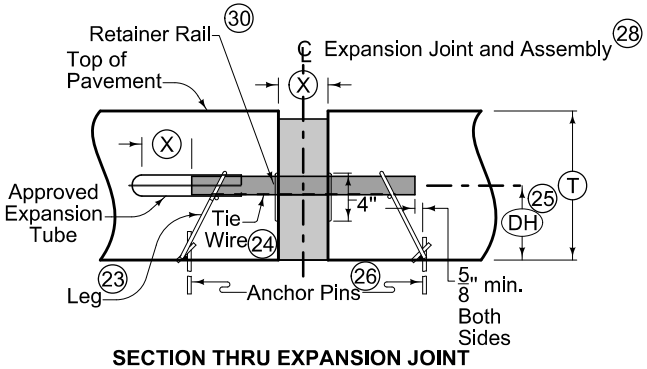
EXPANSION JOINTS



Spaces between dowel bars are nominal dimensions with a 1/4" allowable tolerance.



ELEVATION



SECTION THRU EXPANSION JOINT

JOINT OPENING AND EXPANSION TUBE EXTENSION		
Joint Type	(X)	Minimum Tube Length
"ED"	1"	6"
"EE"	2"	7"
"EF"	3 1/2"	9"

DOWEL HEIGHT AND DIAMETER FOR DOWELED EXPANSION JOINTS		
(T)	(DH) (25)	Diameter
7" to 7 1/2"	3 1/2"	3/4"
8" to 9 1/2"	4 1/4"	1 1/4"
10" to 11 1/2"	5 1/4"	1 1/2"
12" to 13"	6 1/4"	1 1/2"
Tubular Dowel Bars will not be allowed for expansion joints.		

DOWEL ASSEMBLIES (19) (20) (21)

(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

(21) Details apply to both transverse contraction and expansion joints.

(22) Weld alternately throughout.

(23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.

(24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.

(25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.

(26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.

(27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.

(28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

(29) Clip and remove center portion of tie during field assembly.

(30) 1/4 inch diameter wire.

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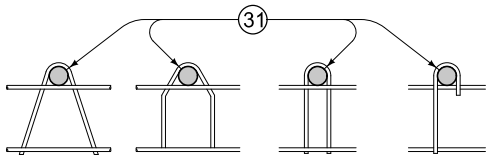
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 7 of 8

REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

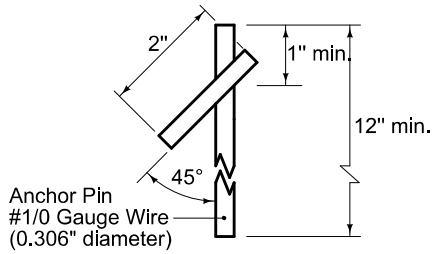
Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 SHEET 7 OF 8



OPTIONAL LEG SHAPES



ANCHOR PIN

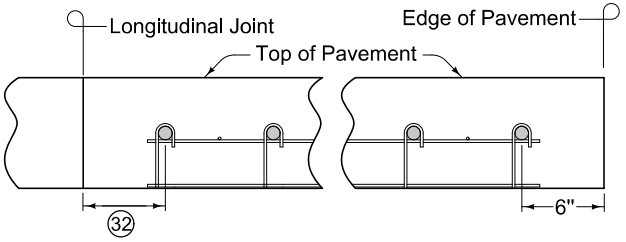
(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

(20) Use wires with a minimum tensile strength of 50 ksi.

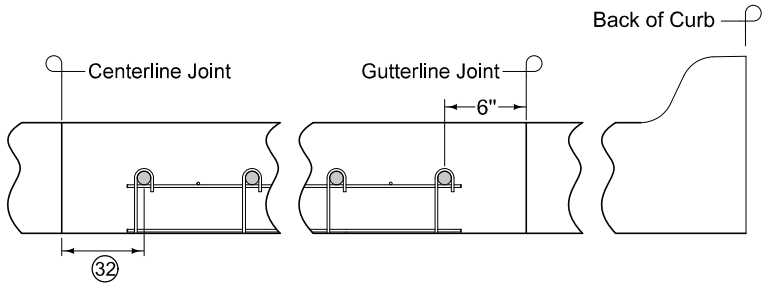
(21) Details apply to both transverse contraction and expansion joints.

(31) Diameter of bend around dowel is dowel diameter + 1/8 to 3/16 inches.

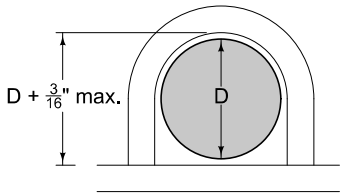
(32) For uniform lane widths: 3" - 6". For taper and variable width pavements: 3" - 12".



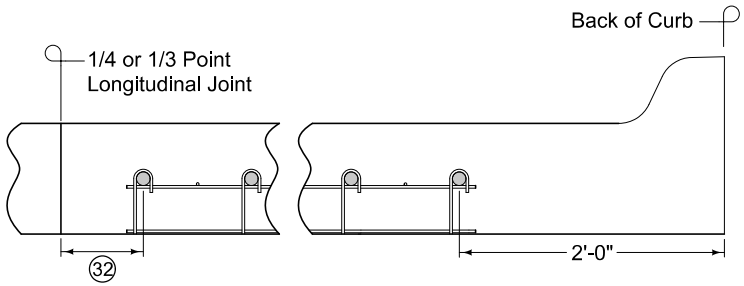
PLACEMENT LIMITS
(Rural Section)



PLACEMENT LIMITS
(Curb and Gutter - Gutterline Jointing)



BEND AROUND DOWEL (31)



PLACEMENT LIMITS
(Curb and Gutter - 1/4 or 1/3 Point Jointing)

DOWEL ASSEMBLIES (19) (20) (21)

FIGURE 7010.101 | SHEET 8 OF 8

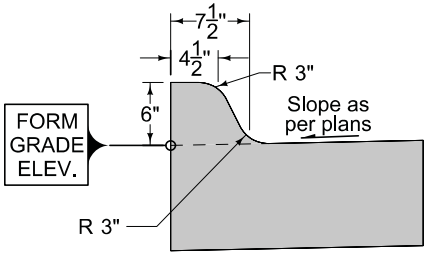
SUDAS	IOWA DOT	REVISION 9 04-16-19
FIGURE 7010.101	STANDARD ROAD PLAN	PV-101
		SHEET 8 of 8

REVISIONS: Added tubular dowel option to transverse contraction joints. Modified circle note 2. Added new circle note 14 and renumbered remaining notes.

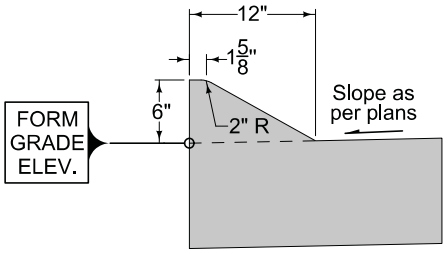
Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

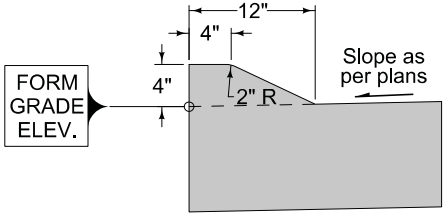
JOINTS



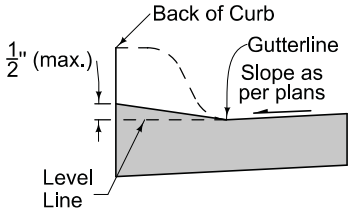
6" STANDARD CURB



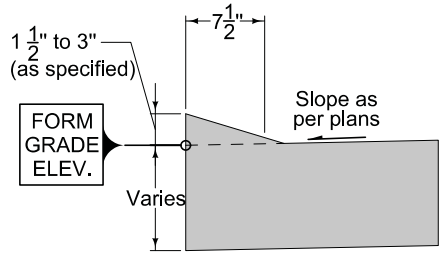
6" SLOPED CURB



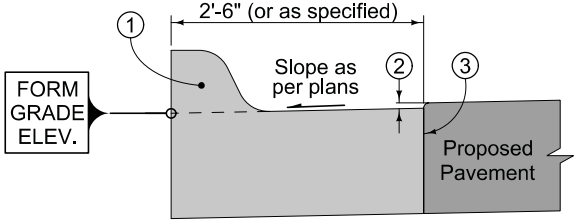
4" SLOPED CURB



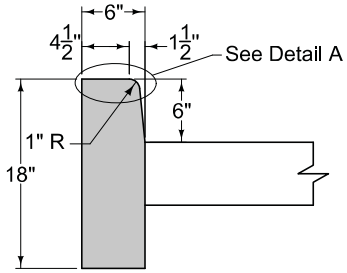
DROP CURB AT SIDEWALK



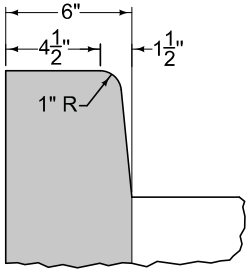
DRIVEWAY DROP CURB



CURB AND GUTTER UNIT



BEAM CURB*
*For short replacement sections, match existing curb profile



DETAIL A

For joint details, see PV-101.

1. 6" Standard Curb, 6" Sloped Curb, or 4" Sloped Curb as specified.
2. 1/8" if Proposed Pavement is HMA. No elevation difference if Proposed Pavement is PCC.
3. 'BT' , 'KT', or 'L' joint if Proposed Pavement is PCC. 'B' joint if Proposed Pavement is HMA.

FIGURE 7010.102 SHEET 1 OF 2

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FIGURE 7010.102 | STANDARD ROAD PLAN | PV-102 | SHEET 1 of 2

REVISIONS: Added note, 'Slope as per plans' on Drop Curb views on page 1. Updated DOT logo to new version.

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

PCC CURB DETAILS

PART 2 - PRODUCTS

2.01 MATERIALS

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

B. Supplementary Cementitious Materials (SCM): Comply with Section 7010, 2.01, B.

C. Fine Aggregate for Concrete: Comply with Section 7010, 2.01, C.

D. Coarse Aggregate for Concrete:

1. Crushed stone particles with Class 2 durability complying with Iowa DOT Section 4115 and Materials I.M. 409.

2. Comply with Iowa DOT Section 4115 and Article 4109.02, Gradation No. 3 and 5 in the Aggregate Gradation Table.

3. Bonded PCC Overlays:
   a. Use the maximum nominal coarse aggregate size that is no greater than one-third of the overlay thickness.
   b. Provide aggregates that will produce a concrete mixture having a coefficient of thermal expansion (CTE) equal to or less than the CTE of the existing concrete pavement.

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

E. Fiber Reinforcement:

1. Provide macro-synthetic fibers complying with ASTM C 1116, Type III Section 4.1.3

2. Incorporate at a dosage rate according to the manufacturer's recommendations (typically 3 pounds per cubic yard to 7.5 pounds per cubic yard).

F. Water Requirements: Comply with Section 7010, 2.01, E.

G. Admixtures: Comply with Section 7010, 2.01, F.

H. Tie Bars, Dowel Bars, and Expansion Tubes: Comply with Section 7010, 2.01, G and H.

I. Joint Fillers and Sealers: Comply with Section 7010, 2.01, L.

J. Liquid Curing Compound:

1. **White Pigmented Compounds.** Comply with Iowa DOT Section 4105.

2. Poly Alpha-methylstyrene: Comply with ASTM C 309, Type 2, Class B with 100% of the resin consisting of poly alpha-methylstyrene (PAMS) meeting the requirements of Table 7011.01.

Table 7011.01: PAMS Curing Compound

Properties	Range
Total solids, % by weight of compound	$\geq$ 42
% reflectance in 72 hr (ASTM E 1347)	$\geq$ 65
Loss of water, kg/m^2 in 24 hr (ASTM C 156)	$\leq$ 0.15
Loss of water, kg/m^2 in 72 hr (ASTM C 156)	$\leq$ 0.40
V.O.C. Content, g/L	$\leq$ 350

2.01 MATERIALS (Continued)

K. HMA Separation Layer for Unbonded Overlay over Concrete:

1. Asphalt Binder: PG 58-28S.

2. Mixture: Standard Traffic (ST) 3/8 inch HMA mix.
a. Target air voids is 3%.
b. No maximum film thickness restriction.
c. No minimum filler/bitumen ratio restriction.

3. Aggregate:
a. Type B.
b. No percent crushed particle requirement.
c. Gradation cannot fall below the restricted zone.

L. Geotextile Fabric Separation Layer for Unbonded Overlay over Concrete:

1. Material Properties: Based on the contract document's specified mass per unit area, provide a geotextile fabric meeting the requirements of Table 7011.02.

2. Fabric Weight and Thickness:
a. For unbonded overlays less than or equal to 4 inches thick, provide a geotextile separation layer with a weight of 13.3 oz/yd^2 and a thickness of 130 mils.
b. For unbonded overlays greater than or equal to 4.5 inches thick, provide a geotextile separation layer with a weight of 14.7 oz/yd^2 and a thickness of 170 mils.

Table 7011.02: Geotextile Separation Layer

Property	Requirements	Test Procedures
Geotextile Type	Nonwoven, needle-punched, no thermal treatment to include calendaring*	EN 13249, Annex F (Certification)
Color	Uniform/nominally same color fibers	(Visual Inspection)
Weight (mass per unit area)[13]	≥ 13.3 oz/yd^2 ≥ 14.7 oz/yd^2 ≤ 16.2 oz/yd^2	ISO 9864 (ASTM D 5261)
Thickness under load (pressure)	[a] 0.29 psi: ≥ 0.12 in. [b] 2.9 psi: ≥ 0.10 in. [c] 29 psi: ≥ 0.04 in.	ISO 9863-1 (ASTM D 5199)
Wide-width tensile strength	≥ 685 lb/ft.	ISO 10319 (ASTM D 4595)
Wide-width maximum elongation	≤ 130 percent	ISO 10319 (ASTM D 4595)
Water permeability in normal direction under load (pressure)	≥ 3.3 x 10^{-4} ft/s at 2.9 psi	DIN 60500-4 (modified ASTM D5493)
In-lane water permeability (transmissivity) under load (pressure)	[a] ≥ 1.6 x 10^{-3} ft/s at 2.9 psi [b] ≥ 6.6 x 10^{-3} ft/s at 2.9 psi	ISO 12958 (ASTM D 6574) or ISO 12958 (modified ASTM D 4716)
Weather resistance	Retained strength ≥ 60 percent (70% average)	EN 12224 (ASTM D 4355 @ 500 hr exposure for grey, white, or black material only)
Alkali resistance	≥ 96 percent polypropylene/polyethylene	EN 13249, Annex B (Certification)

* Calendering is a process that passes the geotextile through one or more heated rollers during the manufacturing process. The surface of the geotextile is modified during this process. Calendering may reduce the absorption properties of the geotextile on the calendered side.

1.08 MEASUREMENT AND PAYMENT

A. HMA Pavement by Ton:

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

2. **Payment:** Payment will be at the unit price per ton of HMA pavement.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

B. HMA Pavement by Square Yards:

1. **Measurement:** Measurement will be in square yards for each different thickness of HMA pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of HMA pavement.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

C. HMA Base Widening by Ton:

1. **Measurement:** Measurement will be in tons of HMA base widening.

2. **Payment:** Payment will be at the unit price per ton of HMA base widening.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat between layers, construction zone protection, and quality control.

D. HMA Base Widening by Square Yard:

1. **Measurement:** Measurement will be in square yards for each different thickness of HMA base widening. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured base widening area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of HMA base widening.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat between layers, construction zone protection, and quality control.

E. HMA Railroad Crossing Approach:

1. **Measurement:** Measurement will be in square yards of railroad crossing approach.

