Annual Revisions to the SUDAS Standard Specifications
2022 Edition

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

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

Division	***Section***	***pg #***	***Summary of Revision(s)***
Manual introductory info			Updated the Contributors and Acknowledgments and the General Table of Contents pages. *Note - if you want to replace the small business card for the spine of your manual, you can print a copy from our website.*
1	1010, 1.02	1-2	Added abbreviations for API and NPDES.
	1090, 1.04, C	1-2	Added standard markup for the general contractor when subcontractor executes an extra work order.
2	Table of Contents	i	Updated Table of Contents based on changes made to Division 2.
	2010	3-14	Added bid items for option to provide topsoil, updated topsoil information, and other minor revisions.
3	3020, 2.01 and 2.02	1-2	Added fusible pipe as an option. Added equivalent material to improve availability and potentially reduce costs.
4	4010, 2.01 and 2.02	5-8	Modified HDPE liner thickness and joint requirements to include additional products. Added fusible PVC and HDPE pipe.
	4050, 3.01, D, 1	11-12	Minor revision.
5	Table of Contents	i-iv	Update Table of Contents based on changes made to Division 5.
	5010, 1.08 and 3.10-3.12	3-13	Added abandonment and removal as options for water mains.
	5011	ALL	Added new section on fusible pipe.
	5020	ALL	Replace ENTIRE SECTION with enclosed pages (INCLUDING figure). Added alternate fire hydrant assembly option. Added language to ensure the anchor tee and hydrant locations are specified.
	5030, 3.01-3.09	3-6	Updated testing procedures to match AWWA C651.
6	6010, 2.09, A	5-6	Added softening point requirement for use of high density polyethylene adjustment rings in asphalt.
	Figure 6010.545	1-4	(Starts on the back of Figure 6010.542, sheet 4; ends with Figure 6010.601, sheet 1 on the back). Clarified labeling of rebar.
7	Table of Contents	iii-iv & xiii	(Replace pages iii-iv; page xiii is new). Updated Table of Contents based on changes made in Division 7.
	7010, 2.01, 3.01, & 3.02	5-14	Various PCC paving updates. Added note for top of curb to drain to street when adjacent to Class A sidewalk.
	Figure 7010.101	1-8	(Ends with Figure 7010.102, sheet 1 on the back). Minor formatting correction.
	Figure 7010.103	1	Added requirement for minimum amount of concrete outside of casting when it is not centered.
	Figure 7010.901	1	The transverse joint spacing for pavements > 10" should be 17' (changed w/2020 Edition).
	7011, 3.02, J, 1, e	7-8	PCC paving updates.

7 (con't)	Figure 7020.201	1	(Ends with Figure 7020.901, sheet 1 on the back). Added requirement for minimum amount of concrete outside of the casting when it is not centered. Added use of 'B' joint for post PCC construction cut and extracted boxouts.
	Figure 7020.902	1	No changes to this figure; reissuing to remove figure from back.
	Figure 7020.903	1	(Figure was formerly 3 sheets and has been reduced to 1). Moved sheets 2 and 3 to new Figure 7021.101.
	Figure 7021.101 (new)	1-2	Added details formerly included on Figure 7020.903 as they are related to overlays.
	Figure 7030.101	1	Added information on the slope of the curb transition at driveways.
	Figure 7030.102	1	Added information on the slope of the curb transition at driveways.
	Figure 7030.201	1	Added note for top of curb to drain to street when adjacent to Class A sidewalk.
	Figure 7030.202	1	Added note for top of curb to drain to street when adjacent to Class A sidewalk.
	Figure 7030.208	1	Shading is missing from the turning space.
	7040, 3.03, B, 5	9-10	Various PCC paving updates.
	Figure 7040.102	1	Clarified the type of joint to use.
	Figure 7040.105	1	Minor corrections.
	7092 (new)	ALL	Added new section and figure addressing crack and seat projects in urban areas.
8	Table of Contents	i-ii	Updated Table of Contents based on changes made in Division 8.
	8010	ALL	Replace ENTIRE SECTION with enclosed pages (INCLUDING figures). Revised the traffic signal section based on guidance from the SUDAS Traffic Signal Committee.
	8030, 2.03	3-4	Added channelizing devices that comply with NCHRP 350 of MASH-16 (Manual for Assessing Safety Hardware).
9	9020, 2.01, A	3-4	Updated the list of available cultivars for sod.
	9030	ALL	Replace ENTIRE SECTION with enclosed pages (INCLUDING figures). Updated specifications requirements based on industry input.
	9040, 1.08, V	7-8	Provided bid item addition for temporary erosion control to be used when the project will extend over the winter.
	9080, 2.01, B	3-4	Added information for independent staging of steps and wall construction.
	Figures 9080.101	1	No changes to this figure; reissuing to start Figure 9080.102 on the back.
	Figure 9080.102	1-2	(Starts on the back of Figure 9010.101). Added information for independent staging of steps and wall construction.

Contributors and Acknowledgments

In 2021, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2022 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

DEFINITIONS

1.01 DESCRIPTION

Wherever the following definitions, terms, and abbreviations, or pronouns in place of them, are used in the plans, specifications, or other contract documents, the intent and meaning shall be interpreted as specified in this Section.

1.02 ABBREVIATIONS

Wherever in these specifications and contract documents the following abbreviations are used, they shall be understood to mean as follows: The serial designation of each reference shall be the latest year of adoption or revision, unless otherwise specified.

AAN - American Association of Nurserymen
AAR - Association of American Railroads
AASHTO (or AASHO) - American Association of State Highway and Transportation Officials
ACI - American Concrete Institute
AIA - American Institute of Architects
AMG - Automated Machine Guidance
ANSI - American National Standards Institute
API - American Petroleum Institute
APWA - American Public Works Association
ARA - American Railway Association
AREA - American Railway Engineering Association
ASA - America Standards Association
ASCE - American Society of Civil Engineers
ASLA - American Society of Landscape Architects
ASTM - American Society for Testing and Materials
AWPA - American Wood Preservers Association
AWS - American Welding Society
AWWA - American Water Works Association
BSC - Bituminous Seal Coat
CFR - Code of Federal Regulations
CLSM - Controlled Low Strength Material
CMP - Corrugated Metal Pipe
CPM - Critical Path Method
CRSI - Concrete Reinforcing Steel Institute
DIP - Ductile Iron Pipe
DNR - Department of Natural Resources
DOT - Department of Transportation
EEI - Edison Electric Institute
EPA - Environmental Protection Agency
FHWA - Federal Highway Administration
FSS - Federal Specification and Standards
ESAL - Equivalent Single Axle Load
GGBFS - Ground Granulated Blast Furnace Slag
GPS - Global Positioning System
GRI - Geosynthetic Research Institute
HDPE - High Density Polyethylene Pipe
HMA - Hot Mix Asphalt
IAC - Iowa Administrative Code
IEEE - Institute of Electrical and Electronics Engineers
IES - Illuminating Engineering Society
ICEA (or IPCEA) - Insulated Cable Engineers Association
IMSA - International Municipal Signal Association, Inc.
ISO - Insurance Services Office
ITE - Institute of Transportation Engineers
JMF - Job Mix Formula

1.02 ABBREVIATIONS (Continued)

MAPLE - Materials Approved Product List Enterprise
MGAL - 1,000 Gallons
MUTCD - Manual on Uniform Traffic Control Devices
NEC - National Electrical Code
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NPDES - National Pollutant Discharge Elimination
NSF - National Sanitation Foundation
OSHA - Occupational Safety of Health Administration
PCC - Portland Cement Concrete
PLS - Pure Live Seed
PROWAG - Public Right-of-Way Accessibility Guidelines
PVC - Polyvinyl Chloride
RAP - Recycled Asphalt Pavement
RCAP - Reinforced Concrete Arch Pipe
RCP - Reinforced Concrete Pipe
SAE - Society of Automotive Engineers
SDR - Standard Dimension Ratio
SSPC - Steel Structures Painting Council
SUDAS - Statewide Urban Design and Specifications
SWPPP - Stormwater Pollution Prevention Plan
UL - Underwriters' Laboratories, Inc.
US - United States
USC - United States Code
VCP - Vitrified Clay Pipe

1.03 DEFINITIONS AND TERMS

ADDENDUM. A revision to the contract documents written and issued after the notice to bidders, and prior to the time for receipt of proposals. Changes reflected in the Addendum shall govern over all other contract documents.

ALLEY. See Street.

APPROVED EQUAL (EQUIVALENT). A product, process, equipment, or material that, upon approval of the Engineer, is determined to meet or exceed the requirements called for by the specifications. Upon approval, the item will be allowed in lieu of the specified material, process, equipment, or product.

AWARD. The acceptance of the proposal of the lowest responsive, responsible bidder for the work, which shall not be binding upon the Contracting Authority until the contract for the said work has been executed by the bidder and by the Contracting Authority and bond(s) has been provided by the bidder as required by law.

BID. A properly signed and guaranteed written offer of the bidder containing the bid amount to perform the work. Bid is the same as Proposal.

BID AMOUNT. The aggregate sum obtained by totaling the amounts arrived at by multiplying the quantity of each bid item, as shown in the bid or proposal, by the unit price specified in the proposal for that bid item, including lump sum bid items.

BID ITEM. A specifically described unit of work for which a price is provided in the proposal. A bid item may also be referred to as a contract item.

BID SECURITY. The security furnished by the bidder with its bid as guaranty that the bidder will execute the contract and furnish bond for the work if the proposal is accepted. For bids submitted to governmental entities, the bidder shall furnish bid security as defined in Iowa Code Chapter 26.

MEASUREMENT AND PAYMENT

1.01 MEASUREMENT

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

1.02 SCOPE OF PAYMENT

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

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

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

1.03 LUMP SUM BREAKDOWNS

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

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

1.04 PAYMENT FOR CHANGE ORDERS

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

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

1.04 PAYMENT FOR CHANGE ORDERS (Continued)

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

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

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

C. The percentage markup to be allowed to the Contractor for extra work performed by a subcontractor shall be in accordance with the following:

1. 10% of the first $50,000 with a $100 minimum.

5% of the portion over $50,000.

1.05 PROGRESS PAYMENTS

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

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

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

1.06 PAYMENT OF RETAINAGE

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

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

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1.08 MEASUREMENT AND PAYMENT (Continued)

D. Topsoil:

1. On-site Topsoil:

a. Measurement: Measurement will be in cubic yards 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.

c. Includes: Unit price includes but is not limited to, stripping and stockpiling topsoil; preparing the topsoil placement area by tillage or ripping; re-spreading the topsoil; additional tillage to address compaction during placement; and removal of clods, roots, stones, and other undesirable materials.

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. Overhaul will not be paid.

c. Includes: Unit price includes but is not limited to, preparing the placement area by tillage or ripping and furnishing, transporting, placing, and incorporating compost.

3. Off-site Topsoil:

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

b. Payment: Payment will be at the unit price per cubic yard. Overhaul will not be paid.

c. Includes: Unit price includes, but is not limited to, preparing the placement area by tillage or ripping; furnishing, transporting, and spreading the off-site topsoil; completing tillage to address compaction during placement; and removal of clods, roots, stones, and other undesirable materials.

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.

1.08 MEASUREMENT AND PAYMENT (Continued)

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.

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. Granular Stabilization:

1. Measurement: Measurement will be in tons for the quantity of granular stabilization material required to replace unstable subgrade material removed. Measurement will be based on the scale tickets for the material delivered and incorporated into the project.

2. Payment: Payment will be at the unit price per ton for the quantity of granular stabilization material furnished and placed. Payment is in addition to subgrade preparation and use of other foundation options.

3. Includes: Unit price includes, but is not limited to, removal and disposal of unstable material and furnishing, hauling, placing, and compacting granular stabilization material.

1.08 MEASUREMENT AND PAYMENT (Continued)

I. 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].

J. 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.

K. Removals:

1. Structures:
a. Measurement: Each structure to be removed will be counted.
b. Payment: Payment will be at the unit price for each specified structure removed.
c. Includes: Unit price includes, but is not limited to, removal and disposal of structures.

2. Culverts:
a. Known Box Culverts:
1) Measurement: Each type and size of box culvert removed will be measured in linear feet from end to end along the centerline of the flowline.
2) Payment: Payment will be at the unit price per linear foot for each type and size of box culvert removed.
3) Includes: Unit price includes, but is not limited to, removal and disposal of box culverts.
b. Unknown Box Culverts: Removal of unknown box culverts will be measured and paid as extra work.
c. Known Pipe Culverts:
1) Measurement: Each type and size of pipe culvert removed will be measured in linear feet from end to end at the flowline.
2) Payment: Payment will be at the unit price per linear foot for each type and size of pipe culvert removed.
3) Includes: Unit price includes, but is not limited to, removal and disposal of pipe culverts.
d. Unknown Pipe Culverts: Removal of unknown pipe culverts will be measured and paid as extra work.

1.08 MEASUREMENT AND PAYMENT (Continued)

3. Pipes and Conduits:

a. Known Pipes and Conduits:

1) Measurement: Each type and size of pipe and conduit 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 and conduit removed.

3) Includes: Unit price includes, but is not limited to, removal, disposal, and plugging, if specified, of pipes and conduits.

4) Abandoned Private Utilities: Removal of all private utility lines is the responsibility of the respective utility agency, and will not be measured or paid.

b. Unknown Pipes and Conduits: Removal of unknown pipes and conduits will be measured and paid as extra work.

4. Pavement: Comply with Section 7040.

L. Filling and Plugging of Pipe Culverts, Pipes, and Conduits:

1. Known Pipe Culverts, Pipes, and Conduits:

a. Measurement: Each type and size of pipe culvert, pipe, and conduit filled and plugged will be measured in linear feet from end to end.

b. Payment: Payment will be at the unit price per linear foot for each type and size of pipe culvert, pipe, and conduit filled and plugged.

c. Abandoned Private Utilities: Filling and plugging of all private utility lines is the responsibility of the respective utility agency, and will not be measured or paid.

2. Unknown pipe culverts, pipes, and conduits: Filling and plugging of unknown pipe culverts, pipes, and conduits will be measured and paid as extra work.

M. Compaction Testing:

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

2. If the contract documents specify that the Contractor is responsible for compaction 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 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 TOPSOIL

Use suitable topsoil of uniform quality, free from hard clods, roots, sod, stiff clay, hard pan, stones larger than 1 inch (1/2 inch for turfgrass seeding), lime cement, ash, slag, concrete, tar residue, tarred paper, boards, chips, sticks, or any undesirable material.

Use on-site topsoil, unless compost-amended or off-site topsoil is specified.

A. On-site Topsoil: On-site topsoil material is material excavated from the top 12 inches of the site. Use of on-site topsoil material is subject to the Engineer's approval.

B. Compost-amended On-site Topsoil: Amend low-quality on-site topsoil, not meeting the requirements specified for off-site topsoil, with a minimum of 1 inch of compost for every 3 inches of topsoil. Use compost meeting the requirements of mulch for pneumatic seeding in Section 9010, 2.07.

C. Off-site Topsoil: Contains at least 3% organic matter, according to ASTM D 2974, has a high degree of fertility, is free of herbicides that prohibit plant growth, has a pH level between 6.0 and 8.0, and meets the following mechanical analysis requirements:

Sieve	Percent Passing
1"	100
1/2"	95* to 97*
1/4"	40 to 60
No. 100	40 to 60
No. 200	10 to 30

* 100% for turfgrass

The Engineer will approve the source of off-site topsoil. Surface soils from ditch bottoms, drained ponds, and eroded areas, or soils that are supporting growth of noxious weeds or other undesirable vegetation, will not be accepted. The Engineer will determine if testing is necessary. The Contractor will be responsible for payment of the testing if the off-site topsoil does not meet the above requirements. If the testing verifies the off-site topsoil does meet the above requirements, payment for the testing will be the responsibility of the Jurisdiction.

2.02 EXCAVATION MATERIALS

All project site and borrow excavation will be classified as Class 10, Class 12, or Class 13 as defined below, and as indicated in the contract documents.

A. Class 10 Excavation:

1. Class 10 excavation includes all normal soil such as loam, silt, gumbo, peat, clay, soft shale, sand, and gravel. It includes fragmentary rock handled in the manner normal to this class of excavation.

2. Includes any combination of the above described materials and any other material not classified as Class 12 or Class 13.

2.02 EXCAVATION MATERIALS (Continued)

B. Class 12 Excavation:

1. Material deposits so firmly cemented together that they cannot be removed without continuous use of pneumatic tools or blasting.

2. Class 12 excavation includes the actual measured volume of granite, trap, quartzite, chert, limestone, sandstone, hard shale, or slate in natural ledges or displaced masses.

3. Also includes the estimated or measured volume of rock fragments or boulders that occur on the surface or in subsurface deposits mixed with soil, sand, or gravel when their size, number, or location prevents them from being handled in a manner normal to Class 10 excavation.

C. Class 13 Excavation:

1. Class 13 excavation includes all materials listed under the definitions of Classes 10 and 12, and any other material encountered, regardless of its nature.

2. This classification covers work commonly referred to as "unclassified excavation."

3. The contract documents will specify the limits for Class 13 excavation. Excavation within these limits will not be classified as Class 10 or Class 12 excavation.

D. Unsuitable or Unstable Materials:

1. Material encountered during excavation above or below grade that does not meet the suitable soil requirements in Section 2010, 2.03.

2. Rubbish and debris, including trees, stumps, waste construction materials, scrap metals, and other materials that cannot be buried or used for backfill or topsoil.

3. Moisture content does not determine suitability of materials.

E. Borrow: Unless otherwise provided in the contract documents, when the quantity of fill material required is not available within the limits of the project cross-sections or specific borrow areas as indicated, the Contractor should make up the deficiency from borrow areas provided by the Engineer, or furnish equivalent material from other borrow areas.

2.03 SUITABLE EMBANKMENT MATERIALS

Meet the following requirements for all soils provided for the construction of embankments:

A. Density of 95 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).

B. AASHTO M 145 group index of less than 30.

C. Liquid limit (LL) less than 50.

D. Soils not meeting these requirements are considered unsuitable soils, regardless of classification.

E. For soils to be placed below water, use clean granular material.

2.04 FOUNDATION MATERIALS

A. Select Subgrade Materials:

1. All soils required for select subgrade materials must be approved by the Engineer. Approval of materials and their use will be based on AASHTO M 145.
   a. Cohesive soils must meet all of the following requirements:
      1) 45% or less silt size fraction.
      2) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
      3) Plasticity index greater than 10.
      4) A-6 or A-7-6 soils of glacial origin.
   b. Granular soils must meet all of the following requirements:
      1) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
      2) 15% or less silt and clay.
      3) Plasticity index of 3 or less.
      4) A-1, A-2, or A-3 (0).

2. Crushed stone, crushed PCC, crushed composite pavement, or RAP; mixtures of gravel, sand, and soil; or uniformly-blended combinations of the above; as approved by the Engineer.

3. The Engineer may authorize a change in select subgrade materials subject to materials available locally at time of construction.

B. Granular Stabilization Materials:

1. Clean, crushed stone or crushed concrete, with the following gradation:

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

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

C. Subgrade Treatment:

1. Cement: Meet the requirements of AASHTO M 85 for portland cement.

2. Asphalt: Meet the requirements of AASHTO M 140.

3. Fly ash: Provide Class C meeting the requirements of ASTM C 618 with a minimum of 22% CaO; the Loss of Ignition requirements in Table 1 will not apply. Approval of source required.

4. Lime: Hydrated lime should meet requirements of ASTM C 207, Type N or AASHTO M 216, and others.

2.04 FOUNDATION MATERIALS (Continued)

5. Geogrid:

a. Rectangular or Square: Use an integrally-formed grid structure manufactured of a stress-resistant polypropylene material. Use Type 1 geogrid, unless Type 2 is specified. Meet the following minimum physical properties:

Table 2010.02: Geogrid (Rectangular or Square)

Property	Test Method	Units	Type 1[1]	Type 2
Aperture stability modulus at 20 kg-cm	Kinney[2] - 01	kg-cm/deg	3.2	6.5
Minimum true initial modulus in use				
Machine direction (MD)	ASTM D 6637	lb/ft	15,080	32,890
Cross Machine direction (CMD)			20,560	44,725
Tensile strength, 2% strain				
MD	ASTM D 6637	lb/ft	270	410
CMD			380	590
Junction efficiency	GRI-GG2-87	%	93	93
Flexural rigidity	ASTM D 1388	mg-cm	250,000	750,000
Aperture size				
Minimum	N/A	in.	0.5	0.5
Maximum			2.0	2.0

[1] Geogrids meeting the requirements of Iowa DOT Article 4196.01, B and Materials I.M. 496.01 will be acceptable.
[2] Dr. Thomas C. Kinney, P.E. and US Army Corps of Engineers.

b. Triangular: Use punched and drawn polypropylene that is oriented in three substantially equilateral directions. Meet the following minimum physical properties:

Table 2010.03: Geogrid (Triangular)

Property	Test Method	Units	Type 3	Type 4
Aperture stability modulus at 5 kg-cm	Kinney[1] - 01	kg-cm/deg	3.0	3.6
Resistance to loss of load capacity				
Chemical resistance	EPA 9090 Immersion	%	90-100	90-100
Ultra-violet light and weathering (500 hrs)	ASTM D 4355			
Junction efficiency	GRI-GG2-87 GRI-GG1-87	% of ultimate tensile strength	93	93
Radial stiffness	ASTM D 6637	lb/ft @ 0.5% strain	15,000	20,000
Rib Pitch				
Longitudinal	N/A	in.	1.5-1.75	1.5-1.75
Diagonal				
Mid-rib depth	N/A	in.	0.04-0.06	0.05-0.08
Mid-rib width	N/A	in.	0.035-0.05	0.035-0.055

[1] Dr. Thomas C. Kinney, P.E. and US Army Corps of Engineers.

6. Geotextiles: Use a woven or non-woven permeable fabric, manufactured of polymer fibers, meeting the requirements of ASTM D 4439.

2.04 FOUNDATION MATERIALS (Continued)

D. Subbase:

1. Special Backfill:
   a. Comply with Iowa DOT Specifications Section 4132. The quality requirements of Iowa DOT Materials I.M. 210 for recycled pavements are waived.
   b. The Engineer may authorize a change in gradation subject to materials available locally at time of construction.

2. Granular Subbase:
   a. Comply with Iowa DOT Specifications Section 4121.
   b. The Engineer may authorize a change in gradation subject to materials available locally at time of construction.

3. Modified Subbase:
   a. Comply with Iowa DOT Specifications Section 4123.
   b. The Engineer may authorize a change in gradation, subject to materials available locally at time of construction.

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Notification: Notify the Engineer prior to start of clearing and grubbing activities.

B. Tree Cutting:

1. **October 1 through March 31:** No restrictions on tree cutting.