2. **Payment:** Payment will be at the unit price per square yard of railroad crossing approach.

3. **Includes:** Unit price includes but is not limited to excavation for modified subbase and subdrain, furnishing and installing subdrain, furnishing and installing subdrain outlet, furnishing and installing porous backfill material, furnishing and installing fiber board barrier, furnishing and placing modified subbase material, furnishing and applying tack coat, furnishing, placing, and compacting HMA.

1.08 MEASUREMENT AND PAYMENT (Continued)

F. Density Deficiency:

1. **Measurement:** Measurement will be in square yards for each different density of HMA pavement subject to a unit price reduction for density deficiency according to Section 7020, 3.04.

2. **Payment:** Payment will be at the reduced unit price according to Table 7020.02 for each density of HMA pavement. If there is a density deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

G. HMA Pavement Thickness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different thickness of HMA pavement that has deficient pavement thickness as determined in Section 7020, 3.04.

2. **Payment:** Payment will be at the percentage of the unit price indicated in Table 7020.03 for each different thickness of HMA pavement. If there is a pavement thickness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

H. HMA Pavement Smoothness Deficiency:

1. **Measurement:** Measurement will be in square yards for each different segment of HMA pavement subject to a unit price reduction for pavement smoothness according to Section 7020, 3.05.

2. **Payment:** Payment will be at the reduced unit price according to Table 7020.04 for each segment of HMA pavement. If there is a pavement smoothness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

I. HMA Pavement Samples and Testing:

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

2. **Payment:** Payment will be at the lump sum price for HMA pavement samples and testing.

3. **Includes:** Lump sum price includes, but is not limited to, certified plant inspection, pavement thickness cores, density analysis, profilograph pavement smoothness measurement (when required by the contract documents), and air void testing.

J. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

K. Pavement Removal: Comply with Section 7040.

L. Subgrade and Subbase: For excavation and construction of subgrade and subbase, comply with Section 2010.

PART 2 - PRODUCTS

2.01 HMA MATERIALS

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

Follow the procedure outlined in Iowa DOT Materials I.M. 510 for HMA mixture designs, except replace Table 1 in Appendix A, HMA Mixture Design Criteria with the SUDAS HMA Mixture Design Criteria (Table 7020.01) (Tables 2 through 4 in Appendix A still apply).

2.02 WARM MIX ASPHALT MATERIALS

If use of warm mix asphalt (WMA) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

2.03 RECYCLED ASPHALT MATERIALS

A. Recycled Asphalt Pavement: If use of recycled asphalt pavement (RAP) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

B. Recycled Asphalt Shingles: If use of recycled asphalt shingles (RAS) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

2.04 SUBGRADE AND SUBBASE

Comply with Section 2010.

PART 3 - EXECUTION

3.01 HMA PAVEMENT

Construct according to Iowa DOT Section 2303 and the following:

A. Preparation of Pavement Foundation: Construct subgrade and subbase according to Section 2010.

B. Compaction: Compact to a minimum of 94% of laboratory density. Do not exceed 8% average air void level for roadway density specimens.

C. Tack Coats: Apply tack coats according to Iowa DOT Section 2303. In addition, if the emulsion is diluted, the dilution must be done by the manufacturer and certified. Provide the Engineer with the new application rate required to achieve the specified undiluted application rate.

D. Fillets and Runouts: Rake out coarse aggregate prior to shaping and compaction of fillets and runouts.

E. HMA Railroad Crossing Approach: Construct according to Section 7020 and Figure 7020.902.

F. Fixtures in the Pavement Surface:

1. Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with Section 6010, 3.04 for manhole adjustments and Section 5020, 3.04 for water fixture adjustments.

2. Clean outside of fixture to depth of pavement before asphalt placement.

3. Construct boxouts where allowed for later adjustment of fixtures. See Figure 7020.201 for the size and shape of the boxout.

G. Samples and Testing: Take samples from the compacted material and test according to Section 7020, 3.04. Randomly locate samples in the pavement area Notify the Jurisdiction the day prior to coring and testing to give the Jurisdiction the opportunity to witness coring and testing.

3.02 BASE WIDENING

A. Equipment: Use equipment complying with Iowa DOT Section 2213.

B. Conditions:

1. Resurfacing over Concrete Base Widening: When the existing pavement is HMA material over concrete pavement, saw or mill the old asphalt to the full depth of the proposed resurfacing or to depth of sound material producing a reasonable vertical line at the edge of the underlying concrete.

2. HMA Base Widening: Apply a tack coat to the vertical edge of the old pavement at a rate of 0.10 to 0.15 gallon per square yard according to Section 7020, 3.01. No waiting period will be required before placing the widening.

HOT MIX ASPHALT OVERLAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES

HMA Overlays

1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of HMA overlay surface course placed upon an existing pavement.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants and Section 7020, 1.03.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants and Section 7020, 1.05.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as Section 7020, 1.06.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

Comply with Section 7020, 1.08, except as modified herein:

A. HMA Overlay by Ton:

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

2. **Payment:** Payment will be at the unit price per ton of HMA overlay.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

B. HMA Overlay by Square Yards:

1. **Measurement:** Measurement will be in square yards for each different thickness of HMA overlay. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of HMA overlay.

3. **Includes:** Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat, construction zone protection, and quality control.

PART 2 - PRODUCTS

2.01 HMA OVERLAY MATERIALS

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

Follow the procedure outlined in Iowa DOT Materials I.M. 510 for HMA mixture designs, except replace Table 1 in Appendix A, HMA Mixture Design Criteria with the SUDAS HMA Mixture Design Criteria (Table 7020.01) (Tables 2 through 4 in Appendix A still apply).

2.02 WARM MIX ASPHALT MATERIALS

If use of warm mix asphalt (WMA) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

2.03 RECYCLED ASPHALT MATERIALS

When recycled asphalt materials (RAM) are used and they exceed 20% replacement of the total binder, the binder grades may need to be modified. Comply with Iowa DOT Materials I.M. 510.

A. Recycled Asphalt Pavement: If use of recycled asphalt pavement (RAP) is approved by the Jurisdiction, comply with Iowa DOT Section 2303.

B. Recycled Asphalt Shingles: If use of recycled asphalt shingles (RAS) is approved by the jurisdiction, comply with Iowa DOT Section 2303.

2.04 BINDER GRADES

A. Conventional Overlays: Use the specified binder grade.

B. HMA Interlayer: Use PG 58-34E meeting AASHTO T 321 with minimum 100,000 cycles to failure. Comply with Iowa DOT Materials I.M. 510A. Do not use RAP.

C. High Performance Thin Lift: Use PG 58-34E+ meeting AASHTO T-324 with minimum 90% elastic recovery. Comply with Iowa DOT I.M. 510A. Do not use RAS.

2.05 HIGH PERFORMANCE THIN LIFT

A. Mix Design:

Design Gyrations	50
Design Voids Target (based on %Gmm)	≤ 2.0
Film Thickness	8.0 to 13.0
Aggregate Quality	A
Minimum crushed content	50%
FAA minimum	40
Minimum sand equivalency	50
VMA	16%
Friction Aggregate	Minimum 50% Type 4 or better

B. Replacement: Do not use more than 15% binder replacement. Do not use RAS.

C. Hamburg Testing: Compact to 3.5% air voids. No more than 8 mm rutting in first 8,000 passes.

2.05 HIGH PERFORMANCE THIN LIFT (CONTINUED)

D. Gradation:

Sieve Size	Minimum Percent Passing	Maximum Percent Passing
1 1/2”		
1”		
3/8”	91	100
No. 4		90
No. 8	27	63
No. 16		
No. 30		
No. 50		
No. 100		
No. 200	2	10

2.06 NOMINAL AGGREGATE SIZE FOR ASPHALT OVERLAYS

Nominal aggregate size dictates lift thickness. Minimum lift thickness should be at least 3 times the nominal maximum aggregate size to ensure aggregate can be aligned during compaction to achieve required density. Therefore, desired lift thickness can direct the decision on nominal aggregate size to use.

PART 3 - EXECUTION

3.01 HMA OVERLAY

Comply with Section 7020, Iowa DOT Section 2303, Section 7040, and the following:

A. Preparation of Existing Pavement:

1. Remove pavement by milling as required by the contract documents. Mill to the depth, cross-section, or profile specified.

2. Sweep existing pavement with approved broom. Provide dust control during brooming.

3. If milling is not required, correct irregularities in existing pavement cross slope with partial patching, full-depth patching, and leveling base coat prior to placing the overlay. Use base or intermediate course mixes to correct irregularities. Surface course thickness per plan.

B. Special Requirements for Thin Lift Overlays and HMA Interlayer:

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

2. Compact with static steel wheel roller.

3.02 PROTECTION FROM TRAFFIC

Comply with Section 7020, 3.03.

3.03 DEFECTS OR DEFICIENCIES

Comply with Section 7020, 3.04.

3.04 PAVEMENT SMOOTHNESS

Comply with Section 7020, 3.05.

3.05 QUALITY CONTROL

A. General: Comply with Section 7020, 3.06.

B. Special Requirements for Thin Lift Overlays and HMA Interlayer:

1. Complete field voids for Class II compaction as defined in Iowa DOT Section 2303.

2. Sample and test from windrow or hopper. Apply Iowa DOT Article 2303.05, A, 3 for AAD acceptance. Air void target is based on approved JMF.

3. Take at least one cold feed each day for gradation control.

3.06 REMOVAL OF PAVEMENT

Comply with Section 7040.

END OF SECTION

SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of Sidewalks, Shared Use Paths, and Driveways

B. Installation of Sidewalks, Shared Use Paths, and Driveways

1.02 DESCRIPTION OF WORK

A. Remove existing sidewalks, shared use paths, and driveways.

B. Install shared use paths.

C. Install sidewalk.

D. Install driveway.

1.03 SUBMITTALS

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

A. PCC mix design.

B. HMA mix design.

C. Brick source, absorption, compressive strength; samples of brick showing texture and color.

D. Submit type and color of detectable warnings.

E. Results of required testing.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

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

A. Portland Cement Concrete: See Section 7010.

B. Hot Mix Asphalt: See Section 7020.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Provide 10 calendar days advance notification of a pedestrian path closure to the Engineer and the National Federation of the Blind of Iowa (www.nfbi.org).

1.08 MEASUREMENT AND PAYMENT

A. Removal of Sidewalk, Shared Use Path, or Driveway:

1. **Measurement:** Measurement will be in square yards for the area of sidewalks, shared use paths, or driveways removed.

2. **Payment:** Payment will be at the unit price per square yard for the area of sidewalk, shared use path, or driveway removal.

3. **Includes:** Unit price includes, but is not limited to, sawing, hauling, and disposal of materials removed.

B. Removal of Curb:

1. **Measurement:** Measurement will be in linear feet for removal of curb by grinding or sawing, measured along the back of curb.

2. **Payment:** Payment will be at the unit price per linear foot for the removal of curb.

3. **Includes:** Unit price includes, but is not limited to, hauling and disposal of materials removed.

C. Shared Use Paths:

1. **Measurement:** Each type and thickness of shared use paths will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each type and thickness of shared use path.

3. **Includes:** Unit price includes, but is not limited to, subgrade preparation, jointing, sampling, smoothness testing and correction, and testing.

D. Special Subgrade Preparation for Shared Use Paths:

1. **Measurement:** Measurement will be in square yards for special subgrade preparation. Measured area will include 2 feet outside of the pavement on either side of the path.

2. **Payment:** Payment will be at the unit price per square yard for the area of special subgrade preparation.

3. **Includes:** Unit price includes, but is not limited to, water required to bring subgrade moisture content to within the required limits.

1.08 MEASUREMENT AND PAYMENT (Continued)

E. PCC Sidewalk:

1. **Measurement:** Each thickness of PCC sidewalk will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.

2. **Payment:** Payment will be at the unit price per square yard for each thickness of PCC sidewalk.

3. **Includes:** Unit price includes, but is not limited to, minor grade adjustments at driveways and other intersections, subgrade preparation, formwork, additional thickness at thickened edges, jointing, sampling, smoothness testing and correction, and testing.

F. Brick/Paver Sidewalk with Pavement Base:

1. **Measurement:** Measurement will be in square yards for the area of brick/paver sidewalk placed on a pavement base. The area of pavement base will not be measured separately.

2. **Payment:** Payment will be at the unit price per square yard for the area of brick/paver sidewalk.

3. **Includes:** Unit price includes, but is not limited to, subgrade preparation, pavement base, setting bed, neoprene asphalt adhesive for asphalt setting bed, setting the bricks/pavers, installing weep holes and associated materials, and sand/cement joint filler.

G. Detectable Warnings:

1. **Measurement:** Measurement will be in square feet for the area of detectable warnings installed. Paved area beneath detectable warnings will be measured with sidewalk or shared use path item.

2. **Payment:** Payment will be at the unit price per square foot for the area of detectable warnings installed.

3. **Includes:** Unit price includes, but is not limited to, steel bar supports and manufactured detectable warning panels.

1.08 MEASUREMENT AND PAYMENT (Continued)

H. Driveways:

1. **Paved Driveways:**
   - **a. Measurement:** Each type and thickness will be measured in square yards. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
   - **b. Payment:** Payment will be at the unit price for each type and thickness of driveway.
   - **c. Includes:** Unit price includes, but is not limited to, excavation, subgrade preparation, jointing, sampling, and testing.

2. **Granular Surfacing for Driveways:**
   - **a. Measurement:** Measurement will be in square yards or tons, as specified in the contract documents, for the quantity of granular surfacing placed.
   - **b. Payment:** Payment will be at the unit price per square yard or ton, as specified.
   - **c. Includes:** Unit price includes, but is not limited to, excavation and preparation of subgrade.

I. Sidewalk, Shared Use Path, and Driveway Assurance Testing:

1. The Contractor will not be responsible for concrete compression or HMA density testing unless otherwise specified in the contract documents.

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

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

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT CONCRETE

A. Class B or C concrete with materials complying with Section 7010. Use coarse aggregate of Class 2 durability or better.

B. Comply with the following for PCC mixes for sidewalks, shared use paths, and driveways unless otherwise approved by the Engineer.

Table 7030.01: PCC Mixes

	Machine Finish	Hand Finish
Type of Concrete	Class B or C	Class B or C
Slump Minimum	1/2 in.	1/2 in.
Slump Maximum	2 1/2 in.	4 in.
Percent Air Content		
• Target	7%	7%
• Minimum	6%	6%
• Maximum	8 1/2%	8 1/2%

2.02 HOT MIX ASPHALT

Comply with Section 7020 for mix design.

A. Use Low Traffic (LT), 1/2 inch or 3/8 inch mix.

B. For shared use paths adjacent to pavement that also functions as the pavement shoulder, use Low Traffic (LT), 1/2 inch mix.

C. Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28S or 58-34S.

2.03 BRICKS/PAVERS

A. Clay Bricks: Use 8 inch by 4 inch by 2 1/4 inch thick clay paving bricks with straight edges or a maximum chamfer of 1/8 inch manufactured to comply with ASTM C 902, Class SX, Type I. Color selection and surface texture as approved by the Engineer.

B. Concrete Pavers: Supply as specified in the contract documents. Use pavers with straight edges or a maximum chamfer or 1/8 inch.

2.04 SETTING BED FOR BRICKS/PAVERS

A. HMA:

1. Mixture: Proportion mix using 7% asphalt binder and 93% fine aggregate. Apportion each ton in the approximate ratio of 145 pounds asphalt binder to 1,855 pounds sand. Maintain mix temperature at approximately 250°F during placement.

2. Asphalt Binder: Use asphalt binder complying with Section 7020 with a performance grade of PG 58-28 or 64-22.

3. Fine Aggregate: Use clean, hard sand with durable particles free from adherent coating, lumps of clay, alkali salts, and organic matter. Use sand that is uniformly graded from coarse to fine with all passing the No. 4 sieve and meeting AASHTO T 27.

2.04 SETTING BED FOR BRICKS/PAVERS (CONTINUED)

B. Pre-mixed High Performance Cold Mix: If allowed, substitute a pre-mixed high performance cold mix product for the HMA setting bed generally meeting the HMA mixture requirements noted above.

C. Sand: Use clean, hand sand free from deleterious materials. Use sand meeting ASTM C 33 that is uniformly graded with all passing the No. 4 sieve and 3% or less passing the No. 200 sieve.

2.05 NEOPRENE MODIFIED ASPHALT ADHESIVE FOR BRICKS/PAVERS

A. Mastic (Asphalt Adhesive):

Solids (Base):	74% to 76%
Pounds per Gallon:	8 to 8 1/2 pounds
Solvent:	Mineral spirits with a flash point above 100° F

B. Base (2% Neoprene, 10% Asbestos-free Fiber, 88% Asphalt):

Melting Point:	200° F minimum according to ASTM D 36
Penetration:	23 to 27 according to ASTM D 5
Ductility:	1250 mm minimum according to ASTM D 113 @ 25° C, and a rate of 50 mm/minute

2.06 BRICK/PAVER JOINT FILLER

Dry sand-cement mixture consisting of one part masonry cement complying with ASTM C 91 and three parts sand complying with ASTM C 144 and passing the No. 16 sieve. Provide colored cement as specified in the contract documents.

2.07 DETECTABLE WARNINGS

Use manufactured detectable warning panels with a non-slip surface and raised truncated domes. Comply with the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (also known as PROWAG) for contrast and dimension requirements. Also comply with Iowa DOT Materials I.M. 411.

2.08 GRANULAR DRIVEWAY SURFACING

Class A crushed stone or Class C gravel complying with Iowa DOT Section 2315.

2.09 ISOLATION AND EXPANSION JOINT SEALANT

Use a polyurethane, self-leveling sealant complying with ASTM C 920. Application temperature range of 40 to 120°F. Minimum elongation 700%.

PART 3 - EXECUTION

3.01 REMOVALS

A. Remove sidewalks, shared use paths, driveways, bricks, and curbs to the removal limits specified in the contract documents.

B. Saw pavement full depth in straight lines to the specified removal limits.

C. Remove to the specified removal limits without damage to adjacent property, trees, utilities, or pavement that are to remain in place.

D. Salvage and stockpile all bricks removed.

E. Grind or saw existing curbs at locations specified in the contract documents to install sidewalks, shared use paths, and driveways.

F. Dispose of rubble and debris resulting from removal operations.

3.02 SUBGRADE PREPARATION

A. Shared Use Paths:

1. Subgrade Preparation: Comply with Iowa DOT Section 2109.

2. Special Subgrade Preparation:
   a. Construct subgrade to final elevation.
   b. Scarify and mix the top 6 inches of subgrade material to a width equal to that of the proposed pavement, plus 2 feet on each side.
   c. Compact loose subgrade material with Type A compaction complying with Section 2010.
   d. Proof roll compacted subgrade according to Section 2010.

B. Sidewalks and Driveways:

1. Remove all vegetation and roots from ground surface.

2. Construct grade to final subgrade elevation.
   a. Cut area: Remove all material that will be displaced by the sidewalk.
   b. Fill area: Scarify the surface to be covered with embankment to a depth of at least 6 inches and compact. Construct embankment in lifts of 6 inches or less and compact each lift. Tamp surface with a mechanical tamper until firm and unyielding.

3. Remove all soft, spongy, or yielding spots and fill the void with suitable backfill material.

3.03 ADJUSTMENT OF FIXTURES

A. Adjust fixtures to conform to the finished pavement surface. Cooperate and coordinate with the utility agency to ensure proper fixture adjustment.

B. Comply with Sections 5020, 6010, or 8010 as appropriate.

3.04 PCC SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS

A. Form Setting: Comply with Section 7010 with the following additional requirements and exceptions.

1. Slip form paving equipment may be allowed in lieu of setting forms, if approved by the Engineer.

2. Wood forms are allowed.

3. Use of an automated subgrade trimmer is not required.

4. Set forms true to line and grade and hold them rigidly in place by stakes placed outside the forms and flush with or below the top edge of the forms.

5. Measure or stake as required to construct project elements. If either of the following is met and construction survey is not a bid item, the Contracting Authority will verify that form work complies with the design requirements:
   a. The tolerance between the design running slope and the maximum allowable running slope is less than 1.0%.
   b. The tolerance between the design cross slope of the sidewalk, turning space, or shared use path and the maximum allowable cross slope is less than 0.5%.

   If adequate tolerances are contained in the design, the Contracting Authority will not verify the form work for the construction of sidewalks or shared use paths. If field adjustments cause changes that will bring the facility into the range of tolerances shown above, notify the Engineer prior to construction.

B. Concrete Pavement Placement:

1. Shared Use Paths: Comply with Section 7010.

2. Sidewalk:
   a. Maintain moist subgrade in front of paving operation
   b. Deposit concrete on the subgrade as required to minimize rehandling to prevent segregation.
   c. Hand spread with shovels, not rakes.
   d. Place concrete as required to slightly overfill the space between the forms.
   e. For thicknesses less than 5 inches, consolidate by knifing with hand tools. When thickness is 5 inches or greater, consolidate with hand or mechanical vibrators meeting Section 7010, 3.01, C, 3. Smooth by use of a straightedge.
   f. Do not contaminate freshly mixed concrete with earth or other foreign materials.

3. Driveways: Comply with Figures 7030.101 and 7030.102 and Section 7010. The use of a paving machine is not required.

C. Finishing:

1. Shared Use Paths and Driveways:
   a. Comply with Section 7010.
   b. Provide a burlap drag or broom finish.

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.

3.04 PCC SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS (Continued)

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. Shared Use Paths:
1) Space transverse joints equal to the width of the shared use path, or as specified in the contract documents.
2) Saw contraction joints according to Section 7010.
b. Sidewalks and Driveways:
1) Space sidewalk contraction joints equal to the width of the sidewalk.
2) Space driveway contraction joints so panel length does not exceed 12 feet.
3) Form transverse contraction joints to a depth of 1 1/4 inches with a pointed trowel or jointing tool. In lieu of forming, joints may be sawed within 12 hours of placement with a 1/8 inch blade saw to a depth of 1/3 the pavement thickness. Use a straightedge if joints are sawed with a hand-held saw.

3. Longitudinal Contraction Joints:
a. Shared Use Paths and Sidewalks: Saw joint to 1/8 inch wide and to a depth of 1/3 the pavement thickness.
b. Driveways:
1) Space longitudinal contraction joints so panel width does not exceed 12 feet.
2) Form longitudinal contraction joints to a depth of 1 1/4 inches with a pointed trowel or jointing tool. In lieu of forming, joints may be sawed with a 1/8 inch blade saw to a depth of 1/3 the pavement thickness. Use a straightedge if joints are sawed with a hand-held saw.

4. Isolation Joints:
a. Install isolation joints where sidewalks, shared use paths, or driveways abut roadway pavement, parking lots, buildings, and structures.
b. For a sidewalk constructed with a driveway, install an isolation joint on the property side of the sidewalk and a 'C' or 'E' joint on the street side of the sidewalk.
c. Install a 1/2 inch or 3/4 inch thick strip of preformed resilient joint material, according to Section 7010, to the full depth of concrete. Trim any isolation joint material protruding above the finished work to the level of the abutting concrete.
d. If the isolation joint is to be sealed, place the preformed material 1/2 inch below the level of the abutting concrete.

5. Joint Sealing:
a. Do not seal construction or contraction joints in sidewalks, shared use paths, or driveways.
b. If sealing of expansion or isolation joints is specified in the contract documents, trim preformed joint material to a depth of 1/2 inch below the concrete surface. Ensure the joint is clean and dry. Install joint sealant per manufacturer's recommendations.

3.05 HMA SHARED USE PATHS AND DRIVEWAYS

Comply with Section 7020.

3.06 BRICK/PAVER SIDEWALKS WITH A PAVEMENT BASE

A. General:

1. Comply with Figure 7030.203.

2. Use a cross-section and patterns as specified in the contract documents or approved by the Engineer.

3. Do not use broken bricks or materials with stained faces in the paving areas.

4. Construct the concrete base to comply with PCC sidewalk construction specifications.

B. Setting Bed:

1. Place 3/4 inch depth control bars on the base to serve as guides for the striking board. Shim depth control bars as necessary to adjust bedding thickness and to ensure the top surface of pavers will be at the required finished grade.

2. Place bedding material between the parallel depth control bars. Pull striking board over bars several times. After each pass, spread fresh bedding material over low or porous spots to produce a smooth and even setting bed. After placing and smoothing each section, advance depth control bars to next section. After removal of depth control bars and shims, carefully fill any depressions that remain.

3. While still hot, roll the HMA setting bed with a power roller to a nominal depth of 3/4 inch.

4. Ensure the joints in the concrete base do not project through the HMA setting bed.

5. Apply neoprene modified asphalt adhesive over the top surface of the cooled asphalt setting bed with notched trowel with serration not exceeding 1/16 inch. Allow adhesive to dry to the touch before placing pavers.

C. Weep Holes:

1. Install 2 inch diameter, 12 inch long, PVC pipe even with the top of the asphalt setting bed at the locations identified on the plans.

2. Fill pipe with 3/4 inch clean rock and cover weep hole with engineering fabric.

3. Install minimum of 12 inch deep and 12 inch wide reservoir of clean 3/4 inch rock around the pipe below the PCC sidewalk base or extend the rock reservoir to the pavement subdrain.

D. Bricks/Pavers:

1. Place the bricks/pavers by hand in straight courses with hand tight joints and uniform top surface.

2. Sweep dry joint filler into joints until the joints are completely filled.

3. Fog surface lightly with water to cure cement.

4. Clean any cement stains from bricks/pavers surface. Remove stains from other concrete surfaces.

3.06 BRICK/PAVER SIDEWALKS WITH A PAVEMENT BASE (Continued)

E. Protection: Protect newly laid bricks/pavers at all times using panels of plywood. Panels can be advanced as work progresses; however, keep the plywood protection in areas that will be subjected to movement of materials, workers, and equipment. Take precautions in order to avoid depressions and protect brick/paver alignment until cured and ready for pedestrian or vehicle traffic.

3.07 DETECTABLE WARNING INSTALLATION

Set detectable warning panels in fresh concrete according to the manufacturer's recommendations and Figure 7030.210.

3.08 SLOPE AND SMOOTHNESS TESTING

A. Slope for Sidewalks, Curb Ramps, Turning Spaces, and Shared Use Paths:

1. Complete slope measurements and documentation according to Iowa DOT Materials I.M. 363.

2. At no additional cost to the Contracting Authority, remove and replace all sections not meeting PROWAG requirements as detailed in SUDAS Design Manual Section 12A-2.

B. Smoothness for Shared Use Paths and Driveways:

1. Check finished surface with a 10 foot straightedge placed parallel to the centerline. Mark areas showing high spots of more than 1/4 of an inch in 10 feet.

2. If directed by the Engineer, correct marked areas by grinding down with an approved grinding tool to an elevation where the area will not show deviations in excess of 1/8 inch.

3.09 GRANULAR DRIVEWAY SURFACING

Comply with Iowa DOT Section 2315.

3.10 CLEANING

A. Remove all litter and construction materials or tools immediately after the end of the curing period.

B. Remove excess dirt from the site.

C. Broom clean completed sidewalks, shared use paths, and driveways.

3.11 MATERIAL TESTING

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

B. Concrete Compression Tests: When the concrete volume placed on a single day exceeds 20 cubic yards, comply with the following test requirements. When deficiencies are encountered, comply with Section 7010, 3.07, E.

1. Prepare at least two test cylinders per day.

2. If the concrete volume placed on a single day exceeds 200 cubic yards, prepare two test cylinders for each 200 cubic yards placed.

3.11 MATERIAL TESTING (Continued)

3. Provide 7 and 28 calendar day tests according to ASTM C 39. Minimum compressive strength is 2,000 psi at 7 days and 4,000 psi at 28 days.

C. HMA Density and Thickness Tests: When the area of HMA placed on a single day exceeds 100 square yards, comply with the following test requirement. When deficiencies are encountered, comply with Section 7020, 3.04, A.

1. Prepare at least two cores per day.

2. If the area of HMA placed on a single day exceeds 2,000 square yards, prepare two cores for each 2,000 square yards placed.

3.12 SIDEWALK AND CURB RAMP COMPLIANCE

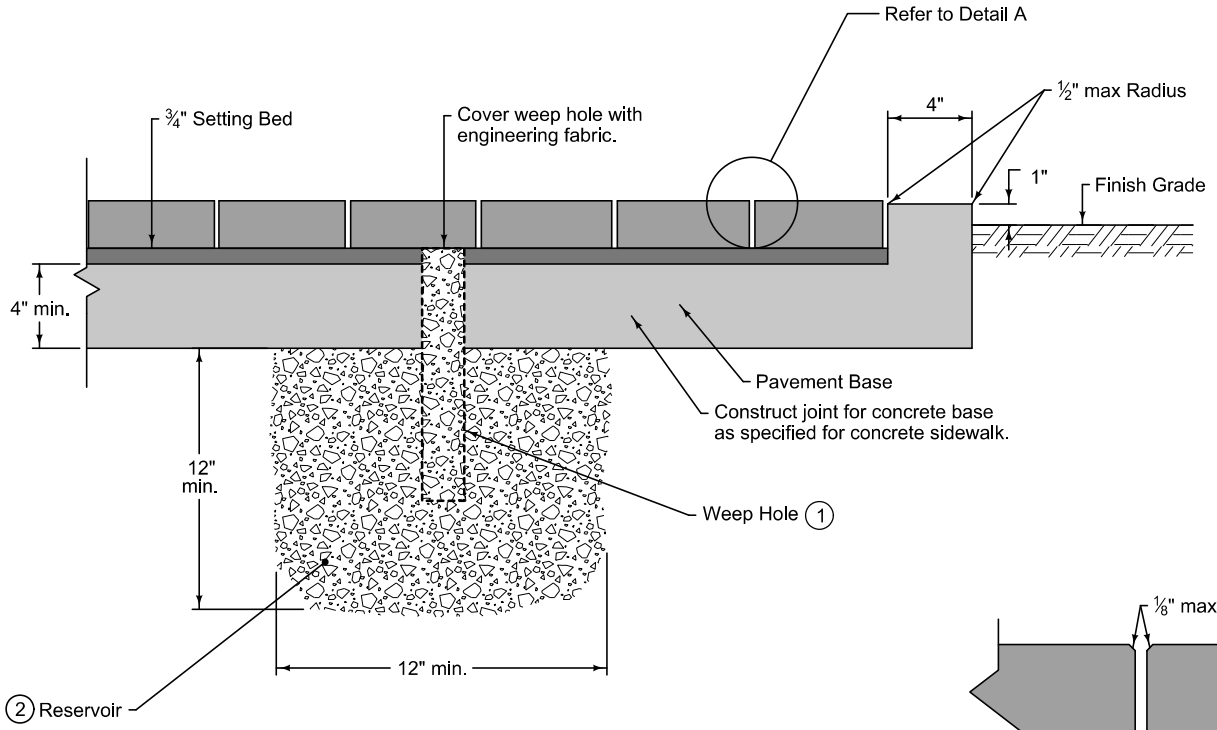
Compliance with cross slopes and grades, as well as all other elements, for sidewalks and curb ramps is crucial. If the construction cannot be completed as specified in the contract documents, it may be necessary to adjust slopes within the accepted legal limitations. Contact the Engineer prior to placement of the concrete if changes from the values specified in the contract documents are being made.