2. **April 1 through September 30:** Cut trees only after authorized by the Engineer and upon receiving a copy of the Determination of Effect indicating no affect to threatened or endangered species is expected within the work area.

C. Removal: Remove the following items:

1. Trees and stumps, including roots, to a depth of at least 12 inches. Place backfill to fill the hole.

2. Logs and downed timber.

3. Hedge rows, brush, field fence, and agricultural products.

4. Vegetation and rubbish.

5. Other objectionable materials.

D. Disposal: Material from clearing and grubbing may be removed according to Iowa Code 335 and must meet local ordinances.

1. Process by chipping logs, downed timber, or brush for mulching material; or salvage logs and downed timber for firewood.

2. Other vegetation, including corn stubble, may be disked into the existing soil if approved by the Engineer.

3. Haul vegetative materials from clearing and grubbing that are not handled on the project to a yard waste disposal site.

4. Remove field fence and other non-vegetative materials from the project.

3.02 TOPSOIL

Prior to placement of all types of topsoil, finish excavation and embankment work according to the specified grades and cross-sections considering topsoil requirements; grade and slope all surfaces to drain away from buildings and prevent ponding. Conform to the grading plan within ± 2 inches. Till or rip constructed surface to a minimum depth of 4 inches to reduce compaction prior to topsoil placement.

A. On-Site Topsoil:

1. **Stripping and Salvaging:**
   a. Mow all weeds, grass, and growing crops or other herbaceous vegetation close to the ground and remove from the site. Shred sod by shallow plowing or blading and thorough disking. Thoroughly shred to allow the soil to be easily spread in a thin layer over areas to be covered. If allowed by the Engineer, herbicides may be applied, and vegetation may be incorporated into the topsoil.

3.02 TOPSOIL (Continued)

b. Remove an adequate amount of topsoil from the upper 12 inches of existing on-site topsoil to allow finish grading with a finished grade of 8 inches of salvaged topsoil. The topsoil may be moved directly to an area where it is to be used, or may be stockpiled for future use.

2. Spreading and Finish Grading:

a. Place topsoil at least 8 inches deep; smooth and finished grade according to the contract documents.

b. After finish grading the topsoil, till surface to a minimum depth of 4 inches. Remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (1/2 inch for turfgrass).

B. Compost Amended Topsoil: Furnish and spread compost a uniform thickness blended according to Section 2010, 2.01. Incorporate compost into underlying soil. Grade the compost amended soil. Till area a minimum depth of 4 inches to loosen surface from compaction during placement. Remove clods and stones and other undesirable materials.

C. Off-site Topsoil: Transport and spread 8 inches of approved off-site topsoil, unless otherwise specified. Grade and till the area a minimum depth of 4 inches to loosen surface from compaction during placement. Remove clods, lumps, roots, litter, other undesirable material, or stones larger than 1 inch (1/2 inch for turfgrass).

3.03 EXCAVATION

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

B. Pavement Removal:

1. Cut surface pavement to full depth as required, and at designated removal lines.

2. Remove all pavement materials.
   a. If specified in the contract documents or allowed by the Engineer, process for re-use.
   b. Dispose of excess material as follows:
      1) Use as unsuitable soil according to this section.
      2) If specified in the contract documents, deliver and stockpile at a site designated by the Engineer.
      3) Otherwise, properly dispose of off-site.

3. Remove pavement material broken or damaged by the Contractor beyond designated removal lines to new line designated by the Engineer, and replaced at the Contractor′s expense.

4. Protect subgrade beneath existing pavement removal areas.

C. Excavation: Perform Class 10, 12, or 13 grading, as specified in the contract documents, to the prescribed grade.

D. Shaping of Borrows:

1. Ensure that borrow areas provided by the Contractor are regular in cross-section to allow accurate measurement.

2. Ensure that care is taken to blend to natural land forms and avoid unnecessary damage to the land.

3. Do not divert natural drainage of surface water onto adjoining owners, and be diligent in draining the surface water in its natural course or channel.

3.03 EXCAVATION (Continued)

4. Complete excavation in a way consistent with the existing natural drainage conditions.

E. Drainage:

1. Provide temporary drainage facilities to prevent damage to public or private interests when necessary to interrupt natural drainage or flow of artificial drains.

2. Restore original drainage as soon as work allows.

3. The Contractor is responsible for damage resulting from their neglect to provide erosion control or artificial drainage.

F. Unsuitable or Unstable Materials:

1. Remove unsuitable or unstable materials to a depth specified in the contract documents, or as directed by the Engineer.

2. The Engineer will determine the need for and type of backfill material, including select soil or granular subbase.

3. Remove all soft areas. Replace with approved materials.

4. If subbase materials are used, provide weight tickets at the time of delivery.

5. Dispose of unsuitable or unstable materials according to the requirements in this section.

G. Removal of Boulders: Remove all boulders with a minimum diameter of 6 inches.

H. Rock Excavation:

1. When excavation to the subgrade elevation results in a surface consisting of loose or solid rock:
   a. Excavate 1 foot below the finished subgrade elevation.
   b. Construct subgrade with suitable material.
   c. Conduct operations so the Engineer is given the opportunity to measure cross-section before placement of subgrade material.

2. When pre-splitting of rock cuts is necessary, the limits of the area and the procedure used will be subject to the approval of the Engineer.

3. Dispose of rocks and boulders 6 inches in diameter and greater off-site.

I. Removal or Filling of Pipe Culverts, Pipes, and Conduits: Remove, plug, and/or fill with flowable mortar, as directed by the Engineer.

3.04 EMBANKMENT CONSTRUCTION

A. Notification: Notify the Engineer prior to start of embankment activities.

B. Site Preparation:

1. Remove all ground cover from the area.

2. When an embankment is placed on or against an existing slope that is steeper than 3:1 and is more than 10 feet high, cut the slope into steps as the construction of the new embankment progresses. The steps should ensure that all sod or other potential sliding surfaces are removed. Cut each step or series of steps to approximate horizontal planes which have vertical slope dimensions of at least 3 feet.

TRENCHLESS CONSTRUCTION (BORING, JACKING, AND TUNNELING)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trenchless Installation of Carrier Pipe with Casing Pipe

B. Trenchless Installation of Carrier Pipe without Casing Pipe

1.02 DESCRIPTION OF WORK

A. Excavate launching and receiving pits.

B. Install casing or carrier pipe by trenchless methods.

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

D. Place backfill material in excavations.

E. Surface restoration for areas removed to determine utility locations.

1.03 SUBMITTALS

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

A. Proposed installation methods and equipment.

B. Gradation reports for bedding materials if required.

C. Shop drawings of casing spacers and proposed spacing.

D. Dewatering plan (if required).

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

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

PART 2 - PRODUCTS

2.01 CARRIER PIPE

A. Carrier Pipe Installed within Casing Pipe:

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

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

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

4. **Culverts:** Comply with Section 4030, 2.01.

5. **Water Main:**
   a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 5010, 2.01.
   b. **Restrained Joint PVC Pipe:** Comply with Section 5010, 2.01.
   c. **Fusible Pipe:** Comply with Section 5011, 2.01.

B. Carrier Pipe Installed without a Casing Pipe:

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

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

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

4. **Water Main:**
   a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 5010, 2.01.
   b. **Restrained Joint PVC Pipe:** Comply with Section 5010, 2.01.
   c. **Fusible Pipe:** Comply with Section 5011, 2.01.

2.02 CASING PIPE

A. Pipe: Use only new, steel pipe meeting the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; ASTM A 53, Grade B; or API 5L X Grade. Pipe may be welded or seamless. Wall thickness will be as specified in the contract documents.

B. Joints:

1. Comply with American Welding Society Code D1.1. Weld all joints with full penetrating weld. Welders must be qualified according to Iowa DOT Article 2408.03, B. Welds must comply with Iowa DOT Materials I.M. 558.

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

PART 2 - PRODUCTS

2.01 SANITARY SEWER (Gravity Mains)

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

1. Comply with ASTM D 3034, SDR 26, unless SDR 35 is specified.

2. Pipe stiffness per ASTM D 2412.
   a. SDR 26: Minimum pipe stiffness of 115 psi.
   b. SDR 35: Minimum pipe stiffness of 46 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12454 or 12364.

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

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

1. Comply with ASTM F 679.

2. Pipe stiffness per ASTM D 2412, 46 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12454 or 12364.

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

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

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

2. Pipe stiffness per ASTM D 2412.
   a. 8 inch to 10 inch: Minimum pipe stiffness of 115 psi, unless 46 psi is specified.
   b. 12 inch to 36 inch: Minimum pipe stiffness of 46 psi.

3. PVC resin meeting ASTM D 1784, Cell Classification 12454.

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

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

1. Comply with ASTM F 1803.

2. Pipe stiffness per ASTM D 2412, 46 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12364.

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

2.01 SANITARY SEWER (Gravity Mains) (Continued)

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

1. Comply with ASTM D 2680. Pipe constructed with truss-type structure between inner and outer PVC walls with voids filled with lightweight concrete.

2. Pipe stiffness per ASTM D 2412, 200 psi.

3. PVC plastic meeting ASTM D 1784, Cell Classification 12454.

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

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

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

2. Pipe Lining:
a. Epoxy Coal Tar:
1) Coat interior pipe barrel and all joint surfaces with two-component coal-tar epoxy-polyamide black paint or approved equal.
2) Lining Material: Steel Structures Painting Council (SSPC) Specification No. 16, Table 1.
a) Minimum epoxy resin content 34% to 35% by dry film weight.
b) Minimum sag resistance 40 mils.
c) Minimum solids 80% by volume.
3) Apply according to lining material manufacturer's recommendations.
b. PVC:
1) Minimum thickness of 0.65 inch.
2) Locking extensions extruded from the same material as the liner a minimum of 0.375 inches tall spaced a maximum of 2.5 inches.
3) Liner to cover the entire interior of the concrete pipe.
4) Minimum tensile strength of liner is 2200 psi with a minimum elongation of 200% at breaking.
5) Meet EPA 9090 for chemical resistance.
6) Free of cracks, cleavages, pinholes, or other defects.
7) Joint sealer strip to be from the same material as the liner.
c. HDPE:
1) Minimum thickness of 0.064 inches according to ASTM D5199.
2) Minimum density of 0.90 g/cm^3.
3) Meet EPA 9090 for chemical resistance.
4) Locking extensions made from the same material as the liner with minimum pullout strength of 14,000 pounds per square foot.
5) Free of cracks, cleavages, pinholes, or other defects.
6) Joint sealer strip to be from the same material as the liner.
7) If gasketed joints, comply with ASTM F 477 and ability to withstand a minimum groundwater pressure equal to that of the pipe liner or 20 psi, whichever is greater.

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

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

2.01 SANITARY SEWER (Gravity Mains) (Continued)

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

3. Exterior Coating: Asphalt.

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

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

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

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

1. Pipe and fittings complying with ASTM C 700.

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

3. Test according to ASTM C 301.

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

1. Comply with ASTM F 2764.

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

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

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

1. Comply with ASTM F 2764.

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

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

2.02 SANITARY SEWER FORCE MAINS

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

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

C. Fusible PVC and HDPE Pipe: Comply with the requirements in Section 5011, 2.01.

2.02 SANITARY SEWER FORCE MAINS (Continued)

D. Sewage Air Release Valve:

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

2. **Materials:**
   a. **Body and Cover:**
      1) Stainless Steel: ASTM A 351.
      2) Cast Iron: ASTM A 126, Grade B.
      3) Ductile Iron: ASTM A 536, Grade 65-45-12.
      4) Other corrosion resistant materials.
   b. **Internal Metal Components:** Stainless steel.
   c. **Float:** Stainless steel, ASTM A 240, Type 304 or Type 316, or foamed polypropylene.
   d. **Seal Plug Assembly:** Stainless steel, foamed polypropylene, EPDM rubber, Nitrile (Buna-N) rubber, and reinforced nylon.

3. **Tapping Saddle:** Stainless steel or nylon.

4. **Pit:** Construct according to Figure 4010.202.

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

F. 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.

2.03 CIPP SERVICE REPAIR (Continued)

3. Comply with the following minimum structural properties:

Table 4050.03: Minimum Structural Properties for CIPP Service

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

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

2.04 CHEMICAL GROUT

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

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

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

2.05 SEWER DYE

Provide tracer dye complying with NSF/ANSI 60.

2.06 PIPE REPAIR COUPLINGS FOR SPOT REPAIRS BY PIPE REPLACEMENT

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

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

C. Materials and Manufacturer:

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

2. MIG welds, fully passivated.

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

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

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

2.07 SEWER MAIN PIPE (FOR SPOT REPAIRS)

A. Comply with Section 4010.

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

PART 3 - EXECUTION

3.01 SEWER CLEANING AND INSPECTION FOR REHABILITATION

A. General:

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

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

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

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

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

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

B. Pre-Cleaning Inspection:

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

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

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

C. Pre-Rehabilitation Sewer Pipe Cleaning:

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

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

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

D. Additional Sewer Cleaning:

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

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

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

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

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Section 5030 - **Testing and Disinfection (Continued)** **Page No.**

Part 3 - Execution

1.08 MEASUREMENT AND PAYMENT (Continued)

D. Water Service Stubs by Each:

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

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

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

E. Water Service Stubs by Length:

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

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

3. **Water Service Curb Stop and Box:**
   a. **Measurement:** Each type and size of water service curb stop and box will be counted.
   b. **Payment:** Payment will be made at the unit price for each type and size of water service curb stop and box.

F. Water Main Abandonment, Cap:

1. **Measurement:** Each size and location of water main to be abandoned will be counted.

2. **Payment:** Payment will be made at the unit price for each size and location of water main abandoned.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary); closing valves; removing valve boxes; installing thrust blocks; cutting pipe; installing MJ caps; and furnishing, placing, and compacting backfill material.

1.08 MEASUREMENT AND PAYMENT (Continued)

G. Water Main Abandonment, Fill and Plug:

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

2. **Payment:** Payment will be made at the unit price per linear foot of water main filled and plugged.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary); closing valves; removing valve boxes; installing thrust blocks; cutting and removing the specified section of pipe; furnishing and pumping flowable material to fill the pipe to be abandoned; installing MJ caps; and furnishing, placing, and compacting backfill material.

H. Water Main Removal:

1. **Measurement:** Each size and location of water main to be 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 pipe removed.

3. **Includes:** Unit price includes, but is not limited to, trench excavation (if necessary); closing valves; installing thrust blocks; cutting pipe; installing MJ caps; removal and disposal of all valves and pipe specified for removal; furnishing, placing, and compacting backfill material.

PART 2 - PRODUCTS

2.01 WATER MAIN

A. Polyvinyl Chloride (PVC) Pipe: Comply with AWWA C900 with ductile iron pipe equivalent outside diameters.

1. **Minimum Wall Thickness:**
   - **a. 4 inch through 24 inch sizes:** DR 18.
   - **b. Sizes over 24 inch:** As specified in the contract documents.

2. **Joint Type:** Use push-on joint type, except as otherwise specified in the contract documents or as authorized by the Engineer.
   - **a. Push-on:** According to AWWA C900.
   - **b. Integral Restrained Joint:** AWWA C900 pipe with restraining system manufactured integrally into pipe end.
   - **c. Mechanical Restrained Joint:** Ductile iron mechanical device designed for joint restraint of AWWA C900 pipe complying with the requirements of ASTM F 1674.

3. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. Spigot insertion depth gauge.
   - d. National Sanitation Foundation (NSF) seal.

B. Ductile Iron Pipe (DIP):

1. **Minimum Thickness Class:**
   - **a. 4 inch through 24 inch sizes:** Special thickness Class 52 according to AWWA C151.
   - **b. Sizes over 24 inches:** As specified in the contract documents.

2. **Cement-mortar Lined:** According to AWWA C104 with seal coat.

3. **External Coating:** Seal coat according to AWWA C151.

4. **Joint Type:** Use push-on type, unless otherwise specified in the contract documents or as authorized by the Engineer.
   - **a. Push-on:** According to AWWA C111.
   - **b. Mechanical:** According to AWWA C111.
   - **c. Restrained, Buried:** Pipe manufacturer′s standard field removable system.
   - **d. Restrained, in Structures:** Restraining gland, flanged or grooved/shouldered.
   - **e. Flanged:** According to AWWA C111.
   - **f. Grooved/Shouldered:** According to AWWA C606.
   - **g. Gaskets:** According to AWWA C111.

5. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. Spigot insertion depth gauge.

2.02 BOLTS FOR WATER MAIN AND FITTINGS

Use corrosion resistant bolts.

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

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

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

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

B. Other Bolts and Nuts:

1. Stainless steel.

2. Ductile iron.

3. Zinc, zinc chromate, or cadmium plated.

2.03 FITTINGS

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

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

2. Lined: Cement mortar lined according to AWWA C104 with seal coat or protective fusion bonded coatings per AWWA C116.

3. Wall Thickness: Comply with AWWA C153.

4. Gaskets: Comply with AWWA C111.

B. Flange Adapter:

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

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

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

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

2.03 FITTINGS (Continued)

C. Pipe Coupling:

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

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

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

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

2.04 CONCRETE THRUST BLOCKS

A. Use Iowa DOT Class C concrete.

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

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

2.05 PIPELINE ACCESSORIES

A. Polyethylene Wrap:

1. Comply with AWWA C105.

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

B. Tracer System: Comply with Figure 5010.102.

1. Tracer Wire:
- **a. Open Cut:**
  - **1) Solid Single Copper Conductor:**
    - **a) Size:** #12 AWG
    - **b) Insulation Material:** Linear low-density polyethylene (LLDPE) insulation suitable for direct burial applications
    - **c) Insulation Thickness:** 0.030 inches, minimum
    - **d) Tensile Strength:** 150 pounds, minimum
    - **e) Operating Voltage:** Rated for 30 volts
  - **2) Bimetallic Copper Clad Steel Conductor:**
    - **a) Size:** #14 AWG
    - **b) Rating:** Direct burial
    - **c) Operating Voltage:** Rated for 30 volts
    - **d) Conductivity:** 21%
    - **e) Copper Cladding:** 3% of conductor diameter, minimum
    - **f) Insulation Material:** High density, high molecular weight polyethylene
    - **g) Insulation Thickness:** 0.030 inches, minimum
    - **h) Tensile Strength:** 175 pounds, minimum
- **b. Directional Drilling/Boring:**
  - **1) Bimetallic Copper Clad Steel Conductor:**
    - **a) Size:** #12 AWG
    - **b) Rating:** Direct burial
    - **c) Operating Voltage:** Rated for 30 volts
    - **d) Conductivity:** 21%

2.05 PIPELINE ACCESSORIES (Continued)

e) Copper Cladding: 3% of conductor diameter, minimum
f) Insulation Material: High density, high molecular weight polyethylene
g) Insulation Thickness: 0.045 inches, minimum
h) Tensile Strength: 1,100 pounds, minimum

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

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

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

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

2.06 SPECIAL GASKETS

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

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

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

2.07 WATER SERVICE PIPE AND APPURTENANCES

A. Controlling Standards: Local plumbing and fire codes.

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

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

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

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

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

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

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

2.08 NON-SHRINK GROUT

Comply with Iowa DOT Materials I.M. 491.13.

2.09 CASING PIPE

Comply with Section 3020.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

A. General:

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

B. Trenched:

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

C. Trenchless: Comply with Section 3020.

3.02 ADDITIONAL REQUIREMENTS FOR DIP INSTALLATION

A. Utilize full-length gauged pipe for field cuts. Alternatively, use a MJ gland or other approved method to field-gauge pipe selected for cutting to verify the outside diameter is within allowable tolerances.

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

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

D. Install pipe according to AWWA C600, except as modified herein.

3.03 ADDITIONAL REQUIREMENTS FOR PVC PIPE INSTALLATION

A. Cut the pipe perpendicular to the pipe barrel. Deburr and bevel cut spigot end of the pipe barrel to match factory bevel. Re-mark the insertion line.

B. When connecting to shallow-depth bells, such as on some cast iron fittings or valves, cut the spigot end square to remove factory bevel. Deburr the end and form a partial bevel on the end.

C. Install pipe according to AWWA C605, except as modified herein.

3.04 POLYETHYLENE ENCASEMENT INSTALLATION

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

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

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

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

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

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

3.05 TRACER SYSTEM INSTALLATION

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

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

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

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

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

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

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

3.06 CONFLICTS

A. Horizontal Separation of Gravity Sewers from Water Mains:

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

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

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

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

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

C. Separation of Sewer and Water Main Crossovers:

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

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

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

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

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

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

3.07 TRANSITIONS IN PIPING SYSTEMS

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

3.08 STRUCTURE PENETRATIONS

A. Wall Pipes:

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

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

B. Wall Sleeves:

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

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

3.09 WATER SERVICE STUB

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

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

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

3.10 WATER MAIN ABANDONMENT

Verify with the Engineer that all services are no longer using the main to be abandoned.

A. For Each Pipe to be Abandoned by Capping:

1. Close valves and remove valve boxes as specified in the contract documents.

2. Construct thrust blocks on each end of the active pipes according to Figure 5010.101.

3. Cut pipe to be abandoned a minimum of 5 feet from the closed valve on each end of the active pipes, leaving a minimum of 12 inches of pipe exposed beyond the thrust block.

4. Remove a minimum of 3 feet of the pipe to be abandoned.

5. Install a MJ cap using a retaining gland according to Figure 5010.101 on the end of each pipe to be abandoned and each active pipe.

3.10 WATER MAIN ABANDONMENT (Continued)

B. For Each Pipe to be Abandoned by Filling:

1. Close valves and remove valve boxes as specified in the contract documents.

2. Construct thrust blocks on each end of the active pipes according to Figure 5010.101.

3. Cut pipe to be abandoned a minimum of 5 feet from the closed valve on each end of the active pipes, leaving a minimum of 12 inches of pipe exposed beyond the thrust block.

4. Remove a minimum of 3 feet of the pipe to be abandoned.

5. Install a MJ cap using a retaining gland according to Figure 5010.101 on each pipe to be abandoned and each active pipe.

6. Fill the pipe to be abandoned by pumping with flowable mortar, foamed cellular concrete, or CLSM complying with Section 3010.

3.11 WATER MAIN REMOVAL

Verify with the Engineer that all services are no longer using the main and have been disconnected from the main to be removed.

A. Close valves as specified in the contract documents.

B. Construct thrust block on each end of the active pipes according to Figure 5010.101.

C. Cut pipe to be removed a minimum of 5 feet from the closed valve on each end of the active pipes leaving a minimum of 12 inches of pipe exposed beyond the thrust block.

D. Install a MJ cap using a retaining gland according to Figure 5010.101 at the end of each active pipe.

E. Remove and dispose of water main pipe. Furnish, place, and compact backfill material.

3.12 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

FUSIBLE PVC AND HDPE PIPE

PART 1 - GENERAL

1.01 SECTION INCLUDES

Water Main Pipe

1.02 DESCRIPTION OF WORK

Construct water mains.

1.03 SUBMITTALS

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

A. Pre-Construction:

1. Recommended Minimum Bending Radius
2. Recommended Maximum Safe Pull Force

B. Post-Construction:

Fusion joint report containing the following information:

1. Pipe size and thickness
2. Machine size
3. Fusion technician identification
4. Job identification
5. Fusion joint number
6. Fusion, heating, and drag pressure settings
7. Heat plate temperature
8. Time stamp
9. Heating and cool down time of fusion
10. Ambient temperature

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. Load, off-load, store, and otherwise handle pipe according to the pipe supplier's recommendations. Handle and support pipe with woven fiber pipe slings or approved equal. Do not use handling devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe.

1.05 DELIVERY, STORAGE, AND HANDLING (Continued)

B. Exercise caution to avoid compression, damage, or deformation to the ends of the pipe during transportation to the site and while stored on site.

C. Notify the Engineer of any damaged pipe and remove from the site; do not use in construction unless allowed by the Engineer. Pipe considered as damaged includes the following:

1. Any length of pipe showing a crack.

2. Any length of pipe which has received a blow that may have caused an incident fracture, even though no such fracture is visible.

3. Any length of pipe with a scratch or gouge greater than 10% of the wall thickness.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

Perform thermal fusion of pipe by a Fusion Technician fully qualified by the pipe supplier for the type(s) and size(s) of pipe being used. Ensure qualification is current as of the date of fusion performance on the project.

1.08 MEASUREMENT AND PAYMENT

A. Fusible Water Main:

1. Trenched:
- **a. Measurement:** Each type and size of fusible pipe installed in an open trench will be measured in linear feet along the centerline of the pipe, including the length through the fittings.
- **b. Payment:** Payment will be made at the unit price per linear foot for each type and size of pipe.
- **c. Includes:** Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, performing fusion jointing, placing bedding and backfill material, tracer system, testing, and disinfection.

2. Trenchless:
- **a. Measurement:** Each type and size of fusible 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 fusible pipe.
- **c. Includes:** Unit price includes, but is not limited to, furnishing and installing pipe; performing fusion jointing, trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; tracer system; testing; and disinfection.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Water Main with Casing Pipe:

1. Trenched:

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

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

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

2. Trenchless:

a. Measurement: Each type and size of fusible 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 fusible carrier pipe.

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

PART 2 - PRODUCTS

2.01 WATER MAIN

A. Fusible PVC Pipe: Comply with AWWA C900 with ductile iron pipe equivalent outside diameters.

1. **Minimum Wall Thickness:**
   - **a. 4 inch through 24 inch sizes:** DR 18.
   - **b. Sizes over 24 inch:** As specified in the contract documents.

2. **Pipe Manufacturing:**
   - a. Provide pipe extruded with plain ends square to the pipe, free of any bevel or chamfer, and without bells or gaskets of any kind.
   - b. Pipe for potable water use to be blue in color.

3. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. NSF International (NSF) seal

B. Fusible HDPE Pipe: Comply with AWWA C906 with ductile iron pipe equivalent outside diameters.

1. **Material Designation Code:** PE4710.

2. **Minimum Wall Thickness:** DR 9.
   - a. 4 inch through 24 inch sizes: DR 9.
   - b. Sizes over 24 inch: As specified in the contract documents.

3. **Pipe Manufacturing:**
   - a. Provide pipe extruded with plain ends square to the pipe, free of any bevel or chamfer, and without bells or gaskets of any kind.
   - b. Pipe for potable water use to be black in color with two blue stripes.

4. **Markings on Pipe:**
   - a. Name of manufacturer.
   - b. Size and class.
   - c. NSF International (NSF) seal.

PART 3 - EXECUTION

Comply with Section 5010, Part 3, as well as the following:

3.01 ADDITIONAL REQUIREMENTS FOR FUSIBLE PIPE INSTALLATION

A. General:

1. Thermally butt fuse pipe joints and install pipe complying with the contract documents and the pipe supplier's recommendations.

2. Assemble pipe lengths in the field with butt-fused joints. Whenever possible, fuse and stage pipe lengths in their entirety prior to installation.

3. Handle and install pipe in a manner that does not over-stress the pipe or exceed the recommended bending radius at any time.

4. Where pipe is installed by pulling in tension, do not exceed the safe pulling force at any time.

5. Once pipe installation has commenced, continue the operation without interruption until the entire length of the fused section of pipe is installed.

6. Repair sections of pipe damaged during installation by cutting out the damaged section, facing the two pipe pieces according to the tolerances set by the manufacturer, and then rejoining with standard butt-fused joints.

B. Equipment:

1. **Fusion Machine:** Use fusion machines in good condition, properly equipped and set up for the pipe size being fused, and approved by the pipe supplier for the fusion process. Fusion machines must incorporate the following elements:
   a. **Heat Plate:** Free of any debris, contamination, or deep gouges or scratches; sized appropriately and capable of maintaining a uniform and consistent heat profile and temperature for the pipe being fused.
   b. **Carriage:** Capable of smooth travel with no binding at operating loads.
   c. **Data Logging Device:** Device compatible with the fusion machine and capable of logging a time stamp with heat plate temperature and pressure during the fusion process.

2. **Pipe Rollers:** Provide pipe rollers of sufficient quantity, spacing, and size to assure adequate support and limit excessive sagging of the pipe during handling and installation operations.

3. **Weather Canopy:** Provide a weather protection canopy which allows full motion of the fusion machine during inclement or windy weather or during extreme temperatures.

4. **Infrared (IR) Pyrometer:** For checking pipe and heat plate temperatures.

5. **Facing Blades:** Use blades specifically designed for cutting the fusible pipe being used.

6. **Pipe Pull Heads:** Where applicable, pull pipe utilizing a pull head specifically designed for use with the type of fusible pipe being used. Provide pull head that employs a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.

3.01 ADDITIONAL REQUIREMENTS FOR FUSIBLE PIPE INSTALLATION (Continued)

C. Fusion Process: Prepare and fuse pipe according to the pipe supplier's recommendations as well as the following.

1. Joint Recording: Record and log each fusion joint with a data logging device connected to the fusion machine. Manually log required data not logged electronically and include in the fusion joint report.

2. Joint Finishing: After fusing, grind the external joint bead to a maximum height of 0.1 inch. If required by the contract documents, grind the internal joint bead to a maximum height of 0.1 inch or as specified.

D. Trenched Installation:

1. Do not drop or roll pipe into the trench or excavation.

2. If the length of the fused pipe is longer than what the available equipment can lower into the trench or excavation at one time, stage equipment so that lowering begins at one end of the installation and proceed along the trench or excavation so that the entire fused length is installed without exceeding the minimum bend radius of the fused pipe.

3. Pipe may also be installed by pulling it into the end of the trench via a sloped section that is constructed so as not to exceed the minimum bending radius of the pipe.

4. Bed and backfill fused pipe per the contract documents and all applicable standards.

E. Trenchless Installation:

1. Where applicable, grade the pipe entry area as necessary to provide support for the pipe so as not to exceed the minimum bending radius of the pipe and to allow free movement into the bore hole.

2. Use a swivel attachment between the reaming head and the pipe to minimize torsion stress on the pipe assembly.

F. Pipe Connections:

1. Allow initial lengths of installed pipe to come to thermal equilibrium with the soil temperature at burial depth, by waiting at least 24 hours after installation prior to making connections such as service lines and laterals.

2. Tap pipe only with standard tapping saddles or sleeves designed according to AWWA C605 for PVC and AWWA M55 for HDPE. Do not direct tap fusible pipe.

3. Observe pipe supplier's guidelines for maximum tap size per pipe diameter and follow pipe supplier recommendations for tapping PVC and HDPE.

5. Use tapping bits specifically made for the pipe type being used, such as slotted shell style cutters. Do not use hole saws intended for cutting wood, steel, ductile iron, or other materials.

3.02 TESTING AND DISINFECTION

Test and disinfect according to Section 5030.

END OF SECTION

VALVES, FIRE HYDRANTS, AND APPURTENANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Butterfly Valves

B. Gate Valves

C. Tapping Valve Assemblies

D. Fire Hydrant Assemblies

E. Flushing Devices (Blowoffs)

F. Valve Boxes

1.02 DESCRIPTION OF WORK

Install valves, fire hydrants, and appurtenances for water mains.

1.03 SUBMITTALS

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, as well as the following:

Remove valves, fire hydrants, and appurtenances contaminated with mud and surface water from the site. Do not use in construction unless thoroughly cleaned, inspected, and approved by the owner.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Valve (Butterfly or Gate):

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

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

3. **Includes:** Unit price includes, but is not limited to, all components attached to the valve or required for its complete installation, including underground or above ground operator, square valve operating nut, valve box and cover, valve box extension, and valve stem extension.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Tapping Valve Assembly:

1. **Measurement:** Each size of tapping valve assembly will be counted.

2. **Payment:** Payment will be at the unit price for each tapping valve assembly.

3. **Includes:** Unit price includes, but is not limited to, tapping sleeve, tapping valve, the tap, valve box and cover, valve box extension, and valve stem extension.

C. Fire Hydrant Assembly:

1. **Measurement:** Each fire hydrant assembly will be counted.

2. **Payment:** Payment will be at the unit price for each fire hydrant assembly.

3. **Includes:** Unit price includes, but is not limited to, the fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchoring pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchoring pipe, fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve and appurtenances, except tapping valve assembly if used.

D. Alternate Fire Hydrant Assembly:

1. **Measurement:** Each alternate fire hydrant assembly will be counted.

2. **Payment:** Payment will be at the unit price for each alternate fire hydrant assembly.

3. **Includes:** Unit price includes, but is not limited to, the fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchoring pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchoring pipes, 90 degree bend; fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve and appurtenances, except tapping valve assembly if used.

E. Flushing Device (Blowoff):

1. **Measurement:** Each size of flushing device will be counted.

2. **Payment:** Payment will be at the unit price for each flushing device

F. Valve Box Adjustment, Minor: Measurement and payment for minor adjustment of an existing valve box by raising or lowering the adjustable valve box is incidental.

G. Valve Box Extension:

1. **Measurement:** Each existing valve box adjusted to finished grade by adding a valve box extension will be counted.

2. **Payment:** Payment will be at the unit price for each valve box extension.

1.08 MEASUREMENT AND PAYMENT (Continued)

H. Valve Box Replacement:

1. **Measurement:** Each existing valve box replaced with a new valve box will be counted.

2. **Payment:** Payment will be at the unit price for each valve box replacement.

3. **Includes:** The unit price for each valve box replacement includes, but is not limited to, removal of existing valve box; excavation; furnishing and installing new valve box; backfill; compaction; and all other necessary appurtenances.

I. Fire Hydrant Adjustment:

1. **Measurement:** Each existing fire hydrant adjusted to finished grade by addition of an extension barrel section and stem will be counted.

2. **Payment:** Payment will be at the unit price for each adjustment of an existing fire hydrant.

3. **Includes:** The unit price for each adjustment of an existing fire hydrant includes, but is not limited to, removal and reinstallation of the existing fire hydrant; furnishing and installing the extension barrel section and stem; and all other necessary appurtenances.

J. Fire Hydrant Assembly Removal:

1. **Measurement:** Each fire hydrant assembly removed will be counted.

2. **Payment:** Payment will be made at the unit price for each fire hydrant assembly removed.

3. **Includes:** The unit price includes, but is not limited to, excavation, removal of the fire hydrant, hydrant valve, thrust block, delivery of the fire hydrant assembly to the Contracting Authority (if specified), capping of the pipe, backfill, compaction, and surface restoration to match the surrounding area.

K. Valve Removal:

1. **Measurement:** Each size of valve removed will be counted

2. **Payment:** Payment will be made at the unit price for each size of valve removed.

3. **Includes:** The unit price includes, but is not limited to, excavation, removal of each valve, replacing the removed valve with pipe and connections if required or capping the former valve connection, delivery of the valve to the Contracting Authority (if specified), backfill, compaction, and surface restoration to match the surrounding area.

L. Valve Box Removal:

1. **Measurement:** Each valve box removed will be counted

2. **Payment:** Payment will be made at the unit price for valve box removed.

3. **Includes:** The unit price includes, but is not limited to, excavation, removal of each valve box, delivery of the valve box to the Contracting Authority (if specified), backfill, compaction, and surface restoration to match the surrounding area.

PART 2 - PRODUCTS

2.01 VALVES

A. General:

1. **Valve Body:** Manufacturer's name and pressure rating cast on valve body.

2. **Direction of Opening:** The opening direction is counterclockwise as viewed from the top, unless otherwise specified in the contract documents or as directed by the Jurisdiction.

3. **Joints:**
   a. For buried installations, use mechanical joints per AWWA C111. Comply with Section 5010 for joint nuts and bolts.
   b. For installation within structures, flanged with dimensions and drillings according to AWWA C110 or ANSI B16.1 class 125.

B. Gate Valves:

1. **Standards:** Comply with AWWA C509 (gray iron or ductile iron) or AWWA C515 (ductile iron) and NSF 61.

2. **Stem Seals:** Double O-rings permanently lubricated between seals. Lubricant certified for use in potable water.

3. **External Bolts and Hex Nuts:** Stainless steel according to ASTM A 240, Type 304.

C. Butterfly Valves:

1. **Standards:** Comply with AWWA C504 class 150B (gray iron or ductile iron) and NSF 61.

2. **Stem:** Stainless steel according to ASTM A 240, Type 304, turned, ground, and polished.

3. **For Seat on Body Valves:**
   a. Disc: Ductile iron or gray iron with plasma applied nickel-chromium edge or stainless steel edge according to ASTM A 240, Type 316, and mechanically fixed stainless steel pins.
   b. Seat: Synthetic rubber compound mechanically retained to the body.

4. **For Seat on Disc Valves:**
   a. Disc: Ductile iron according to ASTM A 536 with synthetic rubber compound seat mechanically retained to the disc.
   b. Seat: Continuous Type 316 stainless steel seat.

5. **External Bolts and Hex Nuts:** Stainless steel according to ASTM A 240, Type 304.

D. Tapping Valve Assemblies:

1. **Tapping Valve:** Gate valve complying with AWWA C509 or AWWA C515.

2. **Sleeve:**
   a. Minimum 14 gauge.
   b. Stainless steel according to ASTM A 240, Type 304.
   c. Working pressure 150 psi.
   d. Must fully surround pipe.
   e. Flanged with dimensions and drillings according to AWWA C110 or ANSI B16.1 class 125.

2.01 VALVES (Continued)

3. **Minimum Sleeve Length:** Comply with the following table.

Table 5020.01: Minimum Sleeve Length

Outlet Flange Size	Minimum Sleeve Length
4”	15”
6”	15”
8”	20”
10”	25”
12”	25”
Over 12”	As approved by the Engineer

4. **Gasket:**
   a. To completely surround pipe.
   b. Minimum thickness 0.125 inch.
   c. Use nitrile rubber.

5. **Outlet Flange:**
   a. Stainless steel complying with ASTM A 240, Type 304.
   b. ANSI B16.1, 125 pound pattern.

6. **Hex Nuts and Bolts:** Stainless steel complying with ASTM A 240, Type 304.

7. **Tapping Valve Assemblies:** Use only where specified in the contract documents.

2.02 FIRE HYDRANT ASSEMBLY

A. Material: Comply with AWWA C502.

B. Manufacturers: As allowed by the Jurisdiction or as specified in the contract documents.

C. Features:

1. **Breakaway Items:** Stem coupling and flange.
2. **Inlet Nominal Size:** 6 inch diameter.
3. **Inlet Connection Type:** Mechanical joint.
4. **Hose Nozzles:** Two, each 2 1/2 inches in diameter.
5. **Direction of Opening:** Counterclockwise, unless otherwise specified.
6. **Items to be Specified:** The following items will be specified by the Jurisdiction or in the contract documents.
   a. Operating nut.
   b. Pumper nozzle.
   c. Nozzle threads.
   d. Main valve nominal opening size.

D. Painting:

1. Shop coating according to AWWA C502.

2. Above grade exterior coating type and color will be selected by the Engineer.

E. External Bolts and Hex Nuts: Stainless steel according to ASTM A 193, Grade B 8.

F. Gate Valve: Comply with Section 5020, 2.01.

G. Pipe and Fittings: Comply with Section 5010.

2.03 APPURTENANCES

A. Flushing Device (Blowoff): As specified in the contract documents.

B. Valve Box:

1. Applicability: For all buried valves.

2. Manufacturer: As allowed by the Jurisdiction or specified in the contract documents.

3. Type:
a. In paved areas, use a slide type.
b. In all other areas, use a screw extension type.

4. Material: Gray iron.

5. Cover: Gray iron, labeled "WATER"

6. Wall Thickness: 3/16 inch, minimum.

7. Inside Diameter: 5 inches, minimum.

8. Length: Adequate to bring top to finished grade, including valve box extensions, if necessary.

9. Factory Finish: Asphalt coating.

10. Valve Box Centering Ring: Include in installation.

C. Valve Stem Extension: For all buried valves, provide as necessary to raise 2 inch operating nut to within 3 feet of the finished grade. Stem diameter according to valve manufacturer's recommendations, but not less than 1 inch.

PART 3 - EXECUTION

3.01 GENERAL

A. Install according to the contract documents.

B. Apply polyethylene wrap to all iron pipe, valves, fire hydrants, and fittings.

C. Set tops of valve boxes to finished grade, unless otherwise directed by the Engineer.

D. Check the working order of all valves by opening and closing through entire range. Before opening the valves, check with the Jurisdiction on operating requirements.

E. Test and disinfect all valves, fire hydrants, and appurtenances as components of the completed water main according to Section 5030.

3.02 FLUSHING DEVICE (BLOWOFF)

Install and construct as specified in the contract documents.

3.03 FIRE HYDRANT

A. Install according to Figure 5020.201. Ensure a 3 foot clear space around the circumference of the fire hydrant. Place anchor tee and hydrant in the locations specified in the contract documents.

B. If the fire hydrant valve is positioned adjacent to the water main, attach it to an anchor tee.

C. If the fire hydrant valve is positioned away from the water main, restrain all joints between the valve and water main.

D. Fire Hydrant Depth Setting:

1. Use adjacent finished grade to determine setting depth.

2. Set bottom of breakaway flange between 2 and 5 inches above finished grade.

3. If finished grade is not to be completed during the current project, consult with the Engineer for proper setting depth.

E. Coordinate installation with tracer wire installation.

F. Orient fire hydrant nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb. Set hydrants having two hose nozzles 90 degrees apart with each nozzle facing the curb at an angle of 45 degrees or as directed by the Engineer.

3.04 ADJUSTMENT OF EXISTING VALVE BOX OR FIRE HYDRANT

A. Minor Valve Box Adjustment: For existing adjustable boxes that have sufficient adjustment range to bring to finished grade, raise or lower valve box to finished grade.

B. Valve Box Extension: For existing valve boxes that cannot be adjusted to finished grade, install valve box extensions as required.

C. Valve Box Replacement: For existing valve boxes that cannot be adjusted to finished grade, remove and replace the valve box.

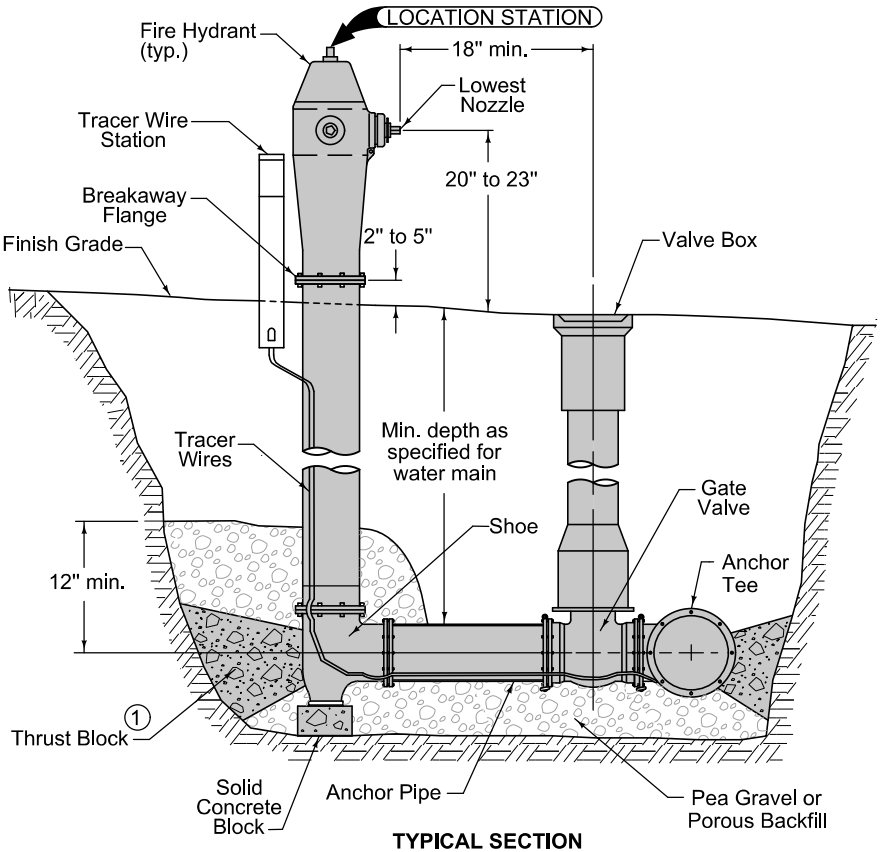
3.04 ADJUSTMENT OF EXISTING VALVE BOX OR FIRE HYDRANT (Continued)

D. Fire Hydrant Adjustment:

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

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

END OF SECTION



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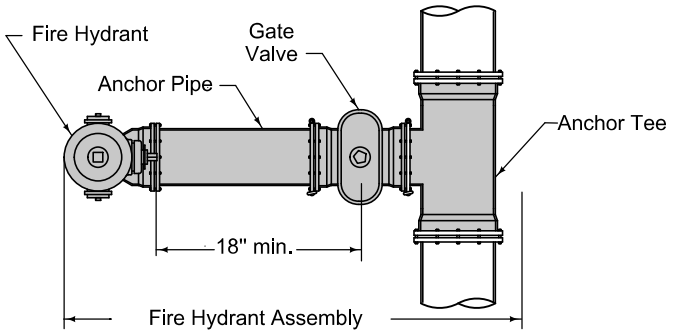
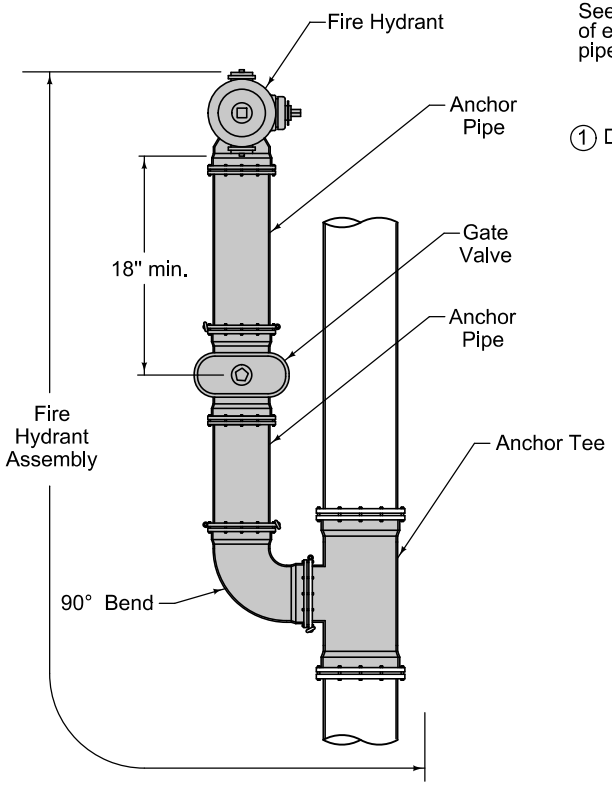


TYPICAL PLAN



ALTERNATE PLAN

Use ductile iron pipe with restrained mechanical joints for fire hydrant assembly and anchor tee.