END OF SECTION

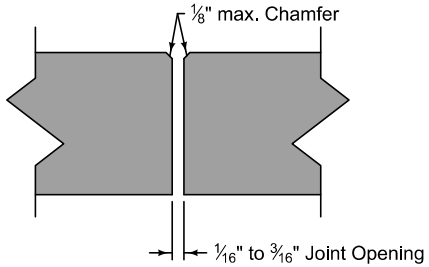
Install brick/paver sidewalk with pattern specified in the contract documents.

(1) Install 2 inch diameter, 12 inch long, PVC pipe even with the top of the asphalt setting bed at locations specified. Fill pipe with 3/4 inch clean rock.

(2) Fill reservoir with 3/4 inch clean rock. Extend reservoir to subdrain if present.



BRICK/PAVER SIDEWALK WITH PAVEMENT BASE



Detail A

FIGURE 7030.203

SHEET 1 OF 1

SUDAS

REVISION 2 10-16-18

7030.203

SHEET 1 of 1

SUDAS Standard Specifications

BRICK/PAVER SIDEWALK

PART 2 - PRODUCTS

2.01 MATERIALS

A. PCC:

1. **Standard Patching:** Use Class C mix complying with Section 7010. Comply with Iowa DOT Materials I.M. 401. Construct all patches as standard patches unless otherwise specified in the contract documents.

2. **High Early Strength Patching:** Use Class M mix complying with Section 7010. Do not use calcium chloride unless otherwise specified in the contract documents.

3. **Partial Depth Patching:** Use a coarse aggregate in concrete mix complying with Iowa DOT Article 4109.02, Gradation No. 5 in the Aggregate Gradation Table.

B. HMA: Provide a minimum Low Traffic (LT) mixture complying with Section 7020, unless otherwise specified in the contract documents. Provide mixture with an asphalt binder meeting or exceeding PG 58-28S.

C. Crack and Joint Filler Material:

1. **Hot Pour Crack and Joint Filler:** Comply with Iowa DOT Section 4136.

2. **Emulsified Asphalt Crack Filler:** Provide CRS-2 or CRS-2P emulsions complying with Iowa DOT Section 4140.

3. **HMA for Filling Cracks:**
   a. Provide a 3/4 inch, 1/2 inch, or 3/8 inch HMA mixture complying with Section 7020, or a similar mixture from a commercial source subject to approval from the Engineer.
   b. Upon approval of the Engineer, a high performance bituminous cold premix may be used, depending on the availability of the specified hot mix asphalt.

4. **Blotting Material:** Provide sand complying with Iowa DOT Sections 4124 or 4125, or similar sand approved by the Engineer.

5. **Soil Sterilant:** Provide soil sterilant as specified in the contract documents.

D. Primer or Tack Coat Bitumen: Comply with Iowa DOT Article 2303.02.

E. Epoxy for Bonding Dowel and Tie Bars: Comply with Iowa DOT Materials I.M. 491.11.

F. Tie Bars and Dowel Bars: Provide epoxy coated bars complying with Iowa DOT Section 4151.

G. Subbase Material: Unless otherwise specified in the contract documents, use modified subbase complying with Section 2010.

H. Liquid Curing Compound: Comply with Iowa DOT Section 4105.

I. Sand-cement Grout: Provide a sand-cement grout mixture with a ratio of one part water to one part sand and two parts cement.

J. Preformed Compression Relief Material: Provide 1/4 inch polystyrene, 1/4 inch polyethylene, 1/4 inch Styrofoam, or 3/16 inch waxed coated cardboard.

2.01 MATERIALS (Continued)

K. Epoxy Coated Dowel Bars: Comply with Figure 7010.101 and Iowa DOT Section 4151 for the length and diameter specified. Uniformly coat dowel bars with approved bond breaker according to Iowa DOT Article 4151.02, B. Include tight fitting nonmetallic end caps that allow a minimum of 1/4 inch movement at each end.

L. Dowel Chairs: Prevent movement of the dowel bar during grout placement with epoxy coated or nonmetallic dowel chair devices which provide a minimum clearance of 1/2 inch between the bottom of the bar and the surface upon which the bar is placed and also between the bar and the end walls of the slot.

M. Caulking Filler: Any commercial caulk designed as a concrete sealant that is compatible with the grout material being used.

N. Foam Core Inserts: Provide 3/8 inch ± 1/8 inch thick closed cell foam core board filler faced with film, foil, or poster board material on both sides.

O. Rapid Set Patch Material: Provide a shrinkage compensated rapid set patch material meeting Iowa DOT Materials I.M. 491.20 and the following strength requirements:

- 3 hour minimum compressive strength of 3,000 psi according to ASTM C 39.
- 24 hour minimum compressive strength of 5,000 psi according to ASTM C 39.
- 24 hour bond to dry PCC strength of 1,000 psi according to ASTM C 882.

Extend rapid set patch material according to the manufacturer's recommendations using pea gravel meeting Iowa DOT Section 4112 and the following gradation:

Sieve Size	Percent Passing
1/2 inch	100
3/8 inch	85 to 100
No. 8	0 to 8

PART 3 - EXECUTION

3.01 GENERAL

A. Conduct all operations to minimize inconvenience to traffic. Confine operations to one traffic lane, unless the road is to be closed to traffic. Minor encroachment into the adjacent lane, such as for sawing and installing forms, will be acceptable with the use of a flagger according to MUTCD.

B. Do not remove pavement for either full depth or partial depth patching unless the patch can be completed before the end of the working day.

C. Construct full depth and partial depth patches to the dimensions specified in the contract documents or as marked by the Engineer in the field. Construct all full depth patches to full panel width.

D. Make saw cuts parallel or perpendicular to the centerline.

E. Remove and dispose of materials not designated for salvage.

F. Restore the area outside the pavement by placing and compacting backfill material, placing topsoil, and sodding or seeding as specified in the contract documents.

3.02 FULL DEPTH PATCHING

A. Pavement Removal:

1. Saw pavement to full depth at the edges of the patch. A second saw cut, 2 inches inside the initial saw cut, may be required to prevent damage to adjacent pavement.

2. Do not damage pavement that is to remain. Do not use heavy equipment adjacent to new concrete until the opening strength is achieved.

B. Restoring Subgrade or Subbase:

1. Excavate 2 inches below the bottom of the existing pavement. If more than 2 inches is excavated, place and compact new subbase material as required to bring the subbase to a level 2 inches below the bottom of the existing pavement. Correct unauthorized over-excavation at no additional cost to the Contracting Authority.

2. Compact the exposed subgrade or subbase by a minimum of four complete passes with a plate-type vibratory compactor with a minimum force rating of 3,500 pounds.

3. When unstable material or excessive moisture is encountered, the Engineer may order removal and replacement of the unstable material.
   a. Remove existing unstable subgrade or subbase, or both, to the depth directed by the Engineer.
   b. Place and compact new subbase material as required to bring the subbase to a level 2 inches below the bottom of the existing pavement.

C. Placing PCC Patches:

1. Equipment: Comply with Iowa DOT Article 2301.03, A, specifications on equipment for standard concrete pavement.

3.02 FULL DEPTH PATCHING (Continued)

2. Tie Bars and Dowel Bars: Comply with Section 7010 and the figures in Sections 7010 and 7040.
   a. When there is a common line between two adjacent patches, a bent bar may be placed in a keyway and later straightened.
   b. Coat dowel bars extending into the patch area with a bond breaker. Do not coat tie bars.

3. Forms: Comply with Section 7010, 3.02, D, as well as the following.
   a. Use forms on all exposed edges and along the centerline for patches that extend into an adjacent lane, unless full pavement width patches are constructed.
   b. Rigid wood forms may be used in lieu of steel.

4. Placing, Consolidation, and Finishing the Concrete:
   a. Moisten the subbase or subgrade.
   b. Except for preplanned joints, place the patch continuously until the patch is completed.
   c. When a delay of 45 minutes cannot be avoided, construct a day's work ('DW') joint.
   d. Carefully place concrete into the patch area to avoid segregation; spread into place and consolidate with a mechanical vibrator. Place full lane width patches over 25 feet in length with a suitable finishing machine that has at least one vibrating screed. Avoid excessive vibrating.
   e. Finish patches per Section 7010, 3.02, H.
   f. For joints with tie bars, tool the edge. For joints with dowel bars, saw to a depth of approximately 1 1/8 inch, leaving an opening of at least 3/8 inch in width to provide a reservoir for joint filler.
   g. Texture the patch to match the adjacent surface.

5. Curing: Comply with Section 7010, 3.02, I. Cure the concrete, including exposed vertical edges, immediately after the concrete has been finished and the surface water has evaporated.

6. Joints: Construct and fill joints according to Section 7010, 3.02. Place joints at locations specified in the contract documents.

7. Pavement Protection: Comply with Section 7010, 3.04.

8. Use of Pavement: Comply with opening strength requirements of Section 7010, 3.05. Maturity testing is not required.

D. Placing HMA Patches:

1. Use equipment complying with Iowa DOT Article 2303.03. Use of a paving machine is not required.

2. Apply tack coat to the vertical edges of the remaining pavement at a rate of 0.10 to 0.15 gallons per square yard.

3. Place HMA patch mixture in lifts that will not exceed 3 inches in thickness after compaction, with the top lift not exceeding 2 inches in thickness when compacted.

4. Compact each lift while hot by rolling or compacting with a vibratory compactor. Subsequent lifts may be placed as soon as the preceding lift has been properly compacted.

COLD-IN-PLACE PAVEMENT RECYCLING

PART 1 - GENERAL

1.01 SECTION INCLUDES

Cold-in-place recycling (CIR) of asphalt roadways

1.02 DESCRIPTION OF WORK

Includes milling and mixing of existing asphalt materials, addition of recycling agents and additives if required, compaction of the reclaimed materials, and curing of the compacted street.

1.03 SUBMITTALS

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

A. Prepare and submit the job mix formula to the Engineer for approval prior to initiating full recycling operations.

B. Provide quality control test results.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Cold-in-place Recycling:

1. Measurement: Measurement will be in square yards for the area of roadway recycled.

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

3. Includes: Unit price includes, but is not limited to, milling and sizing of existing asphalt layers; protecting street fixtures; development of a job mix formula; adding and mixing recycling agents and additives, if required; supplying and incorporating water; compacting the reclaimed mix; shaping of the mix; completing secondary compaction, if required; removing any loose or excess material; and final clean up.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Bituminous Recycling Agents:

1. Measurement: Measurement will be in gallons of asphalt emulsion or foamed asphalt furnished and incorporated.

2. Payment: Payment will be at the unit price per gallon of asphalt emulsion or foamed asphalt furnished and incorporated.

3. Includes: Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the recycled mix.

C. Chemical Recycling Additives:

1. Measurement: Measurement will be in tons of chemical recycling additives.

2. Payment: Payment will be at the unit price per ton of chemical recycling additives.

3. Includes: Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the recycled mix.

D. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

E. Surface Course: Comply with Section 7011 or Section 7021 for overlay pavement.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bituminous Recycling Agent: Use asphalt emulsion (HFMS-2s or CSS-1) meeting the requirements of Iowa DOT Section 4140, or foamed asphalt using PG 52-34S asphalt binder meeting the requirements of Iowa DOT Sections 2318 and 4137.

B. Chemical Recycling Additives:

1. Cement complying with Iowa DOT Article 4101.01, A.

2. Hydrated lime complying with AASHTO M 216.

3. If approved by the Engineer, use other proprietary products according to the manufacturer's requirements.

C. Water: Comply with Iowa DOT Section 4102**.** Potable water obtained from an approved supply does not need to be tested**.**

2.02 JOB MIX FORMULA

Compile a job mix formula using an analysis of the existing asphalt pavement layers and the required strength of the recycled pavement section as specified in the contract documents. The job mix formula will identify the recycling agent and any additives; the rates for the recycling agent and additive, if needed; and the rate of water to reach the optimum moisture content. Tolerances should be included to allow the Contractor to adjust the mixture so that it is placed successfully.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. General:

1. Perform cold-in-place recycling between May 1 and October 1.

2. Perform recycling operations when weather conditions are such that proper mixing, shaping, and compacting the recycled mix can be accomplished. General criteria includes:
   a. Begin operations when air temperature is 55°F and rising.
   b. Cease operations when air temperature is 55°F or less and falling.
   c. Do not begin operations if the National Weather Service forecasts a temperature of 35°F or less in the next 24 hours or if the weather is rainy or foggy.

B. Equipment:

1. Furnish a self-propelled machine capable of milling the existing paving material to the width and depth specified in the contract documents. Ensure the equipment meets the following:
   a. Equipped with automatic depth control to maintain a constant depth and width.
   b. Capable of milling the existing roadway to the required gradation in one pass.
   c. Accurately controls the rate of flow and total delivery of the recycling agent and additives, if needed, into the recycled mixture in relation to the speed and quantity of the material being recycled.
   d. Capable of mixing the recycled material and any recycling agent and additive required by the job mix formula into a homogeneous mixture.

2. If specified in the contract documents, use an asphalt foaming system that accurately and uniformly adds the required percent of water to the hot asphalt binder. Use equipment fitted with a test nozzle to provide field samples of the foamed asphalt. Equip tankers supplying the hot asphalt binder with a thermometer to continuously monitor the temperature of the asphalt in the bottom third of the tank.

3. Use a bituminous paver complying with Iowa DOT Article 2001.19. Heating the screed will not be allowed.

4. Have the following rollers available for use:
   a. Double drum steel roller (static and vibratory)
   b. Pneumatic tire roller (25 ton or greater)

3.02 PREPARATION

Prior to initiating the recycling process, undertake the following tasks:

A. Identify and protect all affected utilities.

B. Remove excess dirt, vegetation, raised pavement markings, standing water, and any other objectionable materials.

3.03 UTILITIES

All utilities within the project limits should be protected prior to the milling. Locate and lower manholes, water valve boxes, and other fixtures a minimum of 2 inches below the bottom of the recycled section. Re-set manhole castings, water valves, and other fixtures to the proper elevations following completion of the compaction of the recycled mixture and placement of any surface course. Protect stormwater intakes by preventing recycled material from entering the drainage system.

3.04 CONTROL STRIP

Construct a control strip during the first day of production to verify that the equipment, construction methodology, and workmanship meet the specifications. Adequately size the control strip to verify that the optimal rates of water, recycling agent, and additives can be achieved. Establish a rolling pattern that will result in optimum compaction. The Engineer may waive the control strip provided the Contractor provides proof that the work will meet the specifications based on previous experience using the same equipment, personnel, and materials.

3.05 MILLING THE PAVEMENT

Mill the existing asphalt pavement and underlying areas to initiate the recycling process.

A. Mill the full depth of the asphalt layers in a single pass.

B. Verify the gradation of the pulverized material meets the specifications.

C. Provide a 3 inch overlap of the longitudinal joint and 24 inches between transverse joints

3.06 RECYCLING AGENT APPLICATION

For single unit recycling trains, add the bituminous agent in the cutting drum. For two-unit trains, add it in the mix paver and for multi-unit trains add the bituminous agent in the pugmill. Ensure residual asphalt content is ± 0.5% of the target established in the job mix formula. Maintain foamed asphalt binder ± 20°F of the optimum temperature established by the job mix formula.

3.07 RECYCLING ADDITIVES

Add chemical recycling agents as additives to applications that use bituminous recycling agents at the rates required by the job mix formula. Apply the chemical additive in dry or slurry form by adding it on the pavement ahead of the milling operation, adding it directly to the mixing chamber, or spraying it over the cutting teeth of the milling machine.

3.08 COMPACTION

Ensure recycled material is ± 2% of the optimum moisture content.