All shaded items are included in the Fire Hydrant Assembly bid item.

See the contract documents for the location of each hydrant and the length of ancoring pipe.

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

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FIGURE 5020.201 | STANDARD ROAD PLAN | WM-201 | SHEET 1 of 1

REVISIONS: Added general note for location and length.

Paul D. Wigand, SUDAS DIRECTOR | Steven Nichols, DESIGN METHODS ENGINEER

FIRE HYDRANT ASSEMBLY

FIGURE 5020.201 | SHEET 1 OF 1

PART 3 - EXECUTION

3.01 GENERAL

Perform operations according to AWWA C651 in the sequence below. Successfully complete each operation specified in subsections 3.02 through 3.08 below before continuing to the next operation. The Jurisdiction will provide reasonable quantities of water for flushing and testing.

3.02 SEQUENCE OF TESTING AND DISINFECTION

A. Continuous-Feed or Slug Method (After Water Main Installation): The sequence of testing and disinfection may be modified with approval of the Engineer.

1. Perform initial flush.
2. Perform disinfection.
3. Flush after disinfection.
4. Perform pressure and leak testing.

B. Tablet Method (Concurrent with Water Main Installation): Use this method only if approved by the Engineer. Modify the procedure for flushing, disinfection, and pressure and leak testing as needed if tablet method is used.

1. Perform disinfection.
2. Flush after disinfection.
3. Perform pressure and leak testing.

3.03 INITIAL FLUSHING

A. Flushing:

1. Coordinate flushing with the Jurisdiction.
2. Flush pipe prior to disinfection using potable water.
3. Measure flushing velocity.
4. Obtain a minimum flushing velocity of 3 feet per second in the pipe to be disinfected.

B. Minimum Flushing Rate: According to AWWA C651, Table 3, based on 40 psi residual pressure (see table below).

Table 5030.01: Minimum Flushing Rate

Pipe Diameter (inches)	Flow Rate for Flushing (gpm)	Number of Taps[2]			Number of 2 1/2" Fire Hydrant Outlets[1]
		1"	1 1/2"	2"	
4	120	1	-	-	1
6	260	-	1	-	1
8	470	-	2	-	1
10	730	-	3	2	1
12	1,060	-	-	3	2
16	1,880	-	-	5	2

[1]With a 40 psi pressure in the main with the fire hydrant flowing to atmosphere, a 2 1/2 inch fire hydrant outlet will discharge approximately 1,000 gpm; and a 4 1/2 inch fire hydrant outlet will discharge approximately 2,500 gpm.
[2]Number of taps on pipe based on discharge through 5 feet of galvanized iron pipe with one 90° elbow.

3.03 INITIAL FLUSHING (Continued)

C. Property Protection: Protect public and private property from damage during flushing operations.

3.04 PRESSURE AND LEAK TESTING

A. Remove debris from within the pipe. Clean and swab out pipe, if required.

B. Secure unrestrained pipe ends against uncontrolled movement.

C. Isolate new piping from the existing water system.

D. Fill and flush all new piping with potable water. Ensure all trapped air is removed.

E. Pressurize the new pipe to the test pressure at the highest point in the isolated system. Do not pressurize to more than 5 psi over the test pressure at the highest point in the isolated system.

F. Test and monitor the completed piping system at 1.5 times the system working pressure or 150 psi, whichever is greater, for 2 continuous hours.

G. If at any time during the test the pressure drops to 5 psi below the test pressure, repressurize the pipe by pumping in potable water in sufficient quantity to bring the pressure back to the original test pressure.

H. Accurately measure the amount of water required to repressurize the system to the test pressure.

I. Maximum allowable leakage rate:

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

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

The following table assumes an average test pressure (P) of 150 psi and 1,000 feet of test section.

Table 5030.03: Maximum Allowable Leakage Rate

Pipe Diameter (inches)	Allowable Leakage Rate (gallons/hour/1,000 feet of pipe)
4	0.33
6	0.50
8	0.66
10	0.83
12	0.99
14	1.16
16	1.32
18	1.49
20	1.66
24	1.99
30	2.48
36	2.98

3.04 PRESSURE AND LEAK TESTING (Continued)

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

K. If the measured pressure loss does not exceed 5 psi, the test will be considered acceptable.

L. Repair all visible leaks regardless of the amount of leakage.

3.05 DISINFECTION

A. General:

1. Disinfect according to AWWA C651. The tablet method contained in AWWA C651 is not to be used unless approved by the Engineer.

2. Keep piping to be chlorinated isolated from lines in service and from points of use.

3. Coordinate disinfection and testing with the Engineer.

B. Procedure:

1. Induce a flow of potable water through the pipe.

2. Introduce highly chlorinated water to the pipe at a point within 5 pipe diameters of the pipe's connection to an existing potable system, or within 5 pipe diameters of a closed end, if there is no connection to an existing system.

3. Introduce water containing a minimum of 25 mg/L free chlorine until the entire new pipe contains a minimum of 25 mg/L free chlorine.

4. Retain chlorinated water in the pipe for at least 24 hours and no more than 48 hours.

3.06 FINAL FLUSHING

A. Flush pipe using potable water until chlorine residual equals that of the existing potable water system.

B. Dispose of chlorinated water to prevent damage to the environment. Dechlorinate highly chlorinated water from testing before releasing into the ground or sewers. Obtain Jurisdiction approval prior to flushing activities.

1. Check with the local sewer department for the conditions of disposal to the sanitary sewer.

2. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in the following table.

3.06 FINAL FLUSHING (Continued)

Table 5030.02: Amounts of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water

Residual Chlorine Concentration mg/L	Sulfur Dioxide (SO_2) lb	Sodium Bisulfite ($NaHSO_3$) lb	Sodium Sulfite (Na_2SO_3) lb	Sodium Thiosulfate ($Na_2S_2O_3 + 5H_2O$) lb	Ascorbic Acid ($C_6O_8H_6$) lb
1	0.8	1.2	1.4	1.2	2.1
2	1.7	2.5	2.9	2.4	4.2
10	8.3	12.5	14.6	12.0	20.9
50	41.7	62.6	73.0	60.0	104

3.07 BACTERIA SAMPLING

Test water mains according to AWWA C651, except as modified below:

A. Collect samples every 1,200 feet of new water main plus one set from the end of the line and at least one from each branch greater than one pipe length. If trench water entered the new main during construction, or if excessive quantities of dirt and debris entered the main, reduce the sampling interval to every 200 feet of new main.

B. Collect samples according to one of the following methods as directed by the Engineer:

1. Collect an initial set of samples after flushing and then an additional set after a minimum of 24 hours without any water use. The engineer may reduce the sampling interval to 16 hours.

2. Allow water to sit in the new main for a minimum of 16 hours after flushing without any water use. Collect an initial set of samples and allow the sampling ports to run for a minimum of 15 minutes. Collect a second set of samples from the sampling ports.

3.08 RE-DISINFECTION

If the initial disinfection fails to produce satisfactory bacteriological samples, flush the main again and reinitiate the sampling process. If check samples show the presence of coliform organisms, re-chlorinate the main prior to flushing and sampling until satisfactory results are obtained.

3.09 PUTTING WATER MAIN IN SERVICE

Put the completed water system in service only after both sets of bacterial samples have passed and obtaining permission from the Jurisdiction.

END OF SECTION

2.03 CAST-IN-PLACE (Continued)

2. Iowa DOT Materials I.M.s:
a. 316 – Flexural Strength of Concrete
b. 318 – Air Content of Freshly Mixed Concrete by Pressure
c. 403 – Chemical Admixtures for Concrete
d. 528 – Structural Concrete Plant Inspection
e. 529 – Portland Cement Concrete Proportions
f. 534 – Mobile Mixture Inspection

B. Reinforcement: Comply with Iowa DOT Section 4151 for epoxy coated reinforcement.

2.04 NON-SHRINK GROUT

Comply with Iowa DOT Materials I.M. 491.13.

2.05 PRECAST RISER JOINTS

A. Joint Ends:

1. Use tongue and groove ends.

2. If cast-in-place base is used, provide bottom riser with square bottom edge.

B. Joint Sealant:

1. Sanitary Sewers:
a. Rubber O-ring or Profile Gasket: Flexible joint, complying with ASTM C 443.
b. Bituminous Jointing Material: Use a cold-applied mastic sewer joint sealing compound recommended by the manufacturer for the intended use and approved by the Engineer. Comply with ASTM C 990.
c. Butyl Sealant Wrap: Comply with ASTM C 877.

2. Storm Sewers: All joint sealants used on sanitary sewers may also be used for storm sewers. The following may also be used.
a. Rubber Rope Gasket Jointing Material: Comply with ASTM C 990.
b. Engineering Fabric Wrap: If specified in the contract documents, supply engineering fabric wrap complying with Iowa DOT Article 4196.01, B.

2.06 MANHOLE OR INTAKE TOP

A. Capable of supporting HS-20 loading.

B. Use eccentric cone on sanitary sewer manholes unless otherwise specified or allowed.

2.07 BASE

A. Sanitary Sewer Manhole:

1. Circular Manhole: Integral base and lower riser section according to ASTM C 478.

2. All Other Manholes: Use precast or cast-in-place concrete base.

B. Storm Sewer Manhole: Use precast or cast-in-place concrete base.

C. Intake: Use precast or cast-in-place concrete base.

2.08 PIPE CONNECTIONS

A. Flexible, Watertight Gasket: Comply with ASTM C 923.

B. Non-Shrink Grout: Comply with Section 6010, 2.04.

C. Waterstop: Provide elastomeric gasket that surrounds pipe and attaches with stainless steel bands and is designed to stop the movement of water along the interface between a pipe and a surrounding concrete collar.

D. Concrete Collar: Comply with Section 6010, 2.02 and 2.03.

2.09 MANHOLE OR INTAKE ADJUSTMENT RINGS (Grade Rings)

A. Use one of the following materials for grade adjustments of manhole or intake frame and cover assemblies:

1. Reinforced Concrete Adjustment Rings: Comply with ASTM C 478. Provide rings free from cracks, voids, and other defects.

2. High Density Polyethylene Adjustment Rings: Comply with ASTM D 1248 for recycled plastic.
   a. Test and certify material properties by the methods in the following table.

Table 6010.02: Test Methods

Property	Test Method	Acceptable Value
Melt Flow Index	ASTM D 1238	0.30 to 30 g/10 min.
Density	ASTM D 792	0.94 to 0.98 g/cm^3
Tensile Strength	ASTM D 638	2,000 to 5,000 lb/in^2

   b. Do not use polyethylene grade adjustment rings when they are exposed to heat shrink infiltration barriers.
   c. When used in a single configuration, provide tapered adjustment ring with thickness that varies from 1/2 inch to 3 inches.
   d. Install adjustment rings on clean, flat surfaces according to the manufacturer's recommendations. Comply with ASTM D 36 with minimum 350°F softening point for butyl rubber sealant.

3. Expanded Polypropylene Adjustment Rings: Comply with ASTM D 4819 for expanded polypropylene when tested according to ASTM D 3575.
   a. Use adhesive meeting ASTM C 920, Type S, Grade N5, Class 25.
   b. Provide finish rings with grooves on the lower surface and flat upper surface.
   c. Do not use when heat shrinkable infiltration barrier is used.

B. Ensure the inside diameter of the adjustment ring is not less than the inside diameter of the manhole frame or not less than the inside dimension of the intake grate opening.

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

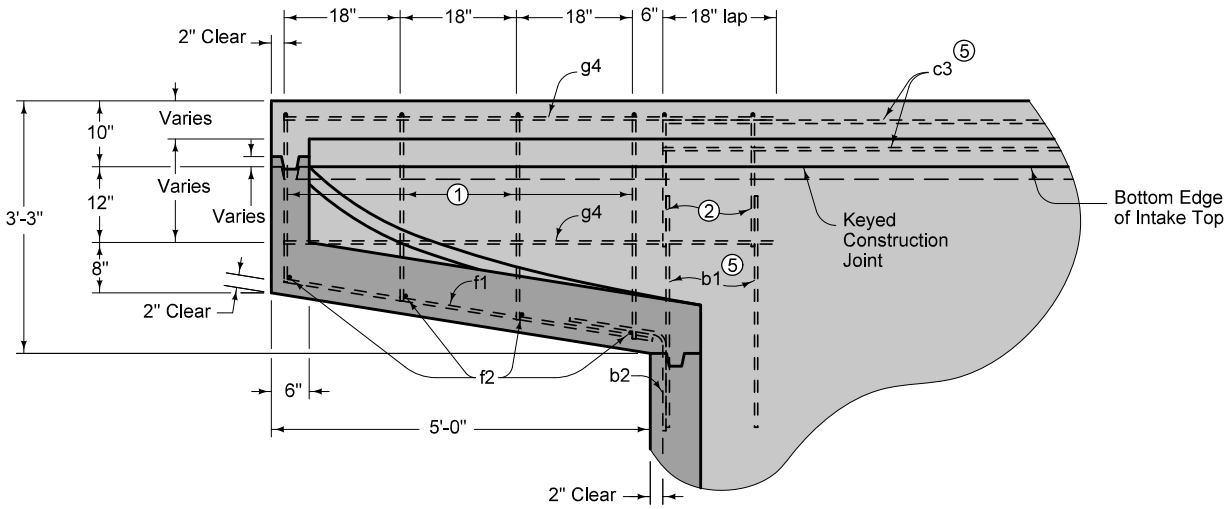
A. Gray Cast Iron: AASHTO M 306.

B. Ductile Iron: ASTM A 536, Grade 80-55-06 or 70-50-05.

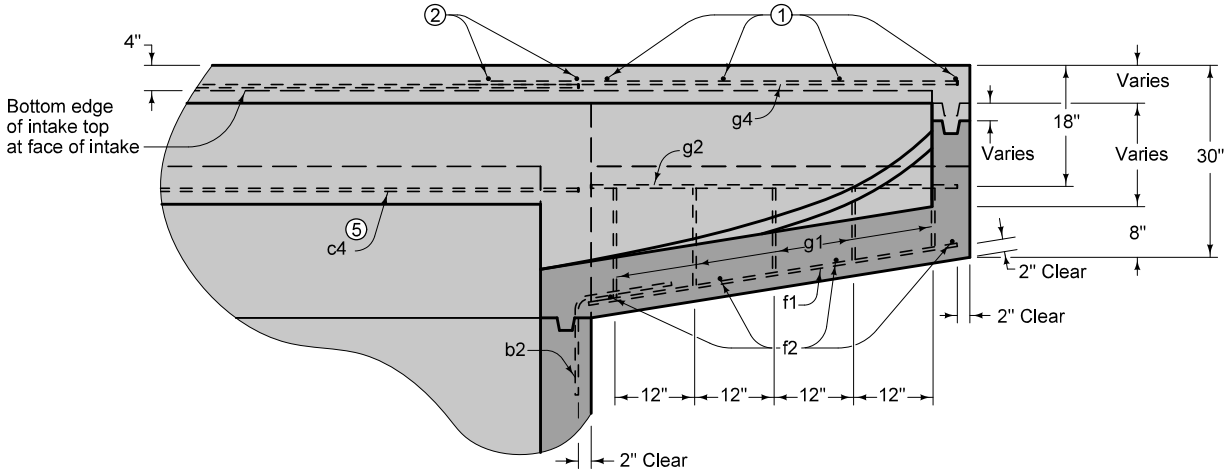
C. Load Capacity: Standard duty unless otherwise shown on the casting figures.

1. Standard Duty: Casting certified for 40,000 pound proof-load according to AASHTO M 306.

2. Light Duty: Casting certified according to requirements of AASHTO M 306 for a 16,000 pound proof-load (HS-20). 40,000 pound proof-load is not required.



SECTION D-D



SECTION E-E

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

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

⑤ See SW-541 for reinforcing.

FIGURE 6010.542 SHEET 4 OF 4

SUDAS IOWADOT

REVISION	
5	10-20-20

FIGURE 6010.542 | STANDARD ROAD PLAN

SW-542

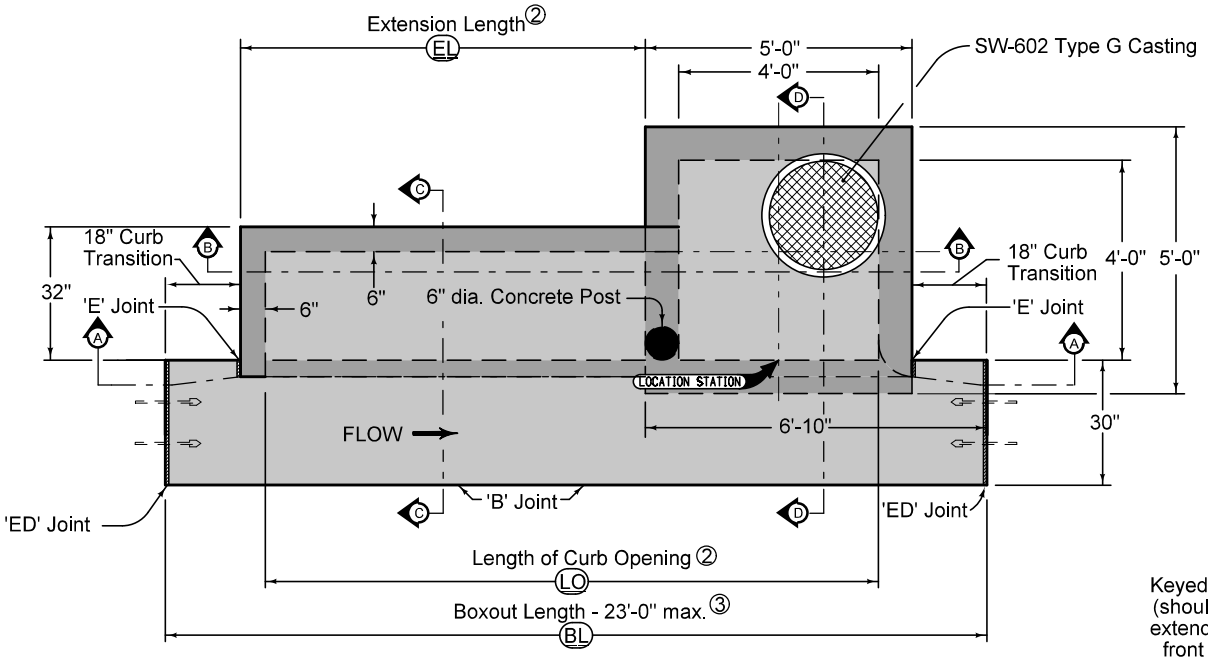
SHEET 4 of 4

REVISIONS: Removed Interim from standard.

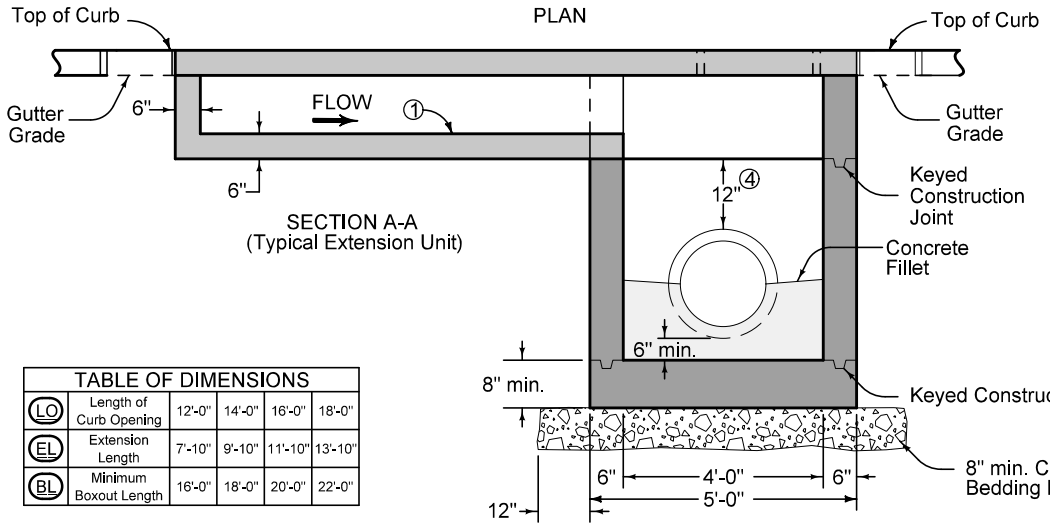
Paul D. Wigant
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

EXTENSION UNIT FOR OPEN-THROAT CURB INTAKE UNDER PAVEMENT

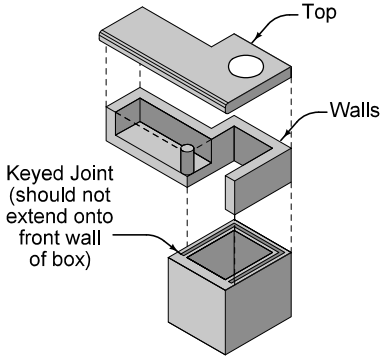


PLAN



SECTION A-A
(Typical Extension Unit)

SECTION B-B
(Typical Intake Well)



ISOMETRIC
INTAKE WELL, WALLS AND TOP

TABLE OF DIMENSIONS					
LO	Length of Curb Opening	12'-0"	14'-0"	16'-0"	18'-0"
EL	Extension Length	7'-10"	9'-10"	11'-10"	13'-10"
BL	Minimum Boxout Length	16'-0"	18'-0"	20'-0"	22'-0"

Extension unit may be used on either or both sides of intake. Details are similar when extension unit is on the opposite side. For joint details, refer to PV-101.

① Match gutter slope. Drain to well.

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

③ Includes 2 inches for 'ED' Joints.

④ 12 inch minimum wall height above all pipes.

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

FIGURE 6010.545 SHEET 1 OF 4

SUDAS | IOWA DOT

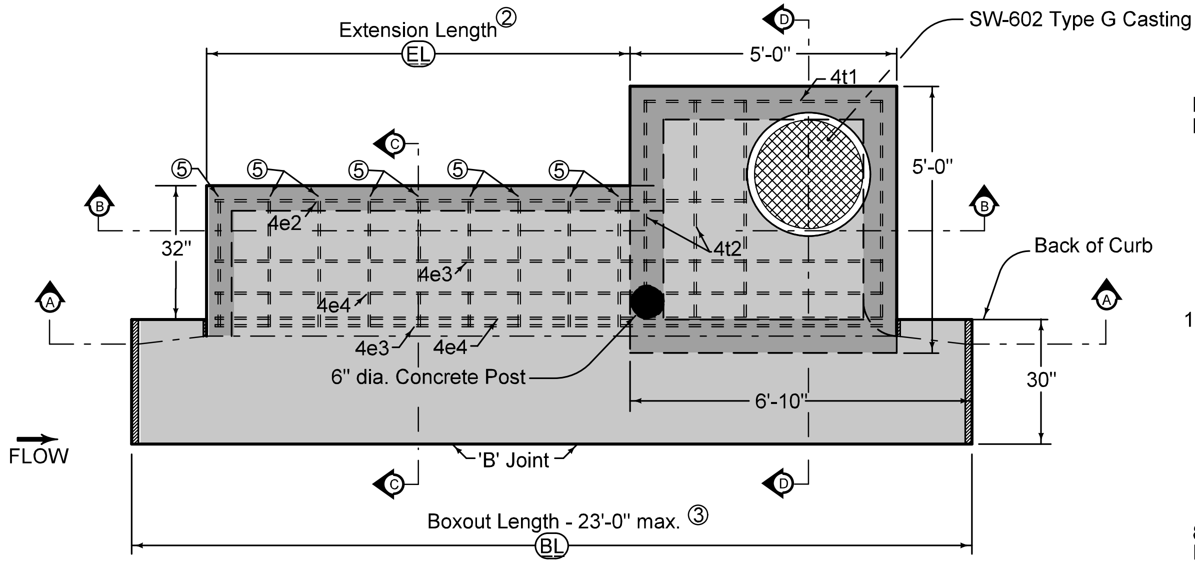
REVISION 6 04-19-22

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

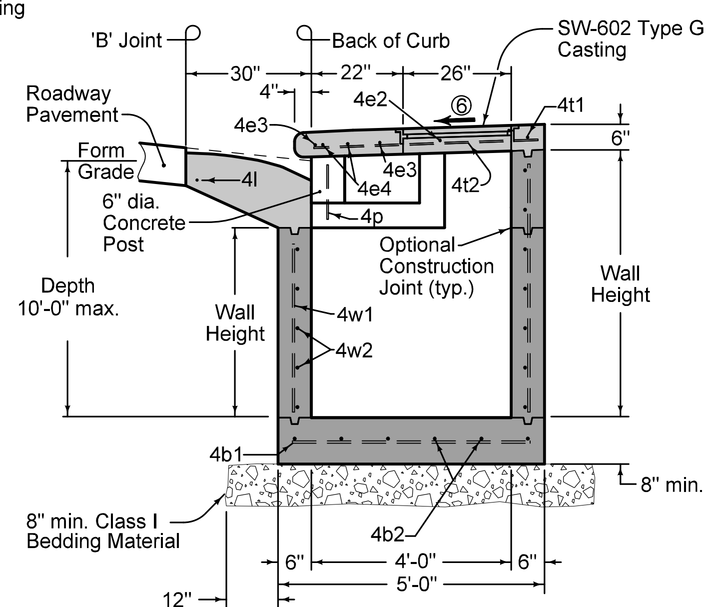
REVISIONS: Clarified labeling of rebar.

Paul D. Wigard, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

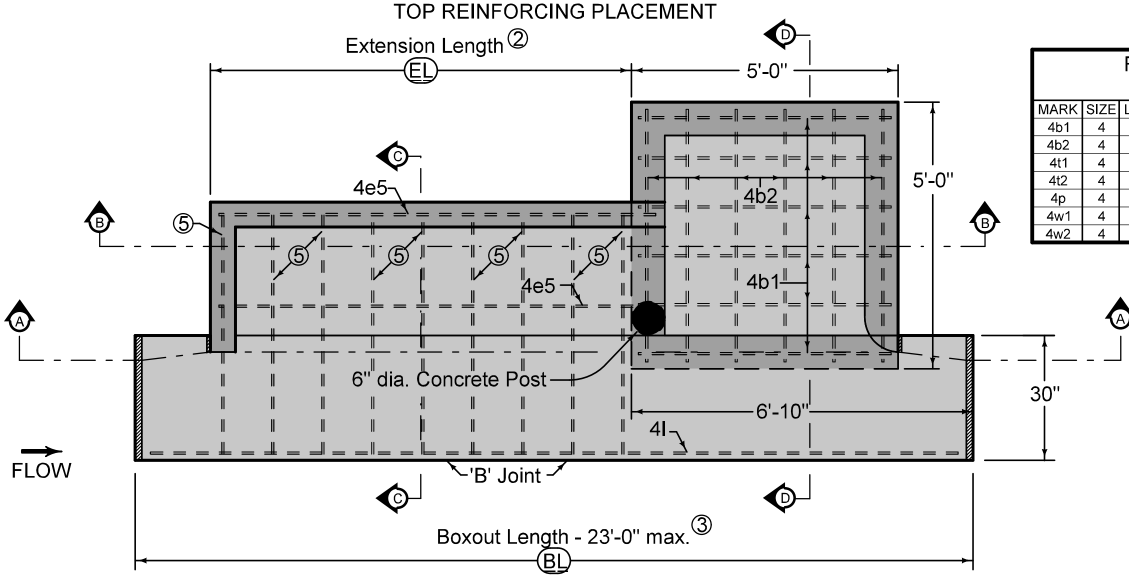
SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING



PLAN
TOP REINFORCING PLACEMENT



SECTION D-D



PLAN
BOTTOM REINFORCING PLACEMENT

REINFORCING BAR LIST
Intake Well

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

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

③ Includes 2 inches for 'ED' Joints.

⑤ 4e1 or 4e6. See Sheets 3 and 4.

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

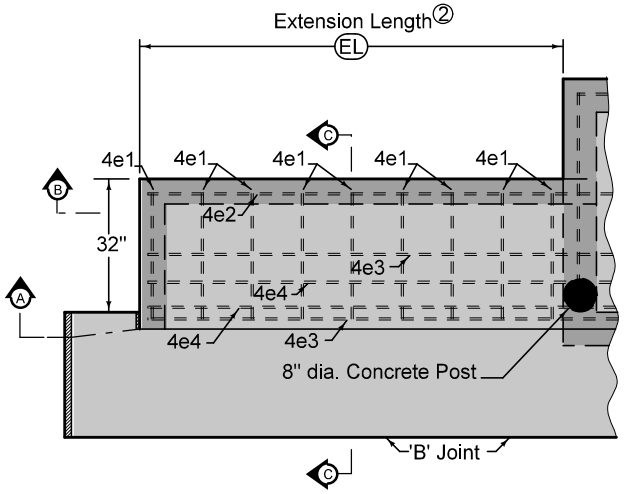
SUDAS | IOWADOT | REVISION 6 04-19-22

FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545 | SHEET 2 of 4

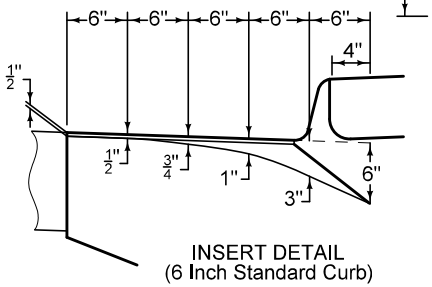
REVISIONS: Clarified labeling of rebar.

SUDAS DIRECTOR | DESIGN METHODS ENGINEER

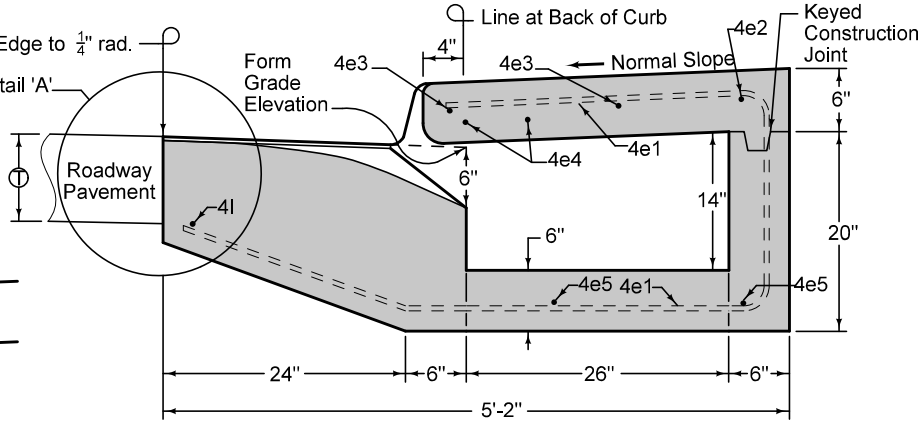
SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING



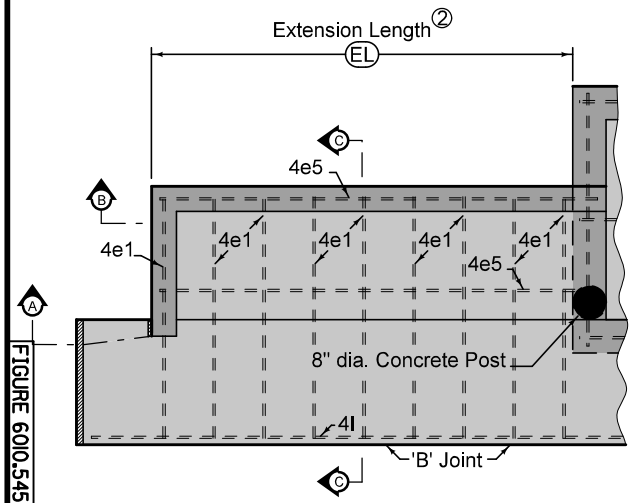
PLAN
TOP OF EXTENSION REINFORCING PLACEMENT



INSERT DETAIL
(6 Inch Standard Curb)



SECTION C-C
(6 Inch Standard Curb)



PLAN
BOTTOM OF EXTENSION REINFORCING PLACEMENT

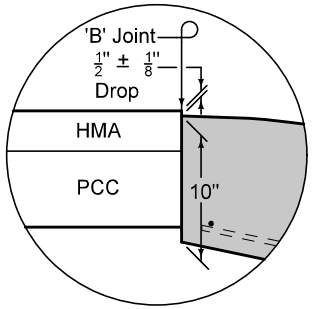
REINFORCING BAR LIST (LO) = 12'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	9	9'-5½"	56.9	12"
4e2	4	Top	1	10'-0"	6.7	
4e3	4	Top	2	12'-9"	17.0	15½"
4e4	4	Top	2	12'-9"	17.0	6"
4e5	4	Base	2	8'-2"	10.9	22"
4l*	4	Insert	1	15'-10"	10.6	
* With 16'-6" Boxout.				Total	119.1 lbs.	

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

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

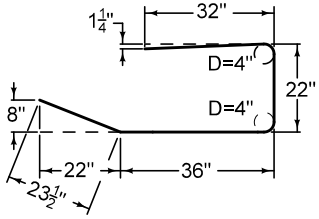
REINFORCING BAR LIST (LO) = 18'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e1	4	Top/Base	15	9'-5½"	94.8	12"
4e2	4	Top	1	16'-0"	10.7	
4e3	4	Top	2	18'-9"	25	15½"
4e4	4	Top	2	18'-9"	25	6"
4e5	4	Base	2	14'-2"	18.9	22"
4l*	4	Insert	1	21'-10"	14.6	
* With 22'-6" Boxout.				Total	189.0 lbs.	

6 INCH STANDARD CURB



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

BENT BAR DETAILS



4e1

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

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

SUDAS | IOWA DOT

REVISION	
6	04-19-22

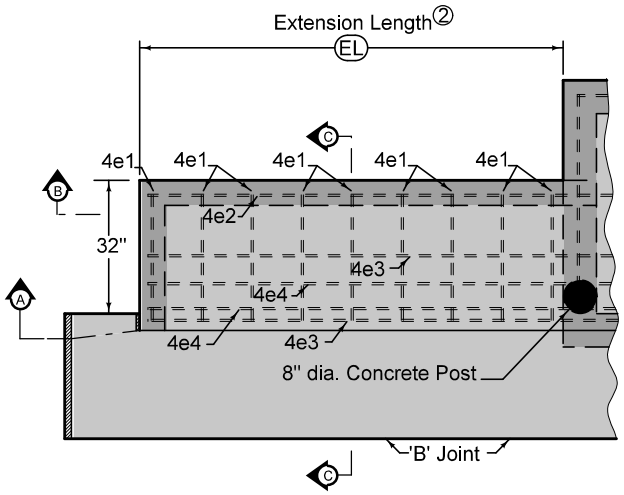
FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545 | SHEET 3 of 4

REVISIONS: Clarified labeling of rebar.

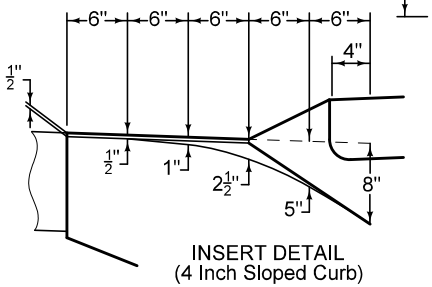
Paul D. Wigard, SUDAS DIRECTOR
Stuart Nicholson, DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

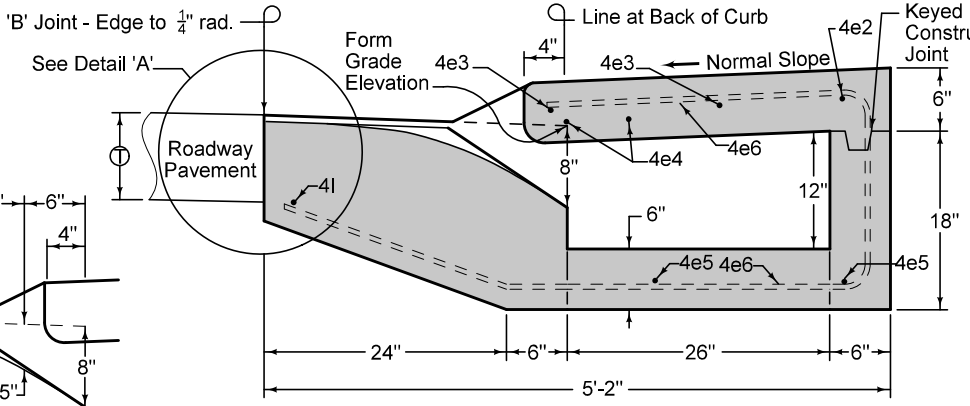
FIGURE 6010.545 | SHEET 3 OF 4



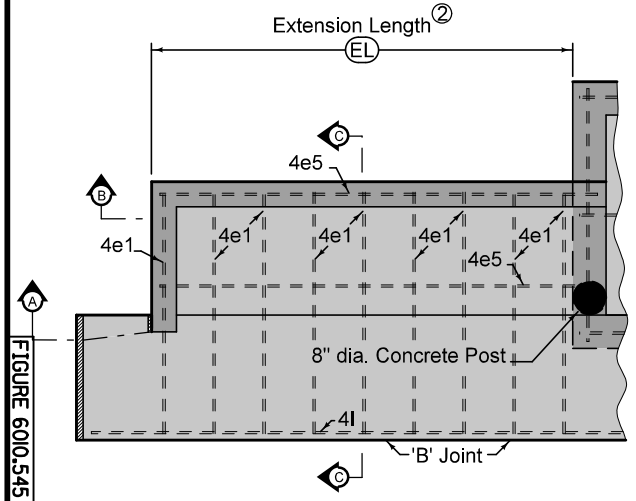
PLAN
TOP OF EXTENSION REINFORCING PLACEMENT



INSERT DETAIL
(4 Inch Sloped Curb)



SECTION C-C
(4 Inch Sloped Curb)



PLAN
BOTTOM OF EXTENSION REINFORCING PLACEMENT

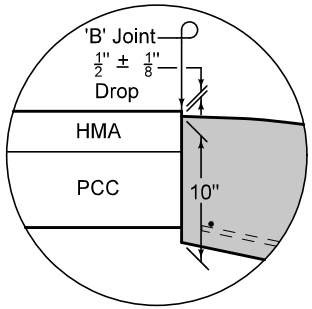
REINFORCING BAR LIST (LO) = 12'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	10'-0"	6.7	
4e3	4	Top	2	12'-9"	17.0	15½"
4e4	4	Top	2	12'-9"	17.0	6"
4e5	4	Base	2	8'-2"	10.9	22"
4e6	4	Top/Base	9	9'-3½"	56.9	12"
4l*	4	Insert	1	15'-10"	10.6	
* With 16'-6" Boxout.				Total	119.0 lbs.	

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

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

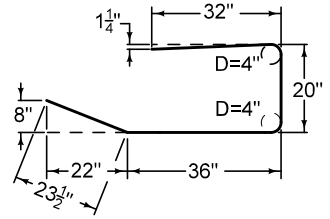
REINFORCING BAR LIST (LO) = 18'-0"						
MARK	SIZE	LOCATION	NO.	LENGTH	WEIGHT	SPACING
4e2	4	Top	1	16'-0"	10.7	
4e3	4	Top	2	18'-9"	25	15½"
4e4	4	Top	2	18'-9"	25	6"
4e5	4	Base	2	14'-2"	18.9	22"
4e6	4	Top/Base	15	9'-3½"	94.8	12"
4l*	4	Insert	1	21'-10"	14.6	
* With 22'-6" Boxout.				Total	188.9 lbs.	

4 INCH SLOPED CURB



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

BENT BAR DETAILS



4e6

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

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

SUDAS | IOWADOT

REVISION 6 04-19-22

FIGURE 6010.545 | STANDARD ROAD PLAN | SW-545

SHEET 4 of 4

REVISIONS: Clarified labeling of rebar.

Paul D. Wigand
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

SINGLE OPEN-THROAT CURB INTAKE WITH EXTENDED OPENING

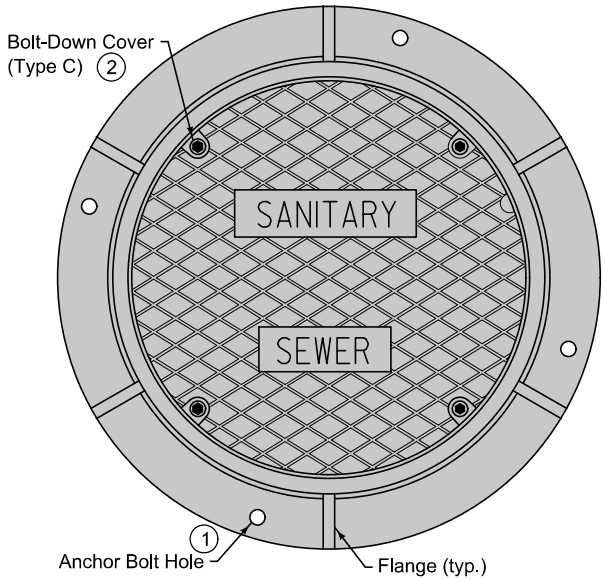
FIGURE 6010.545 SHEET 4 OF 4

TYPE A

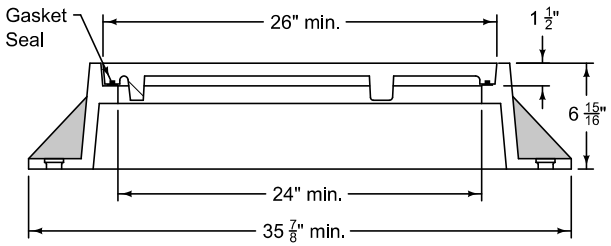
Two-piece fixed casting

TYPE C

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



PLAN



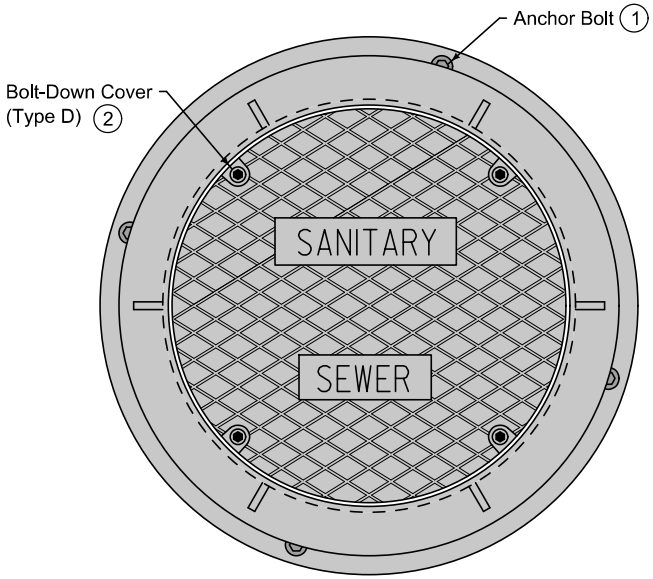
TYPICAL SECTION

TYPE B: HMA

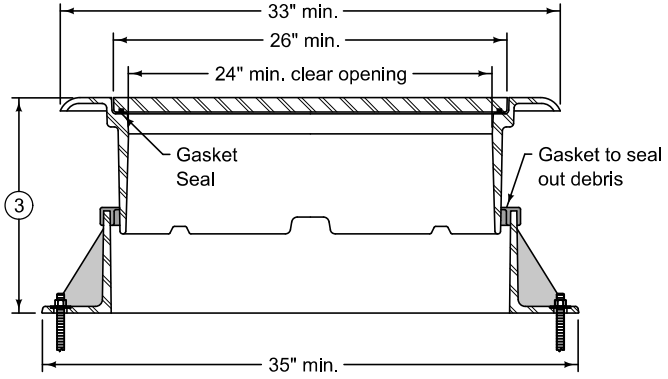
Three-piece floating casting for use in HMA paving

TYPE D: HMA

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



PLAN



TYPICAL SECTION

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

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

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

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

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

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

REVISIONS: Add option for 3-piece HMA casting

Paul D. Wigard
SUDAS DIRECTOR

Stuart Nicholson
DESIGN METHODS ENGINEER

CASTINGS FOR SANITARY SEWER MANHOLES

FIGURE 6010.601 | SHEET 1 OF 2

Section 7020 - Hot Mix Asphalt Pavement **Page No.**

Section 7021 - Hot Mix Asphalt Overlays **Page No.**

Figures **Figure No.**

Section 7092 - Crack and Seat Existing PCC Pavement **Page No.**

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 metallic tie bars and dowel bars or Iowa DOT Section 4156 for glass fiber reinforced polymer dowel bars. Meet the tie bar requirements for bar mats. All metallic 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.