A. Timing: Compact the mixed recycled roadway materials based on the type of recycling agent used as follows.

1. Asphalt Emulsion: Complete compaction at or just after the emulsion breaks.

2. Foamed Asphalt: Initiate immediately after mixing and complete prior to the mixture drying out.

3.08 COMPACTION (Continued)

B. Process: Follow the rolling pattern established with construction of the control strip regarding type and size of roller. Perform initial rolling with the pneumatic tired roller and final rolling with the steel wheeled roller. Set the vibratory amplitude/frequency, tire pressure for pneumatic, and static weight of all rollers based on the depth of the recycled mixture to be compacted. Uniformly compact the mixture to a minimum of 94% of maximum dry density according to AASHTO T 134 on a moving average of five consecutive tests with no individual test below 92%.

C. Shaping: Complete rolling to achieve the required density. Ensure the crown of the compacted recycled roadway is within 6 inches of the established centerline, unless otherwise specified in the contract documents.

3.09 SECONDARY COMPACTION

If necessary, complete secondary compaction to eliminate wheel marks and minor consolidation caused by construction traffic prior to opening. Complete secondary compaction during daylight hours and when the minimum ambient temperature is 80°F. Suspend operations if cracking of the mat occurs.

3.10 SMOOTHNESS

Ensure surface of recycled base course is free of bumps, ruts, indentations, segregation of aggregates and conforms to the required elevations. Check surface with a 10 foot straightedge and correct any irregularity 3/8” or larger. Complete corrective measures at no cost to the contracting agency.

3.11 SURFACE COURSE

Protect the CIR surface from damage prior to adding the surface course. Any damage will be repaired at Contractor’s expense. Restrict application of overlays and other surface treatments until one of the following has been met:

A. Average moisture content of the CIR layer is no more than 0.3% above the residual moisture content according to Iowa DOT Materials I.M. 504 or 3.5%, whichever is greater.

B. The moisture content of the CIR layer has reached a plateau of less than 5% and has remained constant (within ± 0.3%) for a minimum of 3 calendar days.

C. The CIR layer has been completed for 21 calendar days.

The Engineer may adjust this drying period depending on field conditions.

3.12 QUALITY CONTROL

The Contractor is responsible for the quality control of the materials and the CIR process.

A. Sample and test the asphalt recycling agent according to Iowa DOT Materials I.M. 204.

B. Apply the asphalt recycling agent at the target application rate ± 0.06 gallon per square yard per inch for standard emulsion and ± 0.33 gallon per square yard per inch for foamed asphalt.

END OF SECTION

FULL DEPTH RECLAMATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

Full depth reclamation of asphalt roadways

1.02 DESCRIPTION OF WORK

Includes pulverizing and mixing of existing asphalt and underlying materials; addition of stabilizing agents and additives if required; compaction of the reclaimed materials and curing of the compacted street.

1.03 SUBMITTALS

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

A. Prepare and submit the job mix formula to the Engineer for approval prior to initiating full reclaiming operations.

B. Provide quality control test results.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Full Depth Reclamation:

1. Measurement: Measurement will be in square yards for the area of roadway reclaimed.

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

3. Includes: Unit price includes, but is not limited to, pulverizing and sizing of existing asphalt layers; incorporating and mixing of existing underlying materials; protecting street fixtures; development of a job mix formula; adding and mixing stabilizing agents and additives, if required; compacting the reclaimed mix; shaping of the mix; removing any loose or excess material; curing; and final clean up.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Mechanical Stabilization Agents:

1. **Measurement:** Measurement will be in tons of aggregate.

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

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of aggregate and blending of the aggregates.

C. Bituminous Stabilization Agents:

1. **Measurement:** Measurement will be in gallons of asphalt emulsion or foamed asphalt furnished and incorporated.

2. **Payment:** Payment will be at the unit price per gallon of asphalt emulsion or foamed asphalt furnished and incorporated.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the reclaimed mix.

D. Chemical Stabilization Agents:

1. **Measurement:** Measurement will be in tons of chemical stabilization agents.

2. **Payment:** Payment will be at the unit price per ton of chemical stabilization agents.

3. **Includes:** Unit price includes, but is not limited to, furnishing and placing of materials and mixing the agent into the reclaimed mix.

E. Microcracking

1. **Measurement:** Measurement will be in square yards for the area of roadway microcracked.

2. **Payment:** Payment will be at the unit price per square yard of roadway microcracked.

F. Interlayer for Cement Stabilized Base

1. **Measurement:** Measurement will be in square yards for each type and thickness of interlayer.

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

3. **Includes:** Unit price includes, but is not limited to, surface cleaning, furnishing, and placing of the interlayer (if specified).

G. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Mechanical Stabilizing Agents: Use virgin crushed aggregates, RAP, or crushed PCC in the gradation called for in the job mix formula.

B. Bituminous Stabilizing Agent: Use asphalt emulsion (HFMS-2s) meeting the requirements of Iowa DOT Section 4140, or foamed asphalt using PG 52-34S asphalt binder meeting the requirements of Iowa DOT Section 4137.

C. Chemical Stabilizing Agent:

1. Cement complying with Iowa DOT Article 4101.01, A.
2. Class C or Class F Fly Ash complying with Iowa DOT Section 4108.
3. Hydrated Lime complying with AASHTO M 216.
4. Calcium Chloride complying with Iowa DOT Section 4194.
5. If approved by the Engineer, use proprietary products according to the manufacturer's requirements.

D. Fog Seal Cure: Comply with Iowa DOT Section 2306.

E. Water: Comply with Iowa DOT Section 4102**.** Potable water obtained from an approved supply does not need to be tested**.**

F. Interlayer

1. Class A crushed stone complying with Iowa DOT Article 4120.04.
2. HMA interlayer complying with Section 7021, 2.04, B.

2.02 JOB MIX FORMULA

Compile a job mix formula using an analysis of the existing asphalt pavement layers and the subbase/subgrade and the required strength of the reclaimed pavement section as specified in the contract documents. The job mix formula will identify the stabilizing agent and any additives; the rates for the stabilizing agent and additive, if needed; and the rate of water to reach the optimum moisture content. Allowable tolerances should be included to allow the Contractor to adjust the mixture so that it is placed successfully.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. General:

1. Perform full depth reclamation between April 1 and November 1.

2. Perform reclaiming operations when weather conditions are such that proper mixing, shaping, and compacting the reclaimed mix can be accomplished.

B. Equipment:

1. Furnish a self-propelled machine capable of reclaiming the existing paving material to the width and depth specified in the contract documents. Ensure the equipment meets the following:
   a. Equipped with automatic depth control to maintain a constant depth and width.
   b. Capable of pulverizing the existing roadway to the required gradation.
   c. Accurately controls the rate of flow and total delivery of the stabilizing agent and additives, if needed, into the reclaimed mixture in relation to the speed and quantity of the material being recycled.
   d. Capable of mixing the reclaimed material and any stabilizing agent and additive required by the job mix formula into a homogeneous mixture.

2. If specified in the contract documents, use an asphalt foaming system that accurately and uniformly adds the required percent of water to the hot asphalt binder. Use equipment fitted with a test nozzle to provide field samples of the foamed asphalt. Equip tankers supplying the hot asphalt binder with a thermometer to continuously monitor the temperature of the asphalt in the bottom third of the tank.

3. Have the following rollers available for use:
   a. Sheepsfoot roller
   b. Double drum steel roller (static and vibratory)
   c. Pneumatic tire roller (25 ton or greater)

4. Provide a motor grader with grade and cross-slope control.

3.02 PREPARATION

Prior to initiating the reclaiming process, undertake the following tasks:

A. Identify and protect all affected utilities.

B. Remove excess dirt, vegetation, raised pavement markings, standing water, and any other objectionable materials.

3.03 UTILITIES

All utilities within the project limits should be protected prior to the pulverization. Locate and lower manholes, water valve boxes, and other fixtures a minimum of 4 inches below the bottom of the reclaimed section. Re-set manhole castings, water valves, and other fixtures to the proper elevations following completion of the compaction of the reclaimed mixture. If lowering of fixtures is not practical, excavate material from around the fixture to a location where it can be pulverized by the reclaimer. Move the pulverized material back around the fixture after mixing and compact with smaller compaction equipment to the required densities. Protect stormwater intakes by preventing reclaimed material from entering the drainage system.

3.04 CONTROL STRIP

Construct a control strip during the first day of production to verify that the equipment, construction methodology, and workmanship meet the specifications. Adequately size the control strip to verify that the optimal rates of water, stabilizing agent, and additives can be achieved. Establish a rolling pattern that will result in optimum compaction. The Engineer may waive the control strip provided the Contractor provides proof that the work will meet the specifications based on previous experience using the same equipment, personnel, and materials.

3.05 PULVERIZING

Pulverize the existing asphalt pavement and underlying areas to initiate the reclaiming process.

A. Pulverize the full depth of the asphalt layers and the underlying materials in a single pass, unless multiple passes are specified in the contract documents.

B. If multiple passes are specified, leave a minimum of 1 inch of the underlying layer intact with the initial pulverizing pass.

C. Prior to the second pulverizing/mixing pass, complete light compaction and reshaping to establish a solid working base.

D. Verify the gradation of the pulverized material meets the job mix formula.

E. Provide a 6 inch overlap of the longitudinal joint and 24 inches between transverse joints when multiple passes are required.

3.06 REMOVAL OF EXCESS MATERIAL

Following the initial pulverization pass and prior to the mixing pass, if required, remove any excess reclaimed material from the project area to a site designated by the Engineer as a means to meet final design elevations.

3.07 STABILIZING AGENT APPLICATION

A. Mechanical: Spread aggregate in a uniform layer ahead of the pulverizer. Placement can be completed during the initial pulverizing pass or as a part of a mixing pass.

B. Chemical: Spread dry chemical stabilizers onto the reclaimed material between the pulverizing pass and the mixing pass. Take corrective measures if dust is a problem. Apply chemical stabilizers in slurry form through the reclaimer's on-board liquid additive system, if so equipped, or directly on the reclaimed material in advance of the mixing pass. Disburse slurry uniformly over the entire reclaimed roadway. Do not exceed 30 minutes from the time the slurry is applied until the mixing begins. Ensure chemical stabilizer application rate is ± 0.5% as required by the job mix formula.

C. Bituminous: Inject the asphalt emulsion or foamed asphalt at the required rate through the reclaimer's on-board liquid additive system. Ensure residual asphalt content is ± 0.5% of the target established in the job mix formula. Maintain foamed asphalt binder ± 20°F of the optimum temperature established by the job mix formula.

3.08 STABILIZING ADDITIVES

Add chemical stabilizing agents as additives to applications that use bituminous stabilizers at the rates required by the job mix formula. Apply the chemical additive in dry form, slurry form, or through the reclaimer's liquid injection system after the pulverizing pass.

3.09 COMPACTION

Ensure reclaimed material is within 2% of the optimum moisture content.

A. Timing: Compact the mixed reclaimed roadway materials based on the type of stabilizing agent used as follows:

1. **Mechanical:** Upon completion of all mixing passes.

2. **Chemical:**
   a. **Cement:** Do not exceed two hours between mixing and final compaction.
   b. **Hydrated Lime and Kiln Dust:** Initiate compaction 4 hours after mixing. Maintain moisture content above the optimum level during that time.

3. **Bituminous:**
   a. **Asphalt Emulsion:** Complete compaction at or just after the emulsion breaks.
   b. **Foamed Asphalt:** Initiate immediately after mixing and complete prior to the mixture drying out.

B. Process: Follow the rolling pattern established with construction of the control strip with respect to type and size of roller. Perform initial rolling with sheepsfoot roller until the roller pads walk out of the reclaimed mix. Set the vibratory amplitude/frequency, tire pressure for pneumatic, and static weight of all rollers based on the depth of the reclaimed mixture to be compacted. Uniformly compact the mixture to a minimum of 98% of maximum dry density according to AASHTO T 134 on a moving average of five consecutive tests with no individual test below 96%.

C. Shaping: Following sheepsfoot roller walk out, cut the reclaimed road bed and shape to required grade and cross-section to remove roller marks. Complete rolling to achieve the required density. Ensure the crown of the compacted reclaimed roadway is within 6 inches of the established centerline, unless otherwise specified in the contract documents. If grade control is required, stake according to Section 11,010, 3.03, A.

3.10 CURING

A. Moisture: Following final finishing, maintain the surface moisture by completing regular applications of a light spray of water. Continue moisture cure for a minimum of 7 days. Apply water spray such that the surface is not eroded.

B. Bituminous: Apply bituminous fog seal within 24 hours of finishing operations. Maintain moisture cure until bituminous cure is placed. Prior to application of fog seal, clean all loose and extraneous materials from the surface. Complete fog seal cure according to Iowa DOT Section 2306. If traffic is allowed on the roadway prior to the fog seal drying so that material is picked up on tires, add a sand blotter to the entire roadway width.

3.11 MICROCRACKING

If specified in the contract documents, complete microcracking of the cement stabilized reclaimed roadway starting within 24 to 48 hours after moisture curing was initiated. Use a 10 to 12 ton vibratory steel drum roller with vibration set at maximum amplitude and speed limited to 2 mph. Use 3 to 4 passes over the entire roadway except the outside 1 foot on uncurbed sections. Continue moisture curing or apply fog seal cure following completion of microcracking.

3.12 INTERLAYER

If specified in the contract documents, complete placement of the HMA interlayer according to Section 7021. Complete placement of the Class A crushed stone interlayer by complying with Iowa DOT Section 2312.

END OF SECTION

PART 2 - PRODUCTS

2.01 UNDERGROUND

A. Handhole:

1. General:

a. Cable Hooks: Provide four galvanized steel cable hooks with a minimum diameter of 3/8 inch and a minimum length of 5 inches.

b. Granular Base: Comply with the following gradations; however, the Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

Sieve	Percent Passing
2”	100
1 1/2”	80 to 90
1”	15 to 20
3/4”	0 to 0.5

c. Cover: Include “TRAFFIC SIGNAL” as a message on the cover. Alternate messages may be required as specified in the contract documents.

2. Precast Concrete Handhole:

a. Pipe: Comply with ASTM C 76. Minimum Class III, Wall B (Iowa DOT Class 2000D). Four, 8 inch knockouts (conduit entrance points) equally spaced around the handhole.

b. Casting: Gray cast iron and certified according to requirements of AASHTO M 306 for a 16,000 pound proof-load (HS-20).

3. Composite Handhole and Cover: Composed of mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass. Ensure the handhole and cover withstands a load of 20,000 pounds. Provide a skid resistant surface on the cover. Provide two 3/8-16 UNC stainless steel hex head bolts with washers.

B. Conduit:

1. General:

a. Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings.

b. Use a manufactured conduit sealing compound that is readily workable material at temperatures as low as 30°F and will not melt or run at temperatures as high as 300°F.

2. Steel Conduit and Fittings:

a. Comply with ANSI C80.1.

b. Use weatherproof expansion fittings with galvanized, malleable iron, fixed and expansion heads jointed by rigid steel conduit sleeves. As an option, the fixed head may be integral with the sleeve, forming a one piece body of galvanized malleable iron.

c. Provide steel bushings.

3. Plastic Conduit and Fittings:

a. PVC:

1) PVC Schedule 40 plastic conduit and fittings complying with NEMA TC-2 (pipe), NEMA TC-3 (fittings), and UL 651 for Schedule 40 heavy wall type.

2.01 UNDERGROUND (Continued)

2) Solvent welded, socket type fittings, except where otherwise specified in the contract documents.
3) Threaded adaptors for jointing plastic conduit to rigid metal ducts.
4) Provide bell end fittings or bushings.

b. HDPE:

1) Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), SDR 13.5.
2) Use orange colored conduit.
3) Continuous reel or straight pieces to minimize splicing.
4) For dissimilar conduit connections, provide an adhesive compatible with both materials.