2.02 CONCRETE MIXES (Continued)

C. Use of Fly Ash and Ground Granulated Blast Furnace Slag (GGBFS) as Supplementary Cementitious Materials:

1. Mix proportions for the various mixes using fly ash and GGBFS are included in Iowa DOT Materials I.M. 529. The maximum allowable fly ash substitution rate is 20%. Do not use a GGBFS substitution rate of more than 35% by weight (mass). The total supplementary cementitious material substitution rate is not to exceed 40%.

2. If C-SUD or CV-SUD mixes are specified, the maximum allowable Class F fly ash substitution rate is 25% and the maximum Class C fly ash substitution rate is 35%. The maximum combination rate is 20% Class C fly ash and 20% GGBFS.

3. When Type IP or IS cement is used in the concrete mixture, only fly ash substitution will be allowed. Between October 16 and March 15, supplementary cementitious materials will be allowed only when maturity method is used to determine time of opening. Transport, store, haul, and batch fly ash and GGBFS in such a manner to keep it dry.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Batching and Mixing Equipment:

1. General:

a. Weighing and Proportioning Equipment: Comply with Iowa DOT Article 2001.20.

b. Mixing Equipment: Comply with Iowa DOT Article 2001.21.

c. Material Bins: Involves any structure in which materials are stored. Each part of any bin, including foundations and supports, must be adequate to withstand any stress to which it might be subjected to while in use.

2. Batching:

a. Ensure the batching plant is Iowa DOT calibrated and approved. Provide copy of current calibrations and approvals.

b. Coordinate the batch plant operation and batch trucks with the paving operation in order to ensure a steady supply of materials.

c. Operate the batch plant and trucks to minimize dust, noise, or truck nuisances.

3. Mixing:

a. Construction or Stationary Mixer:

1) Ensure the concrete is uniform in composition and consistency. If this condition is not produced because of the size of the batch, the size of the batch may be reduced or the mixing time increased, or both, until this result is obtained. If non-uniform, corrective action must be taken.

2) Ensure the methods of delivering and handling the concrete are such that objectionable segregation or damage to the concrete will not occur, and they will facilitate placing with a minimum of handling.

b. Ready Mixed Concrete:

1) Ensure the concrete is uniform in composition and consistency. If non-uniform, concrete producers must take corrective action.

2) Ready mixed concrete is defined as concrete proportioned in a central plant and mixed in a stationary mixer for transportation in trucks without agitation, proportioned at a central plant, and only partially mixed in a stationary mixer for transportation and finish mixing in a transit mixer, or proportioned at a central plant, and then mixed in a transit mixer prior to or during transit.

3) When necessary to add additional mixing water at the site of placement, mix the batch at least an additional 30 revolutions of the drum at mixing speed.

4) Ensure each vehicle in which concrete will be delivered is capable of discharging concrete having a slump not over 2 inches at an overall rate for its entire load of not less than 1.25 cubic yards per minute. Ensure the concrete is delivered at a rate sufficient to maintain a sustained rate of progress of not less than 100 feet per hour for the width and depth of pavement to be placed.

c. All Methods: Identify each truck load by a plant charge ticket showing plant name, contractor, project data, quantity, class, time batched, and water added at site.

B. Concrete Delivery Equipment:

1. General:

a. In handling concrete from the mixer to the place of deposit, take care to avoid segregation.

b. When concrete is deposited through a chute, slope the chute to allow concrete to flow slowly without segregation. Place the delivery point of the chute as close as possible to the point of deposit. Keep chutes and spouts clean. Thoroughly flush them with water before and after each run. Discharge the water outside the paving area in an approved concrete washout area.

3.01 EQUIPMENT (Continued)

c. Provide alternate plan for concrete delivery in event of equipment failure.
d. Take concrete samples from material placed on the subgrade or subbase.

2. Concrete Transfer Equipment:
a. Utilize placers, conveyors, buckets, or buggies designed specifically for transporting concrete.
b. Do not allow concrete to free fall into or out of transfer equipment.
c. Meet the requirements of Section 7010, 2.02, B, 2 for air entrainment of the concrete mix and testing for compliance.

3. Concrete Pumps:
a. Do not pump concrete through aluminum conduit or tubing.
b. Use the concrete pump to deliver the material as close to horizontal as possible, keep restrictions and drops to a minimum, and avoid free fall.
c. Meet the requirements of Section 7010, 2.02, B, 2 for air entrainment of the concrete mix and testing for compliance.
d. Sample the first load after pumping a minimum of 3 cubic yards. Sample after each significant change in boom angle.
e. Sample before and after the pump to determine if any changes in the slump and other significant mixture characteristics occur.
f. When sampling at the end of the placement line, take care to ensure that the sample is representative of the concrete being placed from the pipeline. Note: Changes to the placement rate or boom configuration can result in changes in the concrete properties. Typically, the vertical position of the boom results in the greatest potential for air loss while the horizontal position of the boom has the least potential. Location of pumping equipment should be determined so that it is possible to maintain a consistent, low boom angle as much as possible during placement.
g. If air test shows that air entrainment is outside of the allowed range, follow procedure as outlined in Section 7010, 3.07, B.
h. Leaks in the line or pump hydraulics, which would allow air to be added to the concrete, are prohibited.

C. Concrete Placement Equipment:

1. Consolidating and Finishing Equipment:
a. Use a paving machine that meets all of the following:
1) Is designed for the specific purpose of placing, consolidating, and finishing concrete pavement.
2) Develops vertical edges on the pavement.
3) Is self propelled and equipped with a means for spreading the concrete to a uniform depth before it enters the throat.
4) Vibrates the concrete to the full width and depth being placed in a single passage. Use vibrating tubes or arms working in the concrete or a vibrating pan operating on the surface of the concrete.
5) Produces a surface reasonably free of voids and tears.
6) When the paver is operated on previously placed concrete, prevent damage to the pavement surface.
7) For slip form pavers, use a paver equipped with automatic horizontal and vertical grade controls.
b. Hand methods utilizing air screeds and vibrating screeds may be used for short pavement runs, cul-de-sacs, driveways, and some intersections.
c. When allowed by the Engineer, use stringless paving equipment capable of providing the same accuracy necessary to comply with the requirements of Section 7010.

3.01 EQUIPMENT (Continued)

d. Use a laser guided screed that meets all of the following:
   1) Designed for the specific purpose of placing and finishing of concrete pavement using a 3-dimensional surface model.
   2) All equipment for laser guided screed, including the guidance system, will meet the project design model tolerances.
   3) Will provide consolidation to full width and full depth of concrete placement. Provide intermediate consolidation by using external hand held vibrators.
   4) Produces a surface reasonably free of voids and tears.
   5) Provide boom-style screed (drive-in screeds are not allowed) with an auger boom, placement head (water spray mechanism not allowed), guidance equipment, and software to produce 3-dimensional surface.
   6) Produces pavement smoothness as specified in Section 7010, 3.07, C.

2. Vibrators for Machine Paving:

a. Consolidate, with a single pass of an approved internal or surface vibrator, the full width and depth of concrete requiring a finishing machine. Operate internal vibrators within a frequency range of 4,000 to 8,000 vibrations per minute. The Engineer may authorize the minimum vibration frequency to be lowered to 3,500 vibrations per minute for particular sections of paving, such as superelevations. Operate surface vibrators within a frequency range of 3,500 to 6,000 vibrations per minute.

b. Avoid operating vibrators in a manner to cause a separation of the mix ingredients, either a downward displacement of large aggregate particles or an accumulation of laitance on the surface of the concrete. When forward motion of the paver is reduced, vibrator frequency may need to be reduced to avoid separation of the mix.

c. If a vibrator fails to operate within the specifications, repair or change the vibrator before the paving begins:
   - The following day, or
   - The same day if the continuous paving that day is stopped at a header or at the end of a session.

d. If two adjacent vibrators fail to operate within the specifications, stop the paving operation and repair or replace the vibrators.

e. Stop vibrators whenever forward motion of the paver is stopped.

f. Set the internal vibrator penetration depth into the concrete pavement to mid slab or as deep as possible while passing above reinforcing steel. Provide an operating position locking device so that no part of the vibrating unit can be lowered to the extent that it will come in contact with reinforcing steel or tie bars while paving.

g. Do not exceed the manufacturer's recommendations for vibrator horizontal spacing. Do not exceed 16 inches from center to center.

h. Mount the longitudinal axis of the vibrator body approximately parallel to the direction of paving. Tilt the trailing end of each vibrator downward to a slope of 10 to 30 degrees below horizontal.

i. Use vibrators that meet or exceed the following specifications at the manufacturer's design frequency of 10,000 vpm:
   1) Amplitude (peak to peak) 0.070 inches.
   2) Centrifugal force 1,200 pounds.

3. Vibrators for Hand Methods: Use a vibration rate between 3,500 to 6,000 vibrations per minute, and use an amplitude sufficient to be perceptible on the surface of the concrete more than 12 inches from the vibrating unit.

4. Hand Finishing Equipment: Provide all finishing tools necessary for proper finishing of the concrete including straightedges for checking and correcting finished concrete surfaces.

3.01 EQUIPMENT (Continued)

5. **Forms:**
   a. **Rigid Forms:** Steel, minimum thickness of 5 gage, height at least equal to design thickness of pavement with base width at least 6 inches.
      1) Minimum section length of 10 feet, joint connections designed to allow horizontal and vertical adjustment with locking device to hold abutting sections firmly in alignment.
      2) Bracing, support, and staking must prevent deflection or movement of forms.

   b. **Flexible Forms:** Use steel or wood flexible forms for curves with a radius less than 100 feet.
      1) Bracing, support, and staking must prevent deflection or movement of forms.
      2) Ensure that forms used to shape back of curbs at returns have height at least equal to design thickness of pavement and curb height.
      3) Forms must be free from scale and surface irregularities.

6. **Curing Equipment:** Use pressure sprayer capable of applying a continuous uniform film of curing compound. Use equipment with a shield if wind conditions do not allow proper coverage

7. **Concrete Saws:** Use power operated concrete saws capable of cutting hardened concrete neatly.

8. **Joint Sealing Equipment:** Use equipment capable of cleaning the joint and heating and installing sealant in joints according to manufacturer's recommendations.

3.02 PAVEMENT CONSTRUCTION

A. Removal of Pavement: Comply with Section 7040, 3.02.

B. Final Subgrade/Subbase Preparation:

1. **General:**
   a. Meet the requirements of Section 2010 for subgrade construction, subgrade treatment, and subbase construction.
   b. Trim the subgrade or subbase to the final grade for placement of concrete.
   c. Unless otherwise ordered by the Engineer, the subgrade or subbase, at time of placing concrete for concrete pavement, must be in a uniformly moist but not muddy condition to a depth of not less than 1 inch.

2. **Subgrade and Subbase Loading:**
   a. Travel of concrete delivery trucks on a subgrade or subbase must be approved by the Engineer. In such cases, watering of the subgrade or subbase must be limited to just ahead of the paving machine.
   b. Enter and exit from side streets to minimize repetitive loading on the subgrade or subbase by concrete trucks.
   c. Do not allow loads in excess of the legal axle load on the completed subgrade or subbase.
   d. Partially loaded trucks may be required.
   e. If subgrade or subbase failure occurs, coordinate the repair with the Engineer.

3. **Paving Suspended:**
   a. Suspend the paving operation where subgrade or subbase stability has been lost.
   b. Do not place concrete on a subgrade or subbase that has become unstable, bears ruts or tire marks of equipment, or that is excessively softened by rain until such subgrade or subbase has been reconsolidated and reshaped to correct the objectionable condition.

3.02 PAVEMENT CONSTRUCTION (Continued)

c. If necessary, scarify to a minimum depth of 6 inches, aerating, and recompacting at no additional cost to the Contracting Authority. Meet the compaction requirements of Section 2010, 3.06.

4. Maintenance of Subgrade or Subbase: Maintain the completed subgrade or subbase during subsequent construction activities.

C. Surface Fixture Adjustment:

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 concrete placement.

3. Construct boxouts where allowed for later adjustment of fixtures. See Figure 7010.103 for the size and shape of the boxout.

D. Setting of Forms: When forms are used, meet the following requirements.

1. Ensure forms have sufficient strength to support paving operations being used.

2. Set base of forms at or below subgrade elevation with top of forms at pavement surface elevation. With Engineer approval, extra height forms may be used to shape the back of integral curb and edge of pavement; set base at or below subgrade elevation with top of form at top of curb elevation.

3. Place and secure forms to required grade and alignment. Do not vary the top face of the form from a true plane by more than 1/8 inch in 10 feet, and do not vary the vertical face from a true plane by more than 1/4 inch in 10 feet.

4. If the soil supporting the forms is softened by rain or standing water so that the forms are inadequately supported, or if voids occur under the forms, remove forms. Rework subgrade to proper elevation and density, and reinstall forms.

5. Ensure forms are free of latent concrete and coated with release agent before concrete is placed.

E. Bar and Reinforcement Placement: Ensure bars are clean, straight, free from distortion and rust, and are firmly secured in position as specified in the contract documents. Place all bars in approved storage to prevent damage; do not distribute along the work site except as needed to avoid delay in paving.

1. Tie Bars:

a. Place bars prior to vibration. For slip form paving, tie bars may be installed after vibration, provided the concrete is consolidated around the bars. Bars may be supported by approved chairs or may be placed in position by a machine or method approved by the Engineer.

b. Use approved continuous bolsters with runners to support reinforcement for bridge approach sections. Place the supports transversely across the approach and space them longitudinally no greater than 4 feet. For double reinforced approach sections the top layer of reinforcing may be chaired off the bottom layer of reinforcing using approved continuous high chairs with runners, provided they are positioned directly above the continuous bolsters with runners supporting the bottom layer of reinforcing. Hold epoxy coated reinforcing steel in place with epoxy or plastic coated bar supports and epoxy or plastic coated tie wires.

3.02 PAVEMENT CONSTRUCTION (Continued)

2. Dowel Bar Assemblies:

a. When dowel bar assemblies are required in the contract documents, accurately place these assemblies as shown. To prevent their movement during subsequent concrete paving operations, securely stake or fasten to the base to line and grade.

b. Do not use assemblies that are damaged prior to placement. If assemblies are damaged after placement, replace prior to paving. Ensure horizontal and vertical alignment of the load transfer bars does not exceed 1/4 inch from parallel to line and grade. Place each assembly so the bars are in a horizontal plane at T/2 ± 1/2 inch.

c. Check the placement of each assembly and the position of the bars within the assembly using a suitable template or other device approved by the Engineer. If the assembly is found to be placed outside of the above tolerances, correct the placement.

d. Cutting the tie wires of the load transfer assemblies is optional.

3. Bar Mats for Reinforced Pavement:

a. When reinforced pavement is specified, assemble bar mats accordingly and firmly fastened together at all bar intersections.

b. Place, secure, latch, and tie bar mats for a continuous mat as specified in the contract documents. Displacement during concrete placement operations is not allowed.

c. Use chairs to ensure proper placement of bar mats.

4. Tie Bars and Dowel Bars in Existing Pavement:

a. When anchoring in existing concrete, use a grout system according to the manufacturer's instructions. Obtain the Engineer's approval for the grout system.

b. For horizontal installations, use either a pressure injection system with mechanical proportioning and mixing, or use encapsulated chemical anchors. Install as follows:

1) Ensure drilled holes to receive the grout match the dimensions and spacing specified in the contract documents. When not specified in the contract documents, the maximum nominal diameter of the hole must be 1/8 inch larger than the outside diameter of the dowel or bar, or as recommended by the manufacturer. Drill holes for tie bars and dowel bars into the face of the existing pavement at midpoint. To ensure proper horizontal alignment, do not allow any hole misalignments to exceed 1/4 inch in the vertical or horizontal plane. Clean the hole with compressed air immediately prior to placing the grout.

2) Use a polymer grout to secure the dowels in the existing pavement. Inject the grout into the rear of the hole with pressure. Use sufficient grout so that when the bar to be grouted is placed in position, excess grout will be forced out the front of the hole. Rotate the bar during the insertion process to ensure complete coating with the grouting material. Hand proportioning and mixing is not allowed.

3) If using grout with approved encapsulated anchors, install according to the manufacturer's recommendations.

4) Use horizontal installation procedures for vertical or angled installations; however, pourable grouts may be used. Pourable grouts must be mechanically mixed.

F. Concrete Pavement Placement:

1. Use paving machine for all uniform width pavements 8 1/2 feet or more in width and 250 feet or more in length, unless alternate methods are approved by the Engineer. Screeds and laser guided screeds may be used on short pavement runs up to 250 feet.

2. Place, consolidate, and finish the concrete to the full depth and width conforming to the specified crown and cross-section in a single operation.

3.02 PAVEMENT CONSTRUCTION (Continued)

3. Keep a uniform pile of concrete in front of the paving machine, up to a maximum of 6 to 8 inches above the design surface elevation. Distribute and spread the concrete as soon as placed. A mechanical concrete spreader may be used.

4. Deposit the concrete upon the in-place bars keeping segregation to a minimum.

5. Use shovels, not rakes, to do necessary hand spreading and spading.

6. Do not allow the edges of pavement, including all longitudinal construction joints, to deviate from the line shown on the plans by more than 1/2 inch at any point.

7. If the paving machine operates on adjacent pavement, protect pavement from damage.

8. When placing by hand methods, consolidate the concrete by using vibrating units. Use a definite system or pattern in the operation of the vibrator so the full width of concrete in each linear foot of lane will receive adequate and uniform consolidation. The system and methods of vibrating is subject to approval of the Engineer. Do not use vibrating equipment as a tool for moving concrete laterally.

9. Stringless Paving:
   a. Provide an electronic file identifying x, y, and z coordinates for curbs and pavement edges, as well as pavement centerline based on project alignments and elevations.
   b. Location and elevation of the finished slab should be verified against grade check hubs at 25 foot intervals for the first 100 feet of each days run and at critical locations, such as intakes and through intersections where grades may be flat. The Engineer may waive these requirements if experience has shown compliance with the design elevations.
   c. Record each verification check and submit to the Engineer.
   d. At the beginning of paving operations on the project or after each modification to the paving machine, verify the paving equipment is calibrated per the manufacturer's recommendations.

G. Integral Curbs: Integral curbs are placed with the pavement in a single paving machine operation; however, hand methods may be allowed for radius, returns, and sections of curb and gutter 100 feet or less in length or in other special sections where mechanical equipment cannot be used.

1. Pave, edge, protect, saw, and cure curb in same manner as pavement.

2. Finish curb as rapidly as finishing operations on pavement permit. Maximum distance behind paving machine is 100 feet.

3. Complete final finish on curbs by hand methods, including the use of a 6 foot straightedge.

4. Check surfaces of curb and gutter with 10 foot straightedge; correct variations greater than 1/8 inch. Ensure top of curb slopes to street when Class A sidewalk will be constructed adjacent to the curb.

5. For drop curb at driveways and where sidewalks intersect streets, use forms to shape the backs of such curbs.

6. When using hand methods for building curb, the following additional requirements will apply:
   a. Remove free water, latency, dust, leaves, or other foreign matter from the slab prior to placing concrete for curb.

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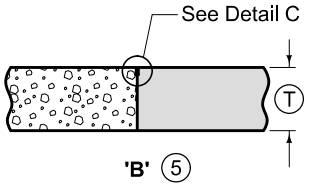
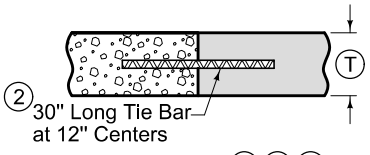
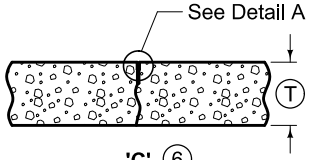


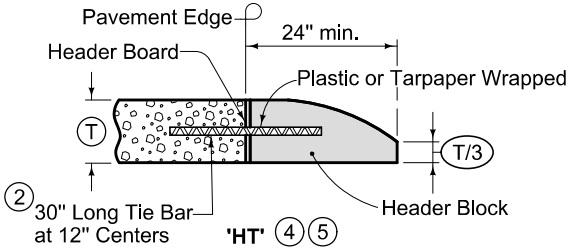
'B' (5)
PLAIN JOINT
(Abutting Pavement Slabs)



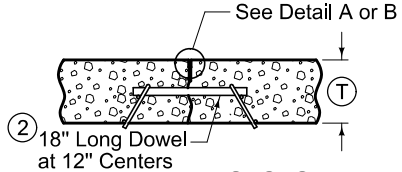
'DW' (3)(4)(7)
DAY'S WORK JOINT(Non-working)



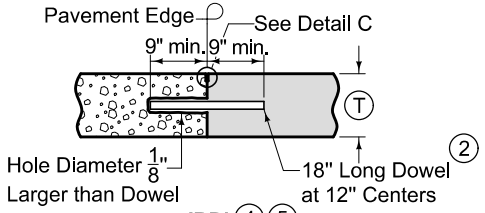
'C' (6)
CONTRACTION JOINT



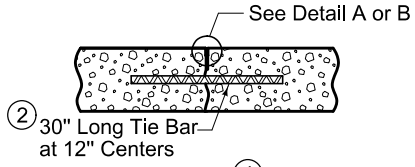
'HT' (4)(5)
HEADER JOINT
(End Rigid Pavement)



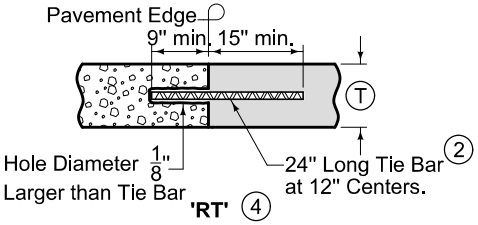
'CD' (1)(4)(6)
DOWELED CONTRACTION JOINT



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

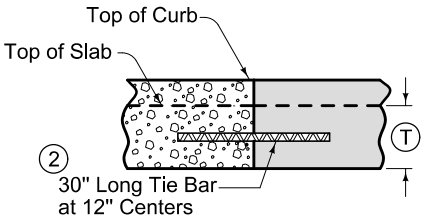


'CT' (4)
TIED CONTRACTION JOINT

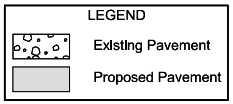


'RT' (4)
ABUTTING PAVEMENT JOINT
RIGID TIE

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



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



TRANSVERSE CONTRACTION

JOINTS

SUDAS | IOWA DOT

REVISION 11 04-19-22

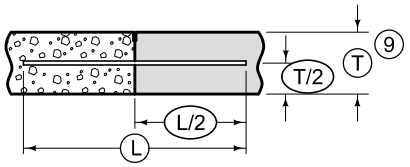
PV-101

FIGURE 7010.101 | STANDARD ROAD PLAN | SHEET 1 of 8

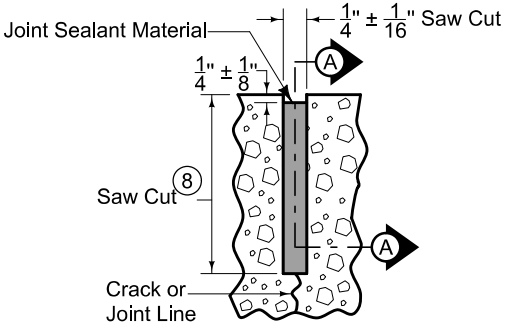
REVISIONS: Modified circle note 32.