C. Wiring and Cable: Provide wire that is plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable.

1. Power Cable: Comply with Iowa DOT Article 4185.11.

2. Signal Cable: Comply with IMSA Specifications 19-1 (PVC jacket) or 20-1 (polyethylene jacket) for polyethylene insulated, 600 volt, solid, multi-conductor copper wire, #14 American Wire Gauge (AWG).

3. Tracer Wire: Comply with #10 AWG, single conductor, stranded copper, type thermoplastic heat and water resistant, nylon-coated (THWN), with UL approval, and an orange colored jacket.

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

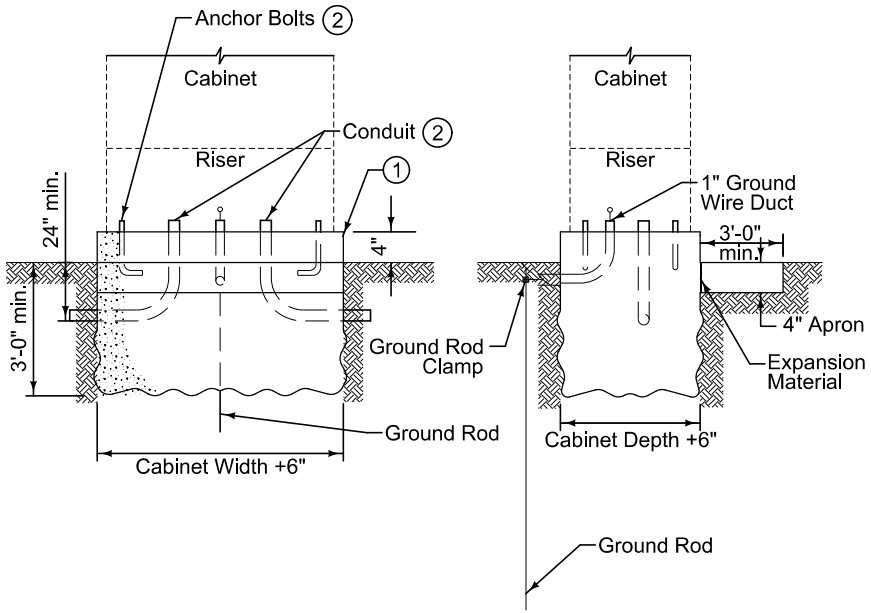
5. Category 5E (Cat5E) Cable: Provide outdoor use rated cable.

6. Fiber Optic Cable and Accessories:

a. Furnish fiber optic cable of the mode type, size, and number of fibers specified in the contract documents, and all associated accessories.
b. Meet the latest applicable standard specifications by ANSI, Electronics Industries Association (EIA), and Telecommunications Industries Association (TIA).
c. Multimode Fiber:
Core Diameter: 62.5 µm ± 1.0 µm
Cladding Diameter: 125.0 µm ± 1.0 µm
Core Concentricity: ± 1%
Max. Attenuation: 3.50 dB/km @ 850 nm
d. Single-Mode Fiber:
Typical Core Diameter: 8.3 µm ± 1.0 µm
Cladding Diameter: 125.0 µm ± 1.0 µm
Core Concentricity: ± 1%
Attenuation Uniformity: No point discontinuity greater than 0.1 dB at either 1310 nm or 1550 nm
Max. Attenuation: 0.25 dB/km @ 1550 nm, 0.35 dB/km @ 1310 nm
e. Dual layer UV cured acrylate coating applied by the fiber manufacturer, mechanically or chemically strip-able without damage to the fiber.
f. Glass reinforced plastic rod central member designed to prevent the buckling of the cable. Cable core interstices filled with water blocking tape to prevent water infiltration. Dielectric fillers may be included in the cable core where needed to lend symmetry to the cable cross-section.

(1) Shape top 11 inches with forms.

(2) Bolt spacing and conduit locations as specified by the manufacturer.



NEMA CONTROLLER CABINET FOOTING

FIGURE 8010.101

SHEET 1 OF 1

SUDAS

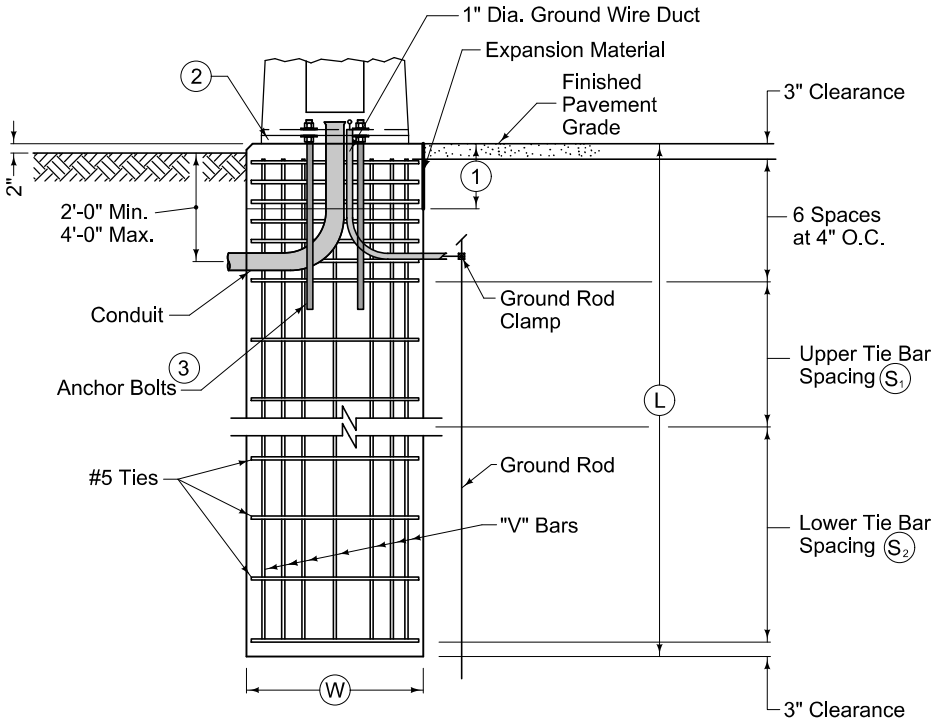
REVISION
New 10-16-12

8010.101

SHEET 1 of 1

SUDAS Standard Specifications

CABINET FOOTING DETAILS



MAST ARM POLE FOUNDATION IN SOIL
TYPE A FOUNDATION

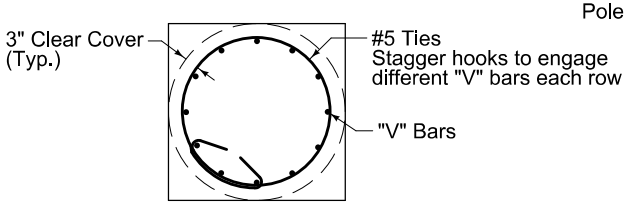
The Type A Foundation is the normally required foundation construction. Where rock is encountered, the Engineer may approve the use of the Type B or C Foundation. Prior to installing a foundation in rock, obtain a subsurface investigation certified by a geotechnical engineer licensed in the State of Iowa.

(1) Shape top 11 inches with forms. See Detail 'A'.

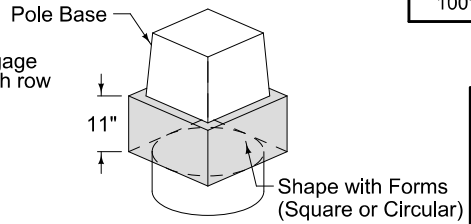
(2) Install rodent guard or non-shrink grout with weep hole.

(3) Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.

Max. Mast Arm Length	Foundation		"V" Bars			Tie Bars				
							Upper Spacing		Lower Spacing	
	W	L	Count	Size	Length	Count	# Spaces	S_1	# Spaces	S_2
35'-0"	3'-0"	12'-0"	12	#8	11'-6"	17	9	12"	N/A	N/A
45'-0"	3'-0"	14'-0"	12	#8	13'-6"	19	11	12"	N/A	N/A
55'-0"	3'-0"	16'-0"	12	#8	15'-6"	25	12	8"	5	12"
60'-0"	3'-0"	18'-0"	13	#8	17'-6"	28	15	8"	5	12"
70'-0"	3'-6"	18'-0"	12	#10	17'-6"	28	15	8"	5	12"
80'-0"	3'-6"	21'-0"	14	#10	20'-6"	40	22	6"	10	8"
90'-0"	4'-0"	22'-0"	16	#10	21'-6"	42	24	6"	10	8"
100'-0"	4'-0"	24'-0"	18	#10	23'-6"	47	32	6"	7	8"

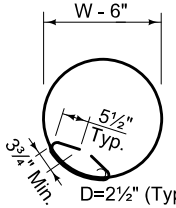


PLAN VIEW



DETAIL 'A'

BENT BAR DETAIL



Note: All dimension are out to out.

SUDAS | IOWA DOT

REVISION 3 04-16-19

FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102

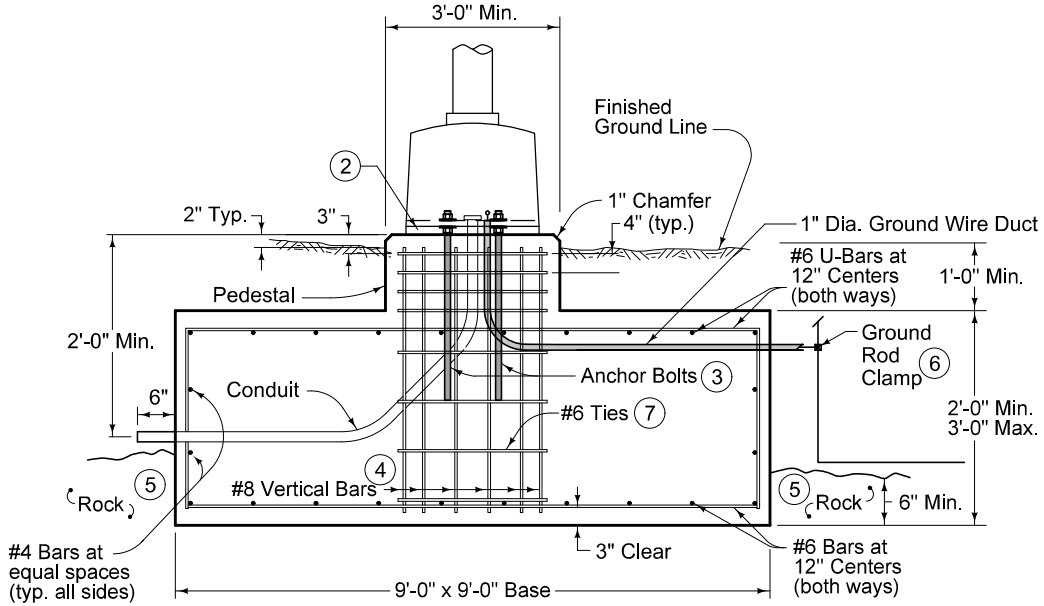
SHEET 1 of 4

REVISIONS: Added Detail 'A' on Sheets 1, 3, and 4. Modified table on Sheet 3.

Paul D. Wigard, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION

FIGURE 8010.102 | SHEET 1 OF 4



MAST ARM POLE FOUNDATION IN ROCK
TYPE B FOUNDATION

Type B Foundation is applicable for traffic signal poles with mast arm lengths up to 60 feet.

If the excavation for a Type B Foundation is left open for more than 1 calendar day, install temporary barrier rail if any part of the excavation is located within the clear zone. Temporary barrier rail layout requires the Engineer's approval.

Competent rock has an average unconfined compressive strength (q_u) of at least 2.0 ksi and rock quality designation of at least 90%. Conditions not meeting minimum requirements will require either:
- A site specific design, or
- Using the parameters for Mast Arm Pole Foundation in Soil.

(2) Install rodent guard or non-shrink grout with weep hole.

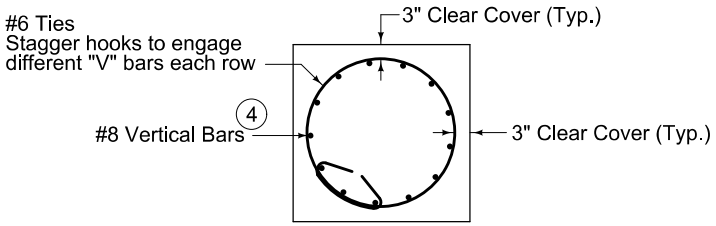
(3) Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.

(4) Place 13 equally spaced #8 vertical bars.

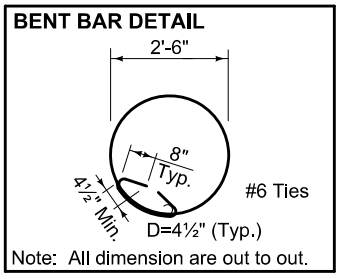
(5) Cast foundation concrete against competent rock. If foundation is formed, place backfill with concrete cast against rock.

(6) When in contact with rock, place ground rods as specified in National Electrical Code, current edition.

(7) #6 bars spaced at 8 inch maximum. Ties may be welded to vertical bars.



PLAN VIEW



SUDAS | IOWADOT | REVISION 3 04-16-19

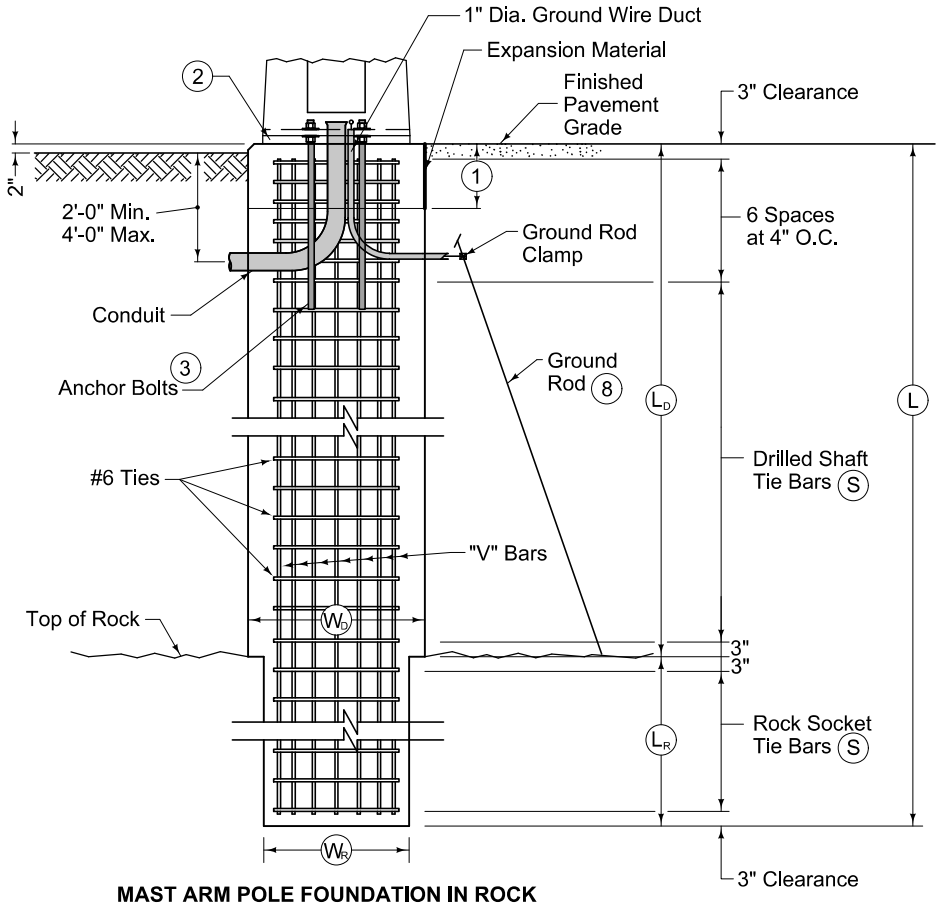
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 2 of 4

REVISIONS: Added Detail 'A' on Sheets 1, 3, and 4. Modified table on Sheet 3.