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

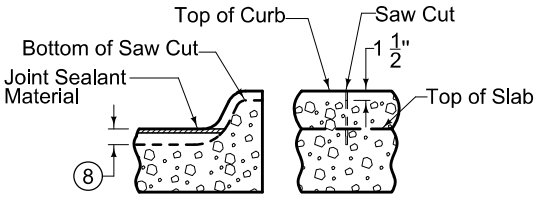
FIGURE 7010.101 SHEET 1 OF 8



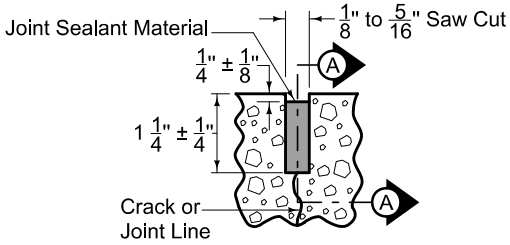
BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



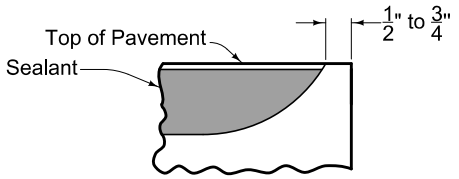
DETAIL A
(Saw cut formed by conventional concrete sawing equipment.)



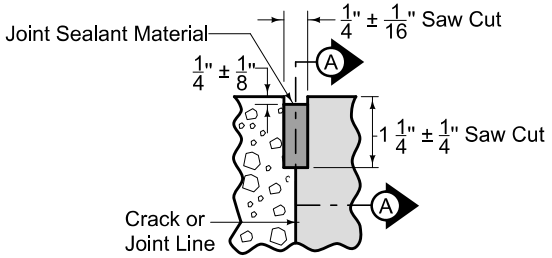
'C' JOINT IN CURB
(Match 'CT', 'CD', or 'C' joint in pavement.)



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



SECTION A-A
(Detail at Edge of Pavement)

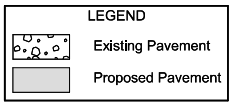


DETAIL C

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 11 04-19-22

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

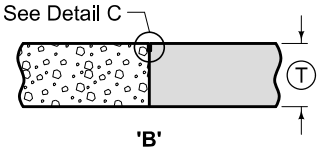
REVISIONS: Modified circle note 32.

Paul D. Wigand, SUDAS DIRECTOR | Steven Nichols, DESIGN METHODS ENGINEER

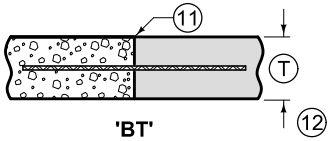
JOINTS

TRANSVERSE CONTRACTION

FIGURE 7010.101 | SHEET 2 OF 8

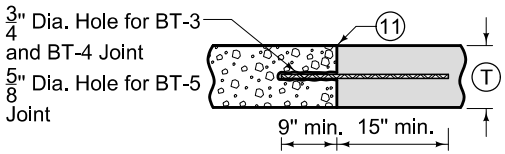


'B'
PLAIN JOINT
(Abutting Pavement Slabs)



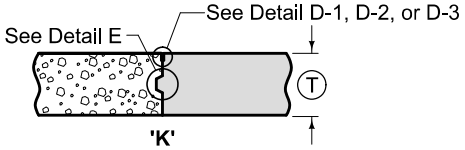
'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE

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

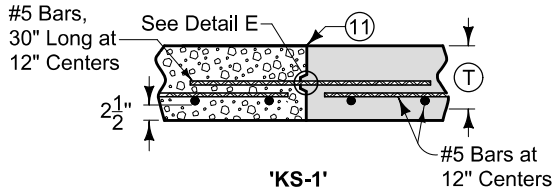


'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE (Drilled)

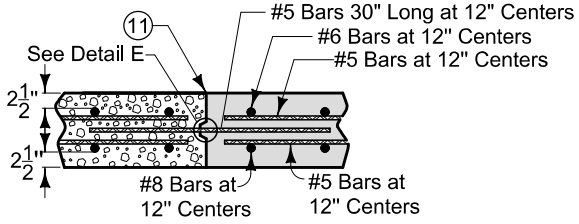
T	Joint	Bars	Bar Length and Spacing
< 8"	'BT-5'	#4	24" Long at 30" Centers
≥ 8"	'BT-3'	#5	24" Long at 30" Centers
	'BT-4'		24" Long at 15" Centers



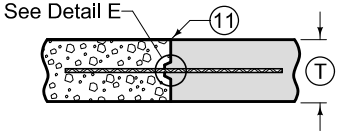
'K'
KEYED JOINT FOR ADJACENT SLABS
(Where T is 8" or more)



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



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



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

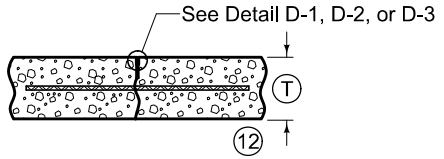
T	Joint	Bars	Bar Length and Spacing
< 8"	'KT-1'	#4	30" Long at 30" Centers
≥ 8"	'KT-2'	#5	30" Long at 30" Centers
	'KT-3'		30" Long at 15" Centers

LONGITUDINAL CONTRACTION

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

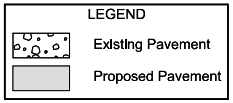
(11) Sawing or sealing of joint not required.

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



'L'
CONTRACTION JOINT

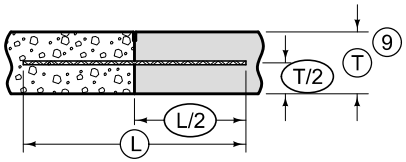
T	Joint	Bars	Bar Length and Spacing
< 8"	'L-1'	#4	36" Long at 30" Centers
≥ 8"	'L-2'	#5	36" Long at 30" Centers
	'L-3'		36" Long at 15" Centers



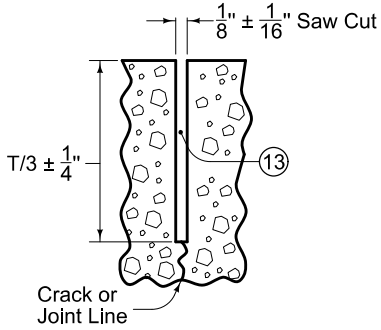
SUDAS | IOWA DOT | REVISION 11 04-19-22
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 3 of 8
REVISIONS: Modified circle note 32.
Paul D. Wigard, SUDAS DIRECTOR — Scott Nicholson, DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 SHEET 3 OF 8



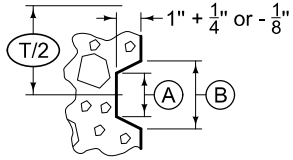
TIE BAR PLACEMENT
(Applies to all joints unless otherwise detailed.)



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

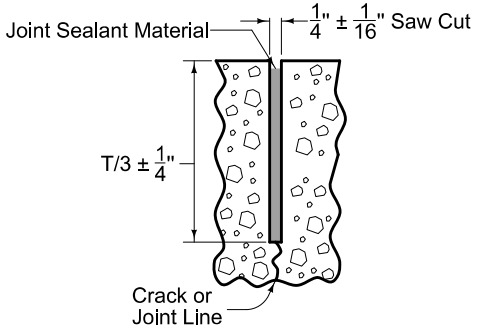
9 When tying into old pavement, T represents the depth of sound PCC.

13 Sealant or cleaning not required.

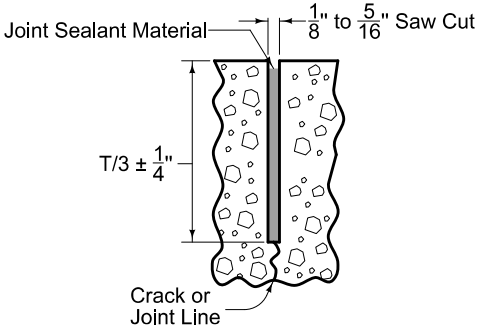


DETAIL E

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)

LEGEND
Existing Pavement
Proposed Pavement

SUDAS | IOWADOT | REVISION 11 04-19-22
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101
SHEET 4 of 8

REVISIONS: Modified circle note 32.

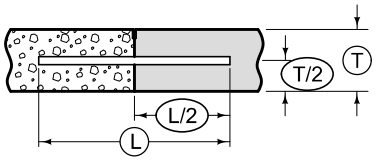
Paul D. Wigand
SUDAS DIRECTOR

Steven Nichols
DESIGN METHODS ENGINEER

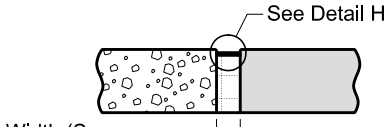
LONGITUDINAL CONTRACTION

JOINTS

FIGURE 7010.101 | SHEET 4 OF 8

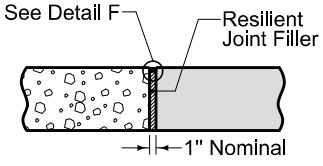


DOWEL PLACEMENT
(Applies to all joints unless otherwise detailed.)

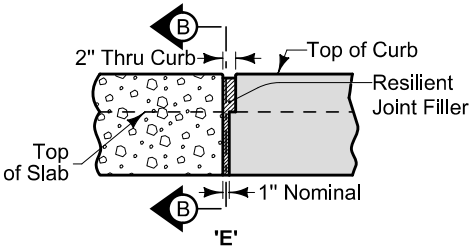


'CF' JOINT

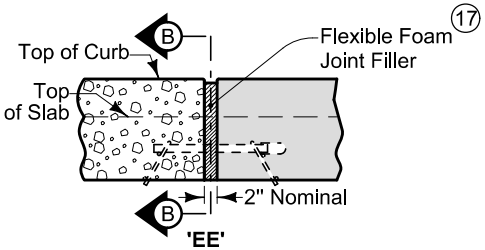
TYPE	WIDTH
CF-1	2"
CF-2	$2\frac{1}{2}$"
CF-3	3"
CF-4	$3\frac{1}{2}$"



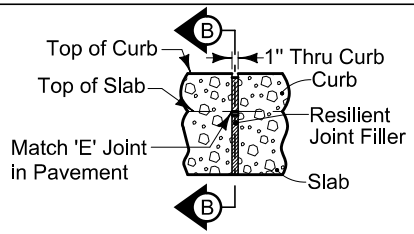
'E'
1" EXPANSION JOINT



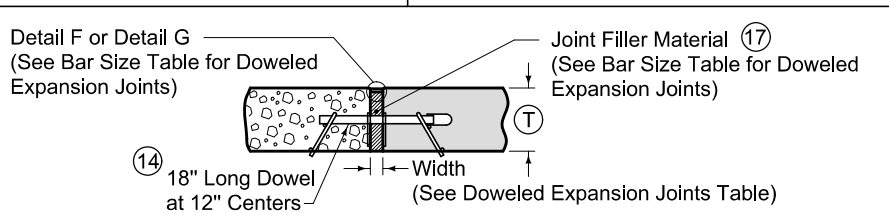
'E'
JOINT IN CURB
(View at Back of Curb)



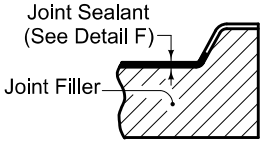
'EE'
JOINT IN CURB
(View at Back of Curb)



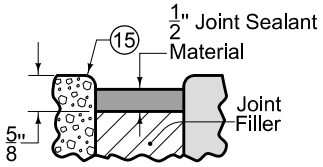
'ES'
JOINT IN CURB
(View at Back of Curb)



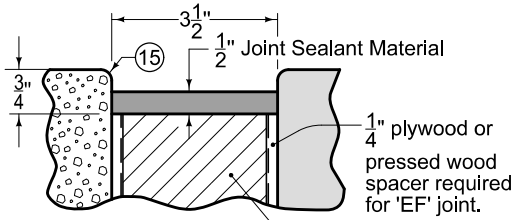
'ED', 'EE', 'EF' 16
DOWELED EXPANSION JOINT



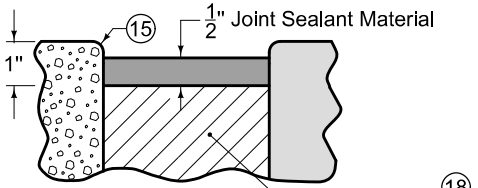
SECTION B-B



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

SUDAS | IOWA DOT

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FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 5 of 8

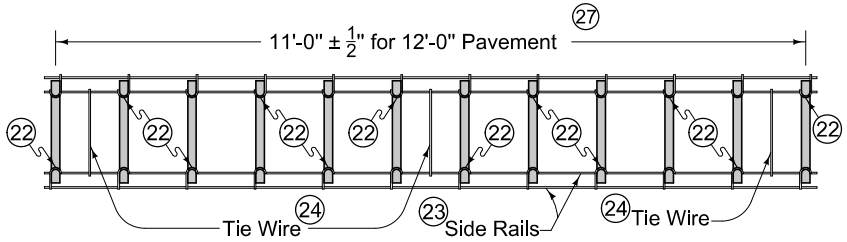
REVISIONS: Modified circle note 32.

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

JOINTS

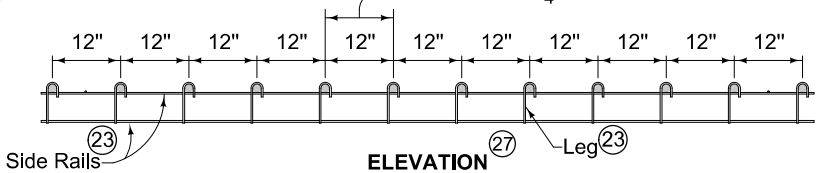
FIGURE 7010.101 SHEET 5 OF 8

CONTRACTION JOINTS

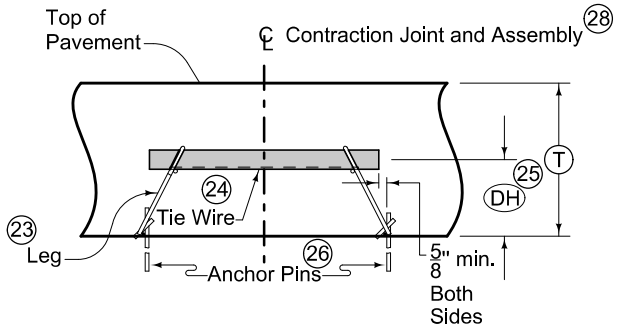


PLAN

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



ELEVATION



LONGITUDINAL SECTION

DOWEL ASSEMBLIES (19) (20) (21)

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

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

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

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

(22) Weld alternately throughout.

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

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

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

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

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

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

FIGURE 7010.101 | SHEET 6 OF 8

SUDAS | IOWADOT | REVISION 11 04-19-22

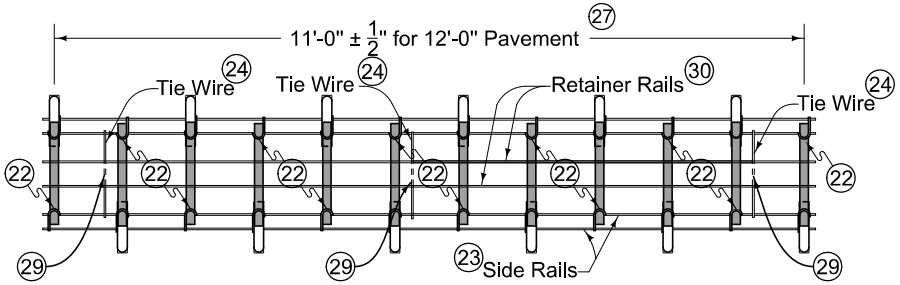
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 6 of 8

REVISIONS: Modified circle note 32.

Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

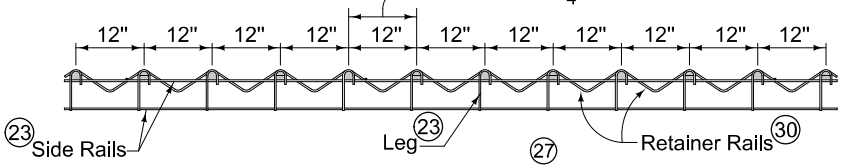
JOINTS

EXPANSION JOINTS

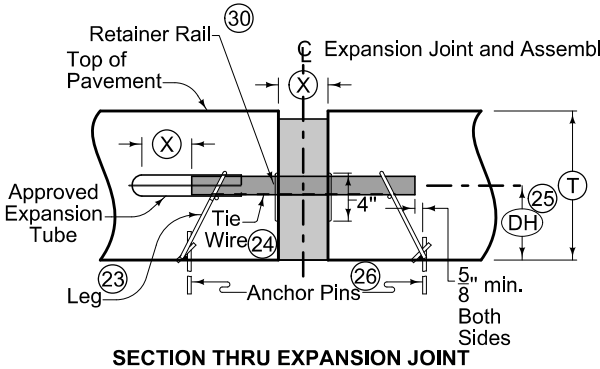


PLAN

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



ELEVATION



SECTION THRU EXPANSION JOINT

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

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

DOWEL ASSEMBLIES (19) (20) (21)

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

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

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

(22) Weld alternately throughout.

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

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

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

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

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

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

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

(30) 1/4 inch diameter wire.

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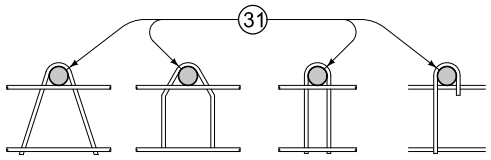
FIGURE 7010.101 | STANDARD ROAD PLAN | PV-101 | SHEET 7 of 8

REVISIONS: Modified circle note 32.

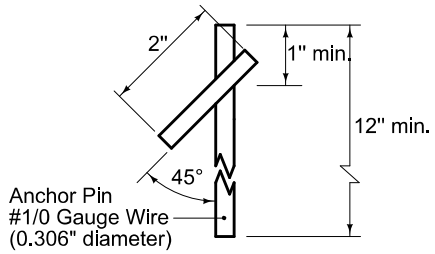
Paul D. Wigard, SUDAS DIRECTOR — DESIGN METHODS ENGINEER

JOINTS

FIGURE 7010.101 | SHEET 7 OF 8



OPTIONAL LEG SHAPES



ANCHOR PIN

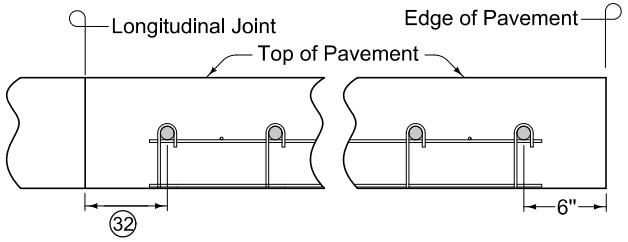
(19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.

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

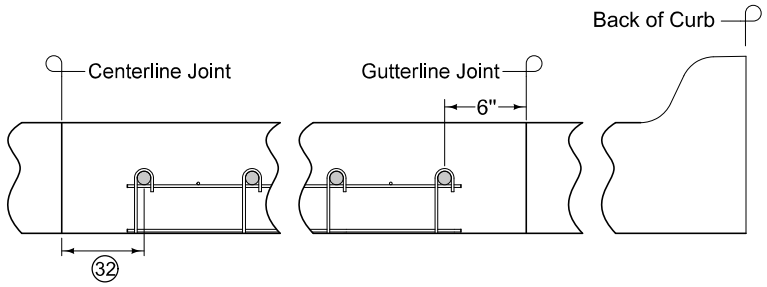
(21) Details apply to both transverse contraction and expansion joints.

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

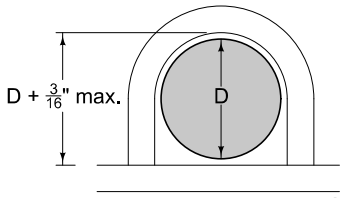
(32) For uniform lane widths: 3 to 6 inches. For taper and variable width pavements: 3 to 12 inches.



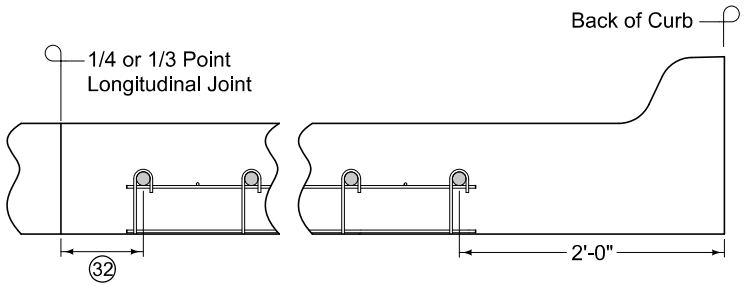
PLACEMENT LIMITS
(Rural Section)



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

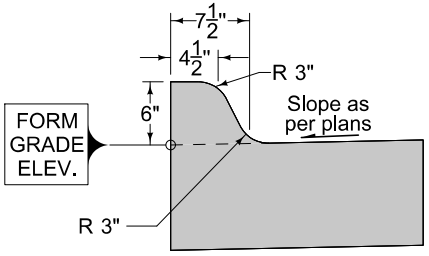
SUDAS	IOWA DOT	REVISION 11 04-19-22
FIGURE 7010.101	STANDARD ROAD PLAN	PV-101
		SHEET 8 of 8

REVISIONS: Modified circle note 32.