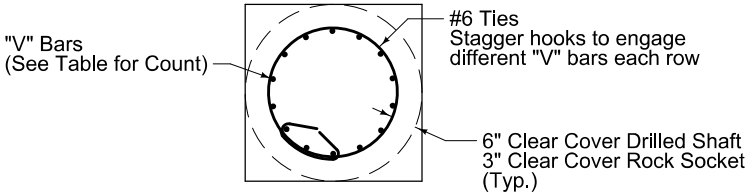
Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION

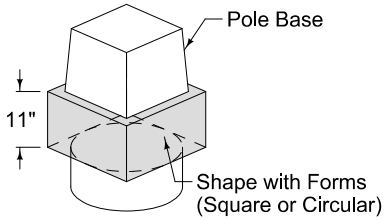
FIGURE 8010.102 | SHEET 2 OF 4



MAST ARM POLE FOUNDATION IN ROCK TYPE C FOUNDATION



MAST ARM POLE FOUNDATION



DETAIL 'A'

(1) Shape top 11 inches with forms. See Detail 'A'.

(2) Install rodent guard or non-shrink grout with weep hole.

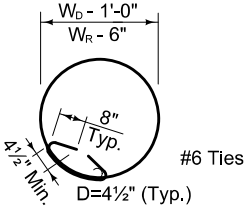
(3) Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.

(8) When in contact with rock, place ground rods as specified in National Electrical Code, current edition.

Max. Mast Arm Length	Foundation						"V" Bars			Tie Bars
	W_D Min.	W_R Min.	L*** Max.	L_D	L_R**** Broken Rock*	L_R**** Competent Rock**	Count	Size	Length	S Spacing
35'-0"	3'-0"	2'-6"	12'-0"	VARIES $L_D = (L - L_R)$	4'-6"	3'-0"	13	#8	L - 6"	6"
45'-0"	3'-0"	2'-6"	14'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
55'-0"	3'-0"	2'-6"	16'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
60'-0"	3'-0"	2'-6"	18'-0"		4'-6"	3'-0"	13	#8	L - 6"	6"
70'-0"	3'-6"	3'-0"	18'-0"		5'-6"	3'-6"	14	#9	L - 6"	5½"
80'-0"	3'-6"	3'-0"	21'-0"		5'-6"	3'-6"	14	#9	L - 6"	5½"
90'-0"	4'-0"	3'-6"	22'-0"		6'-0"	4'-0"	15	#10	L - 6"	5½"
100'-0"	4'-0"	3'-6"	24'-0"		6'-0"	4'-0"	15	#10	L - 6"	5½"

*Broken rock has an average unconfined compressive strength (q_u) of at least 1.0 ksi and rock quality designation of at least 20%.
**Competent rock has an average unconfined compressive strength (q_u) of at least 2.0 ksi and rock quality designation of at least 90%.
***Total foundation length L must be sufficient to provide a 3 inch clearance between the bottom of the traffic signal pole anchor bolts and the bottom of the rock socket.
****The Rock Socket Length L_R can be decreased if the total length of the shaft is L long as shown in the table.
Conditions not meeting minimum requirements will require site specific designs or shall use theType A Foundation Soil parameters.

BENT BAR DETAIL



Note: All dimension are out to out.

SUDAS | IOWA DOT | REVISION 3 04-16-19

FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 3 of 4

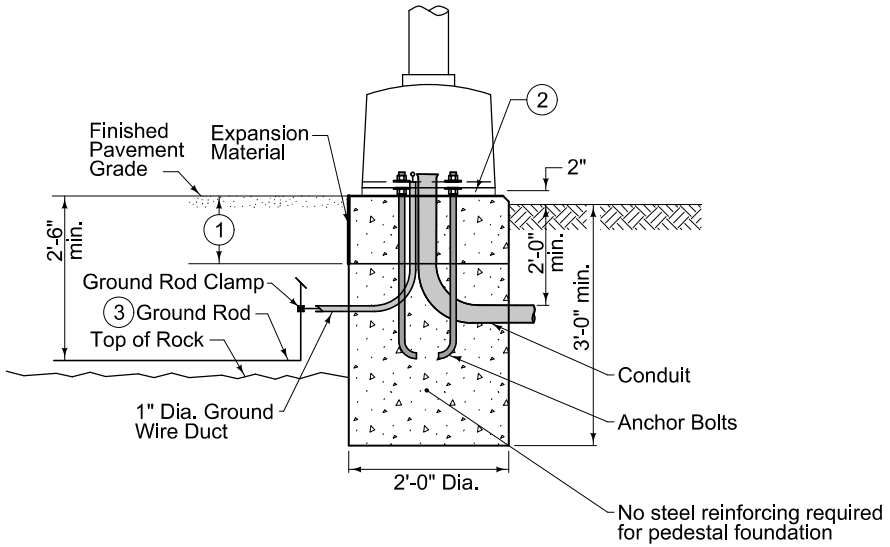
REVISIONS: Added Detail 'A' on Sheets 1, 3, and 4. Modified table on Sheet 3.

Paul D. Wigard, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

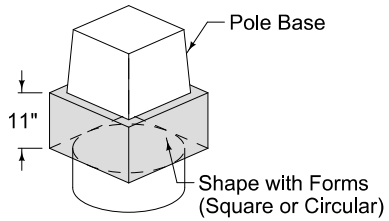
TRAFFIC SIGNAL POLE FOUNDATION

FIGURE 8010.102 | SHEET 3 OF 4

1. Shape top 11 inches with forms. See Detail 'A'.
2. Install rodent guard or non-shrink grout with weep hole.
3. Furnish nut, nut and plate, or nut and anchor bolt assembly ring plate on embedded end.



PEDESTAL POLE FOUNDATION IN SOIL OR ROCK



DETAIL 'A'

FIGURE 8010.102 SHEET 4 OF 4

SUDAS | IOWADOT | REVISION 3 04-16-19

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

REVISIONS: Added Detail 'A' on Sheets 1, 3, and 4. Modified table on Sheet 3.

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

TRAFFIC SIGNAL POLE FOUNDATION

3.20 DUST CONTROL (Continued)

3. Allow product to penetrate through the loosened material.

4. Tight-blade road surface.

3.21 EROSION CONTROL MULCHING

A. Conventional Mulching:

1. Use conventional mulching when the surface cannot be stabilized by seeding, due to season or ground conditions.

2. Uniformly distribute mulch over the required areas, at a rate of 2 tons/acre for dry cereal straw, or 2.5 tons/acre for prairie hay.

3. Work the mulch into the soil with a mulch tucker, designed to anchor the mulch into the soil, by means of dull blades or disks.

B. Hydromulching:

1. Place mulch and tackifier (if applicable) in equipment specifically manufactured for hydraulic mulching.

2. Mix materials with fresh, potable water using a combination of re-circulation through the equipment's pump and mechanical agitation to form a homogeneous slurry.

3. If necessary, dampen any dry, dusty soil as required to prevent balling of the material during application.

4. Apply hydromulch in multiple layers from opposing directions, where possible.

5. Apply the slurry evenly over all specified areas, at the minimum component material rates specified:
   a. Wood Cellulose Mulch:
      1) Mulch: Minimum 3,000 lb/acre dry weight.
      2) Tackifier: Minimum 50 lb/acre.
   b. Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
   c. Mechanically Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.

6. Retain and count empty bags of mulch to ensure final application rate.

3.22 TURF REINFORCEMENT MATS

Install according to the manufacturer's published installation literature for the product specified and application (slope or channel).

3.23 SURFACE ROUGHENING

A. Directional Tracking:

1. Do not use on slopes steeper than 3:1.

2. Operate tracked equipment up and down exposed slope to create ridges perpendicular to the slope.

3. Continue operation until the entire surface has been tracked.

3.23 SURFACE ROUGHENING (Continued)

B. Grooving/Furrowing:

1. May be used on all slopes.

2. Use rippers, disks, harrows, chisel plows, or other equipment capable of operating on the slope and creating grooves a maximum of 15 inches apart and 3 inches deep.

3. Operate equipment along the contour of the slope to create grooves that are perpendicular to the slope.

4. Perform over all exposed slopes as specified.

3.24 INLET PROTECTION

A. Install inlet protection devices according to the manufacturer's recommendations.

B. Remove the accumulated sediment, as required to maintain the inlet protection device in working order. Remove any accumulated sediment from streets open to traffic if it encroaches into the traveled roadway.

3.25 FLOW TRANSITION MATS

Install according to the manufacturer's published recommendations.

3.26 TEMPORARY EROSION CONTROL SEEDING

Comply with Section 9010.

END OF SECTION

2.04 FINISH (Continued)

b. Application:

1) Apply coating to the thickness specified by the coating manufacturer. Comply with coating manufacturer's recommendations for application of powder coating.
2) Apply coating in uniform thickness coats without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

4. Curing: Cure the powder coating at the temperature and for the time recommended by the powder coating manufacturer.

2.05 ATTACHMENT

A. Bolted Connection:

1. Anchor plate: 1/4 inch thick, 6 inch by 6 inch steel anchor plate with a 46,000 psi yield strength. Paint or galvanize anchor plate to match handrail or safety rail.

2. Bolts: Provide 3/8 inch galvanized anchor bolts or threaded rod with length as required to provide a 3 inch embedment. Comply with ASTM A 36.

3. Adhesive Anchoring Material:

a. Epoxy complying with ASTM C 881, Type IV. Provide appropriate epoxy class based upon concrete temperature at time of installation.
b. Grout on approved products list in Iowa DOT Materials I.M. 491.11, Appendix C.

B. Grouted Connection:

1. Polymer Grout: Comply with Iowa DOT Materials I.M. 491.11.

2. Non-shrink Grout: Comply with Iowa DOT Materials I.M. 491.13.

PART 3 - EXECUTION

3.01 INSTALLATION OF STEPS

A. Prepare Subgrade: In fill areas, construct and compact subgrade to 95% of maximum Standard Proctor Density.

B. Forming: Comply with Iowa DOT Article 2403.03, B.

C. Concrete: Comply with Section 6010, 3.02. Deposit concrete for the full depth of the steps in one operation.

D. Reinforcing Steel: Comply with Iowa DOT Section 2404. Provide a minimum 2 inches of cover on all reinforcing steel.

3.02 INSTALLATION OF RAIL

A. General:

1. Install rail continuously with no gaps or breaks along the length specified in the contract documents.

2. Use welded connections between rail components. Grind connections to remove sharp or abrasive edges and to remove other irregularities.

B. Handrail: Install the top rail between 34 inches and 38 inches above the nose of the step tread. Maintain a consistent height above the step treads. Install the bottom rail midway between the nose of the step and the top rail.

C. Safety Rail:

1. **Rails:** Install the top rail a minimum of 42 inches above the finished grade. Install the bottom rail a maximum of 4 inches above finished grade.
2. **Pickets:** Locate pickets in the center of the top and bottom rails and space evenly between posts. Provide a maximum clear opening between pickets of 4 inches.

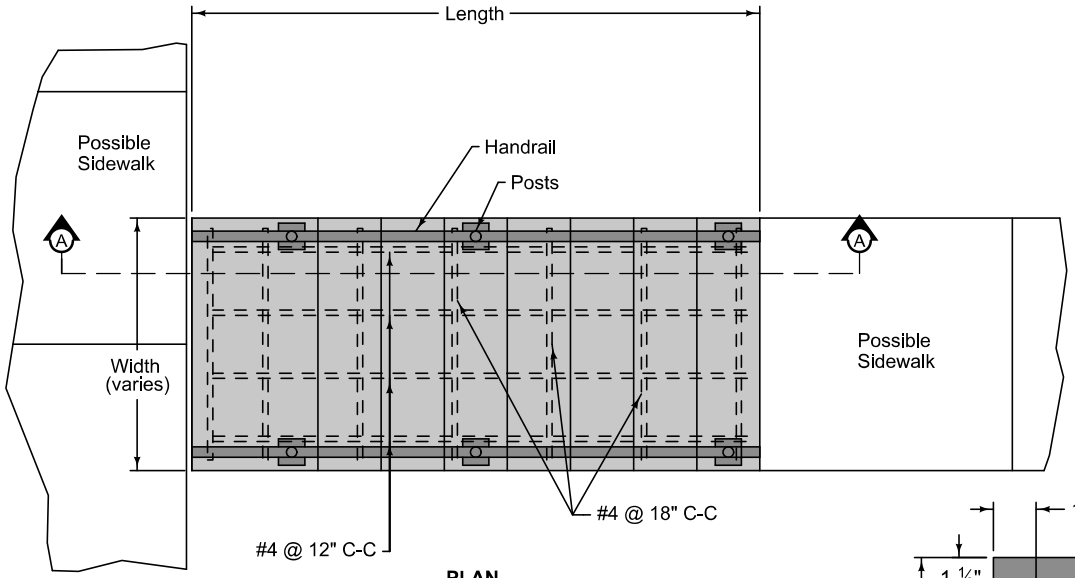
D. Posts: Install posts at a maximum spacing of 8 feet. Attach handrail posts in one of following two ways.

1. Bolted Connection:

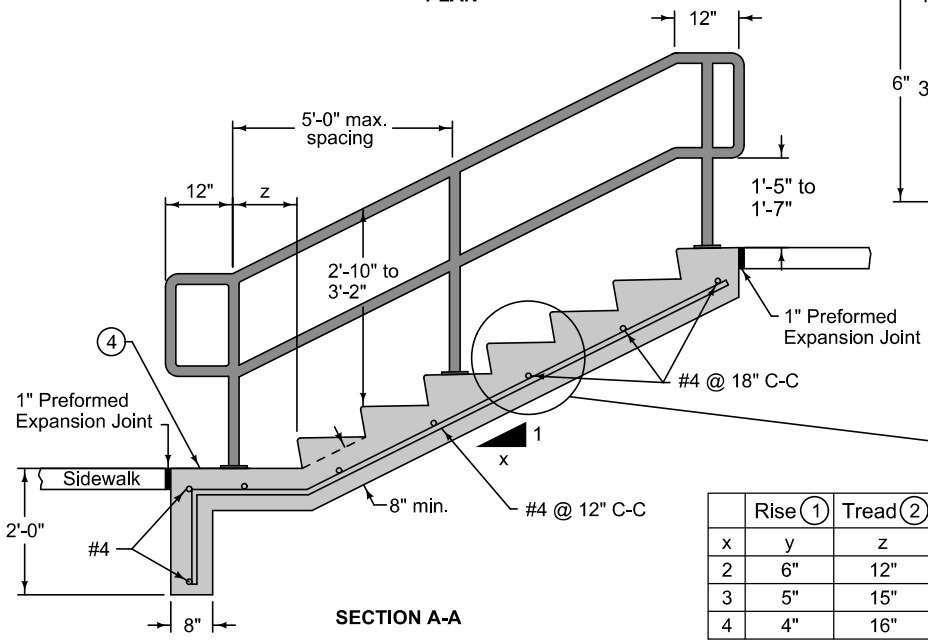
a. Weld anchor plate to the bottom of the handrail posts.
b. Layout location and drill four 7/16 inch holes for anchor bolts at each post attachment point. Drill holes with a carbide drill bit; do not core drill anchor bolt holes.
c. Apply adhesive anchoring material according to manufacturer's published recommendations and install threaded rod or anchor bolts.

2. Grouted Connection:

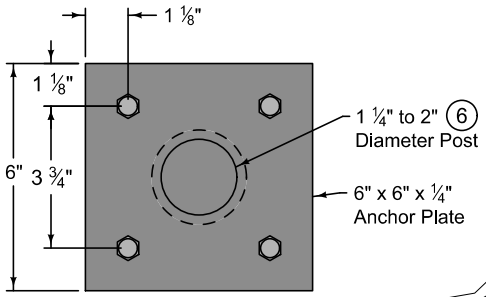
a. Form a 6 inch deep hole in the concrete curb 1 inch larger than the outside diameter of the post. Alternatively, hole may be core drilled in hardened concrete.
b. After the concrete hardens, set handrail posts into holes and temporarily secure.
c. Fill the void between the post and holes with non-shrink or polymer grout.



PLAN

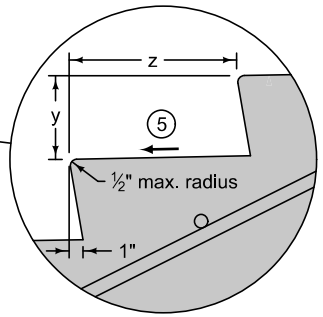


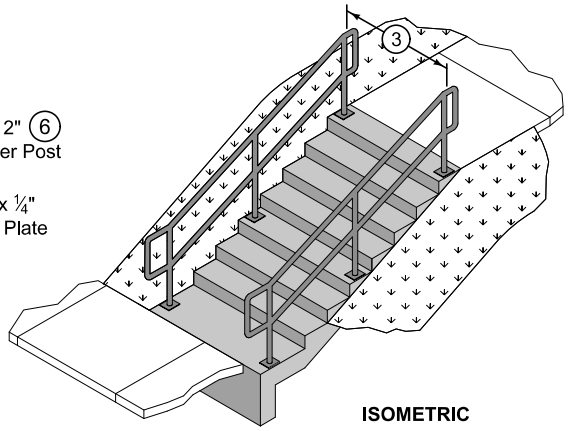
SECTION A-A



ANCHOR PLATE DETAIL

	Rise (1)	Tread (2)
x	y	z
2	6"	12"
3	5"	15"
4	4"	16"





ISOMETRIC

Provide a minimum of 2 inches of cover for all reinforcing.

Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

(1) Minimum riser height is 4 inches. Maximum riser height is 7 inches.

(2) Minimum tread depth is 11 inches.

(3) Match existing sidewalk width.

(4) Construct cross slope of landing to match adjacent sidewalk.

(5) Slope tread 1% minimum to 2% maximum in any direction.

(6) Weld post to anchor plate with 1/4 inch weld. Grind weld to provide smooth surface, free of burrs.

FIGURE 9080.101

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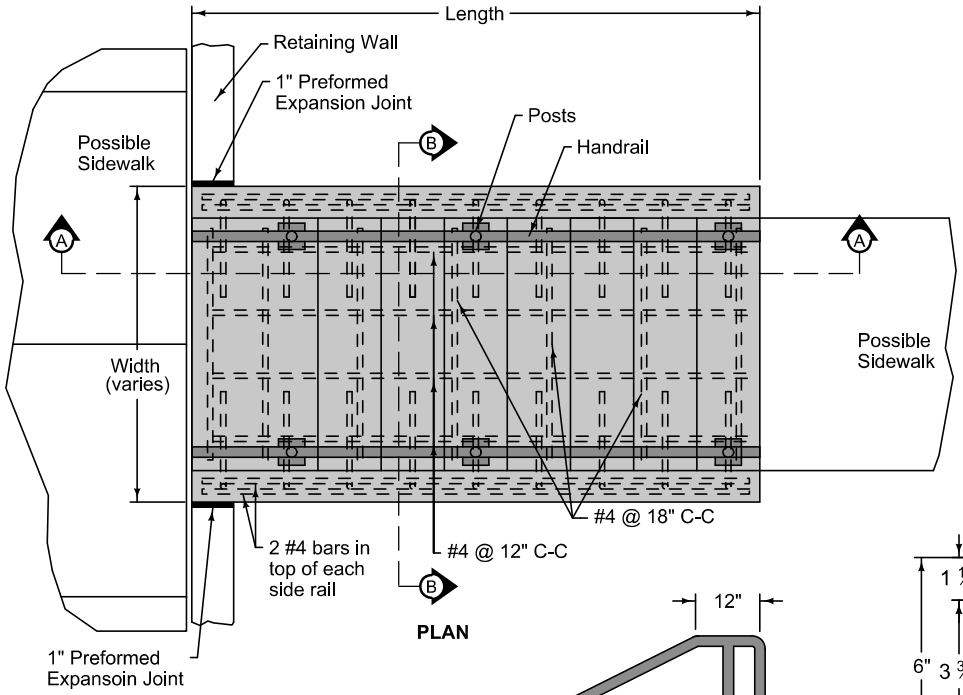
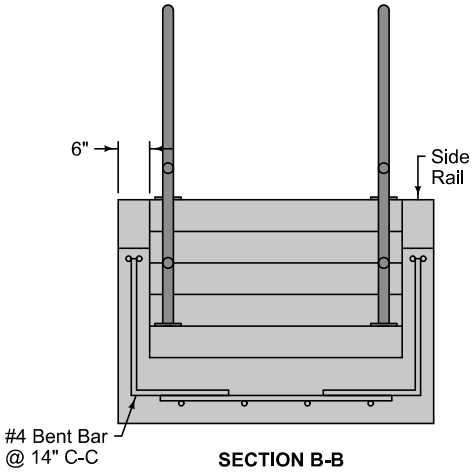
TYPE A CONCRETE STEPS WITH HANDRAIL



PLAN

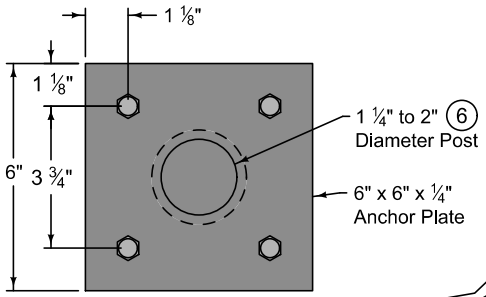


SECTION B-B

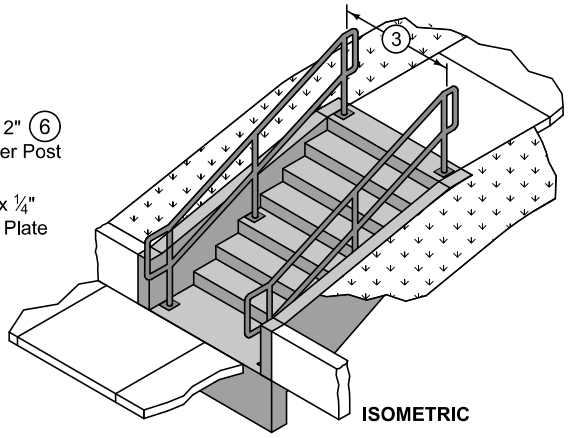
Provide a minimum of 2 inches of cover for all reinforcing.

Ensure all risers are an equal height and all treads are an equal depth within a flight of stairs.

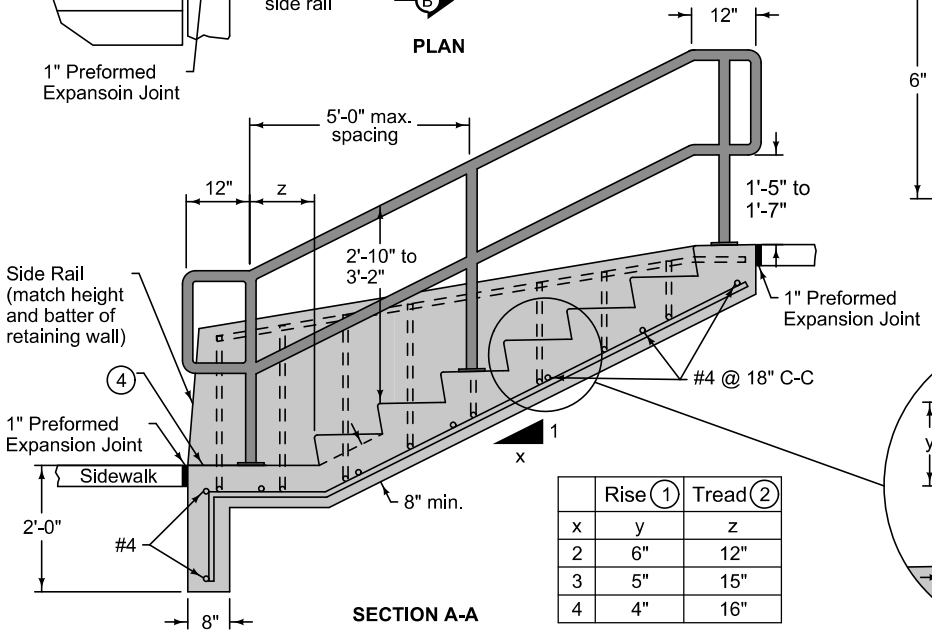
1. Minimum riser height is 4 inches. Maximum riser height is 7 inches.
2. Minimum tread depth is 11 inches.
3. Match existing sidewalk width.
4. Construct cross slope of landing to match adjacent sidewalk.
5. Slope tread 1% minimum to 2% maximum in any direction.
6. Weld post to anchor plate with 1/4 inch weld. Grind weld to provide smooth surface, free of burrs.



ANCHOR PLATE DETAIL

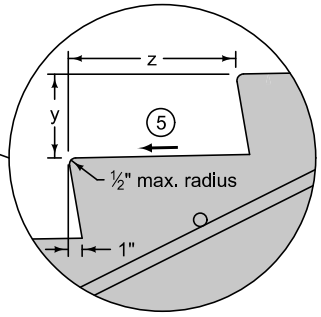


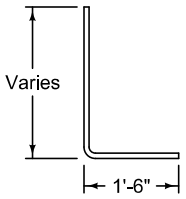
ISOMETRIC



SECTION A-A

	Rise (1)	Tread (2)
x	y	z
2	6"	12"
3	5"	15"
4	4"	16"





BENT BAR

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TYPE B CONCRETE STEPS WITH HANDRAIL

FIGURE 9080.102

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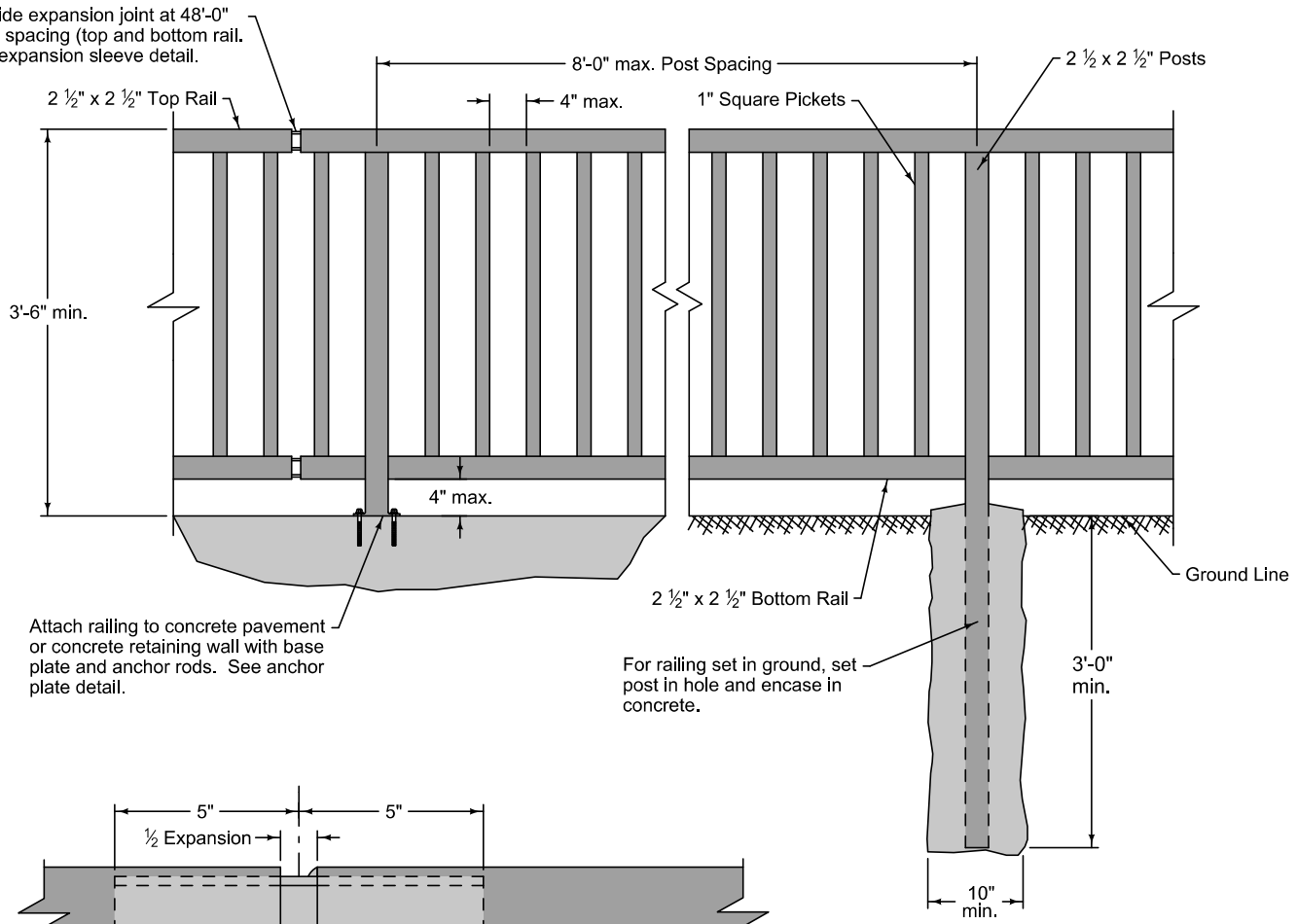
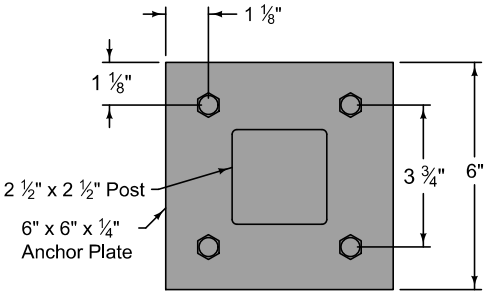


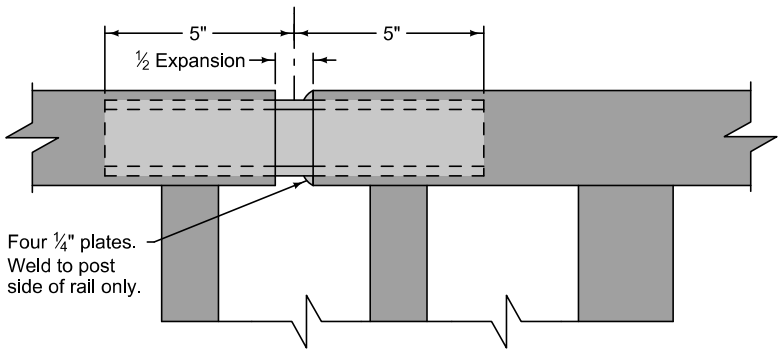
Weld all components with 1/4 inch fillet welds. Grind welds and connections as requried to provide a smooth surface, free of burrs.

Field paint safety rail after installation as specified in the contract documents.

(1) Detail shown is for top rail. Expansion joint for bottom rail is similar.



ANCHOR PLATE DETAIL



EXPANSION SLEEVE DETAIL (1)

FIGURE 9080.103

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SAFETY RAIL