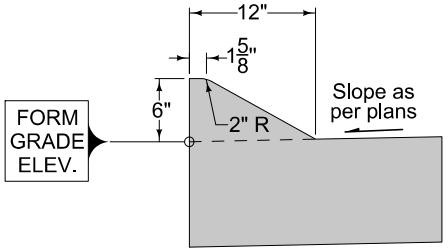
Paul D. Wigand
SUDAS DIRECTOR

Steven Nichols
DESIGN METHODS ENGINEER

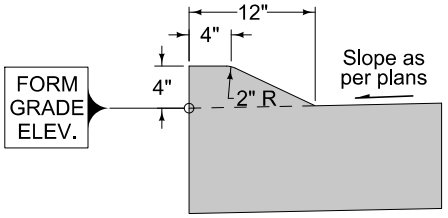
JOINTS



6" STANDARD CURB



6" SLOPED CURB



4" SLOPED CURB

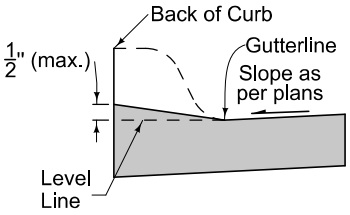
For joint details, see PV-101.

(1) 6 inch Standard Curb, 6 inch Sloped Curb, or 4 inch Sloped Curb as specified.

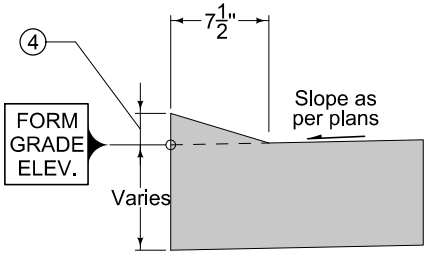
(2) ⅛ inch if Proposed Pavement is HMA. No elevation difference if Proposed Pavement is PCC.

(3) 'BT' , 'KT', or 'L' joint if Proposed Pavement is PCC. 'B' joint if Proposed Pavement is HMA.

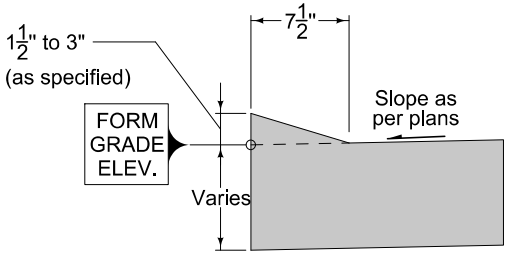
(4) 0 to 2 inches for residential entrances. 1½ to 3 inches for industrial or commercial entrances.



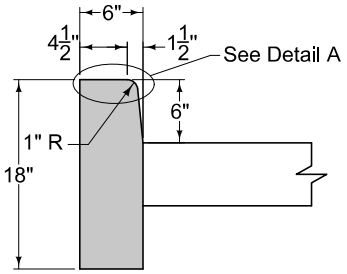
DROP CURB AT SIDEWALK



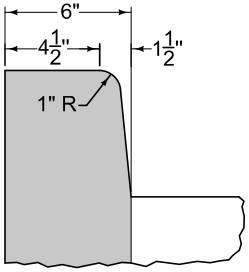
DRIVEWAY DROP CURB (IowaDepartment of Transportation is not the Contracting Authority)



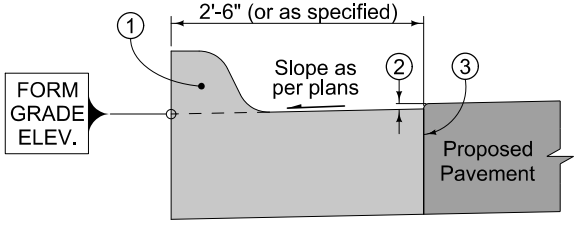
DRIVEWAY DROP CURB (Iowa Department of Transportation is the Contracting Authority)



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



DETAIL A



CURB AND GUTTER UNIT

FIGURE 7010.102

SHEET 1 OF 2

SUDAS | IOWA DOT

REVISION 5 04-21-20

PV-102

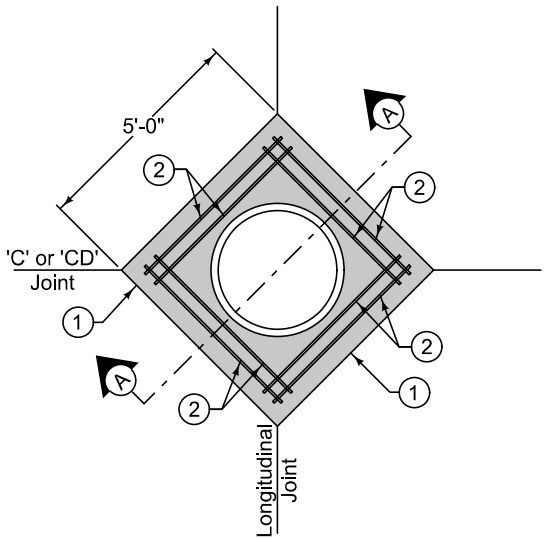
FIGURE 7010.102 | STANDARD ROAD PLAN | SHEET 1 of 2

REVISIONS: Split DRIVEWAY DROP CURB detail into two details. Added new circle note 4 on Sheet 1. Renumbered circle note on Sheet 5.

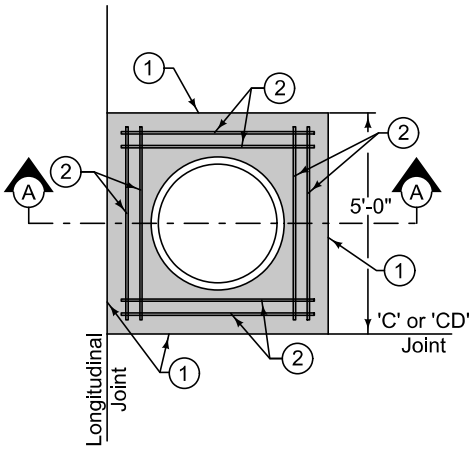
Paul D. Wigant — SUDAS DIRECTOR

Stuart Nicholson — DESIGN METHODS ENGINEER

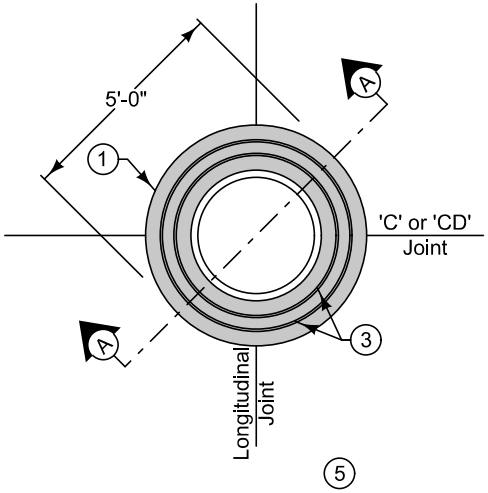
PCC CURB DETAILS



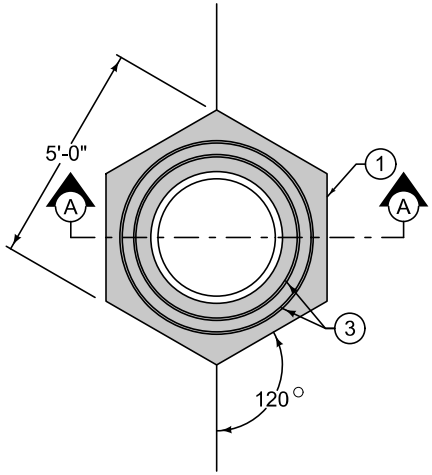
AT JOINT INTERSECTION



OFFSET AT JOINT INTERSECTION



CIRCULAR (5)



AT A SINGLE JOINT

Construct boxout with Class C concrete or match pavement class. Minimum 2 inches clear on reinforcement. Minimum 12 inches of concrete between outside of casting and nearest joint. Center casting within boxout area if possible.

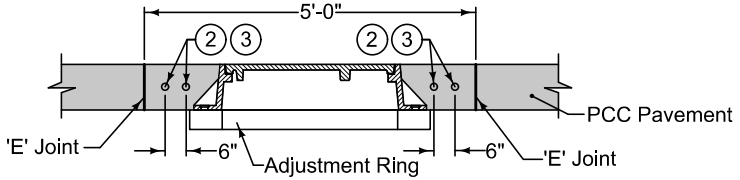
(1) 'KT-1', 'KT-2', 'BT-1', or 'BT-2' joint if three-piece floating casting (SW 601 Type B and D or SW-602 Type F) is used. 'E' joint if two-piece fixed casting (SW 601 Type A and C or SW-602 Type E) is used.

(2) 4 foot 8 inch (typ.) #4 bar. Place at mid-slab.

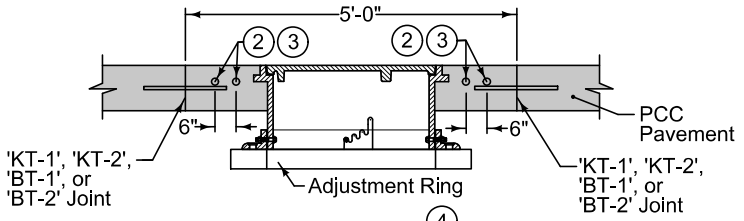
(3) #4 hoops (variable length). Place at mid-slab.

(4) No boxout is required for three-piece floating castings (SW 601 Type B and D or SW-602 Type F). If a boxout is used with a three-piece casting, construct as detailed in Section A-A for three-piece floating casting.

(5) If a circular boxout is cut and extracted after PCC construction, a 'B' joint may be substituted for the 'E' joint if approved by the Engineer.



SECTION A-A
(For two-piece fixed casting)



SECTION A-A (4)
(For three-piece floating casting)

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FIGURE 7010.103 | STANDARD ROAD PLAN | PV-103

SHEET 1 of 1

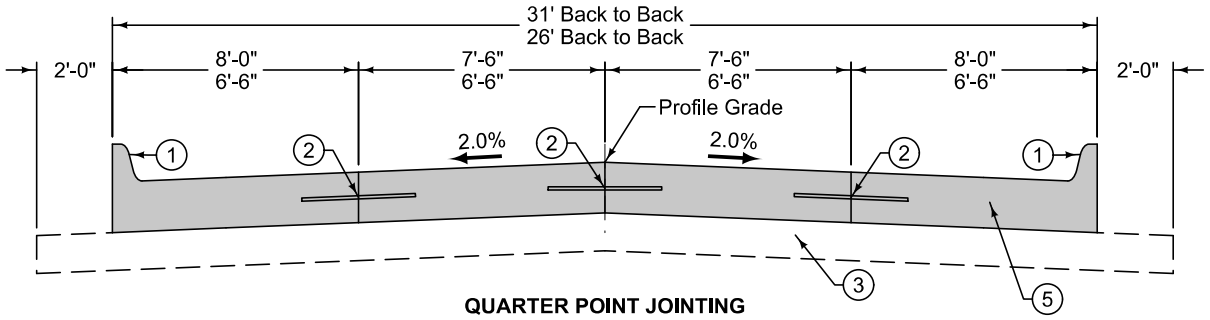
REVISIONS: Added note 5.

Paul D. Wigand
SUDAS DIRECTOR

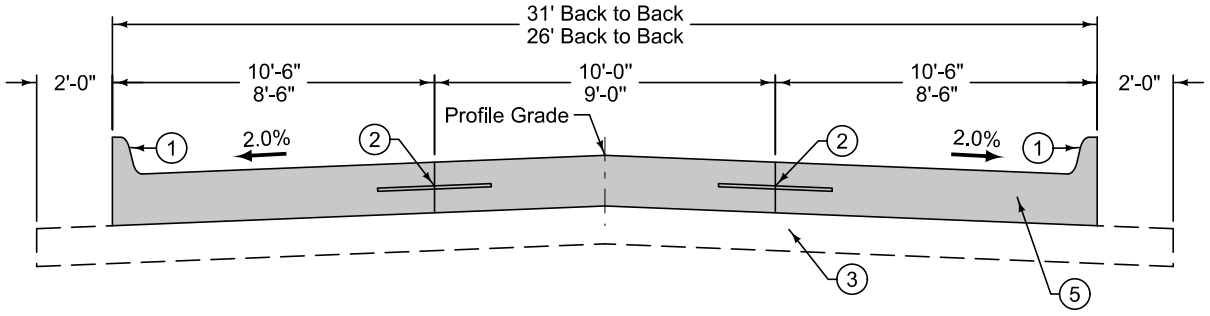
Steven Nichols
DESIGN METHODS ENGINEER

MANHOLE BOXOUTS IN PCC PAVEMENT

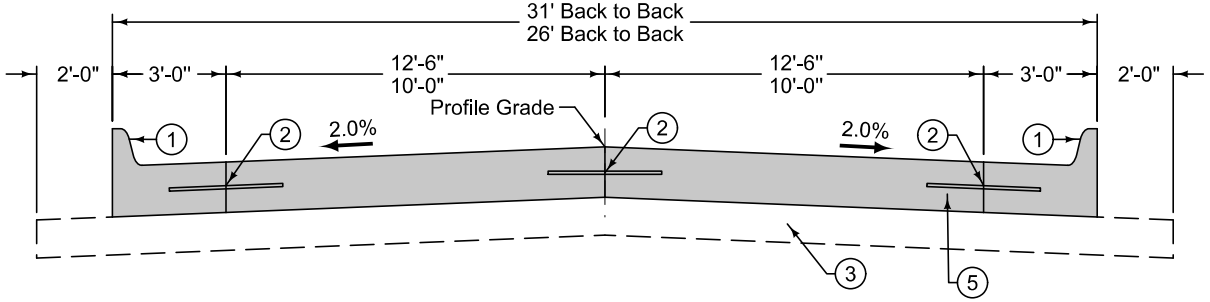
FIGURE 7010.103 | SHEET 1 OF 1



QUARTER POINT JOINTING



THIRD POINT JOINTING



GUTTERLINE JOINTING

(1) 6 inch standard curb.

(2) BT, KT, or L joint depending on pavement thickness and construction staging.

(3) Subbase or subgrade as specified.

(4) Unless otherwise specified in the contract documents.

(5) No dowels within 24" of the back of curb. With gutterline joint, place first dowel 6 inches from the joint. See Figure 7010.101, Sheet 8.

TRANSVERSE JOINT REQUIREMENTS (4)		
Pavement Thickness	Transverse Joint Type	Transverse Joint Spacing
6"	C	12'
7"	C	15'
8"	CD (5)	15'
9"	CD (5)	15'
≥10"	CD (5)	17'

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7010.901

SHEET 1 of 1

SUDAS Standard Specifications

PCC PAVEMENT JOINTING

FIGURE 7010.901 | SHEET 1 OF 1

3.02 CONSTRUCTION (Continued)

E. Unbonded Overlay Surface Preparation: Clean the existing pavement surface immediately prior to paving to remove dirt or debris.

1. Over PCC with HMA Separation Layer:
a. Do not scarify the existing PCC surface if an HMA separation layer will be constructed.
b. Use Class II compaction except use only static steel wheeled rollers complying with Iowa DOT Articles 2303.03 and 2303.04.

2. Over PCC with Geotextile Fabric Separation Layer:
a. Limit ridges on milled surfaces to 1/4 inch maximum height.
b. Roll fabric onto pavement and pull fabric tight without wrinkles.
c. Do not place more fabric than can be paved over within one day.
d. Overlap adjacent rolls by 8 inches ± 2 inches. No more than three layers should overlap.
e. Fasten fabric to existing pavement with pneumatic driven nails every 6 feet or less or secure the geotextile with 3M HoldFast 70 Cylinder Spray Adhesive or approved equal. Apply adhesive to all edges of the fabric and as needed to prevent shifting or folding of the fabric during concrete placement.

3. Over HMA:
a. Mill high spots in the existing asphalt surface as specified in the contract documents.
b. Remove all loose asphalt material after milling.

F. Existing Pavement Loading:

1. Do not allow concrete delivery trucks to travel over existing pavement unless approved by the Engineer. If approved, limit cleaning and water misting of the existing pavement to just ahead of the paving machine.

2. Do not allow loads in excess of the legal axle load on the existing pavement.

3. Partially loaded trucks may be required to prevent damage to the existing pavement. If asphalt thickness after milling is 3 inches or less, reduce loaded truck hauling over the existing pavement.

G. Paving Suspended:

1. Suspend the paving operation where stability of the underlying pavement section has been lost.

2. Do not place concrete on an underlying pavement that has become unstable.

H. Bar and Reinforcement Placement:

1. Tie Bars: When the contract documents require tie bars for widening units greater in thickness than the overlay:
a. Provide No. 4 tie bars.
b. For overlay thickness 4.5 inches or less, secure tie bars to surface of existing pavement.
c. For overlay thickness 5 inches or greater, place tie bars at mid-point of overlay thickness.

3.02 CONSTRUCTION (Continued)

2. Dowel Bars:

a. At least 7 days prior to the beginning of concrete paving, submit a written Quality Control Plan that provides a method for keeping the dowel basket assemblies anchored to the subgrade, the existing pavement, or bond breaker layer and into the underlying pavement. Ensure the Quality Control Plan includes the following:
   1) Proposed type and number of fasteners
   2) Proposed installation equipment
   3) Dowel basket assembly anchoring plan (i.e. anchor all basket assemblies prior to concrete placement, one lane at a time, anchor all basket assemblies during the concrete placement operation, etc.)
   4) Action plan if misaligned baskets are identified during concrete pavement placement

b. Paving operations may be suspended by the Engineer if basket anchoring fails to comply with the Quality Control Plan.

I. Surface Curing:

1. For bonded concrete overlays, apply curing compound at twice the standard rate recommended by the manufacturer.

2. For unbonded concrete overlays 6 inches or thinner, apply curing compound at twice the standard rate recommended by the manufacturer.

3. If PAMS curing compound is specified per Section 7011, 2.01, J, apply at the rate recommended by the manufacturer.

J. Saw Joints:

1. General: Submit a plan for the Engineer's approval, which includes the following items.

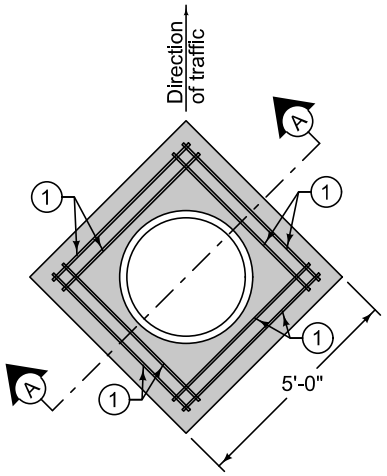
a. Method(s) for assuring adequate sawcut depth in areas of variable concrete overlay thickness.
b. Anticipated production rate of concrete overlay placement.
c. Estimated number of saws necessary to prevent random cracking.
d. Appropriate corrective actions should random cracking occur.
e. Seal all joints unless directed otherwise.

2. Bonded Overlay Over Existing Concrete Pavement: Submit a plan for the Engineer's approval, which includes the following items.

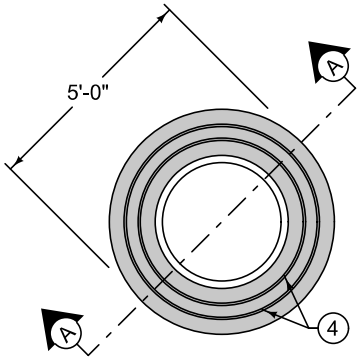
a. Marking of all existing joint locations to ensure that joints in the overlay will be placed directly over all existing joints in the underlying concrete pavement.
b. Transverse Joints:
   1) Saw transverse contraction joints directly over the existing concrete joint the full depth of the overlay plus 1/2 inch (including accommodating variable thickness of the bonded concrete overlay).
   2) Ensure that the width of the sawed transverse joints in the bonded concrete overlay exceeds the width of the crack opening in the underlying joints.
c. Longitudinal Joints: Saw directly over existing joints full depth.

3. Bonded Overlay Over Existing Asphalt or Composite Pavement:

a. Transverse Joint: Saw to a depth of 1/3 of the overlay thickness or no less than 1.25 inches with an early entry saw.
b. Longitudinal Joints: Saw to a depth of 1/3 of the overlay thickness.
c. Expansion Joints: Match expansion joints in the bonded overlay to those in the existing concrete pavement.



RECTANGULAR



CIRCULAR

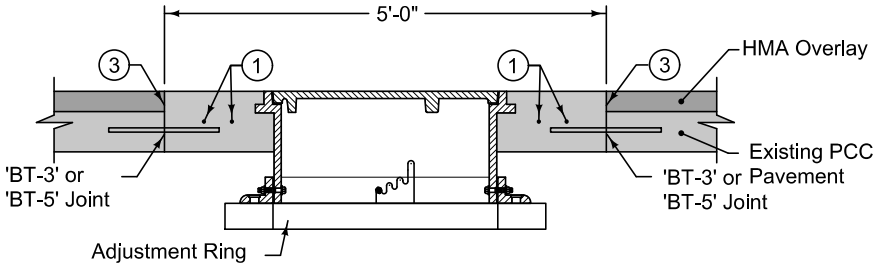
Construct boxout with Class C concrete or match pavement class. Minimum 2 inches clear on reinforcement. Minimum 12 inches of concrete between outside of casting and nearest joint. Center casting within boxout area if possible.

(1) 4 foot 8 inch (typ.) #4 bar. Place at mid-slab.

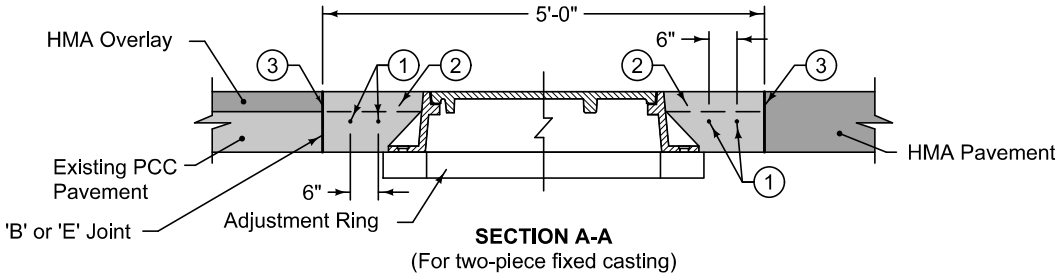
(2) If boxout is constructed prior to placement of HMA overlay or final lift of HMA pavement, boxout may be constructed low, with a 'B' joint in place of the 'E' joint, and then final lift or overlay placed.

(3) Apply tack coat.

(4) #4 hoops (variable length). Place at mid-slab.



SECTION A-A
(For three-piece floating casting)



SECTION A-A
(For two-piece fixed casting)

FIGURE 7020.201 | SHEET 1 OF 1

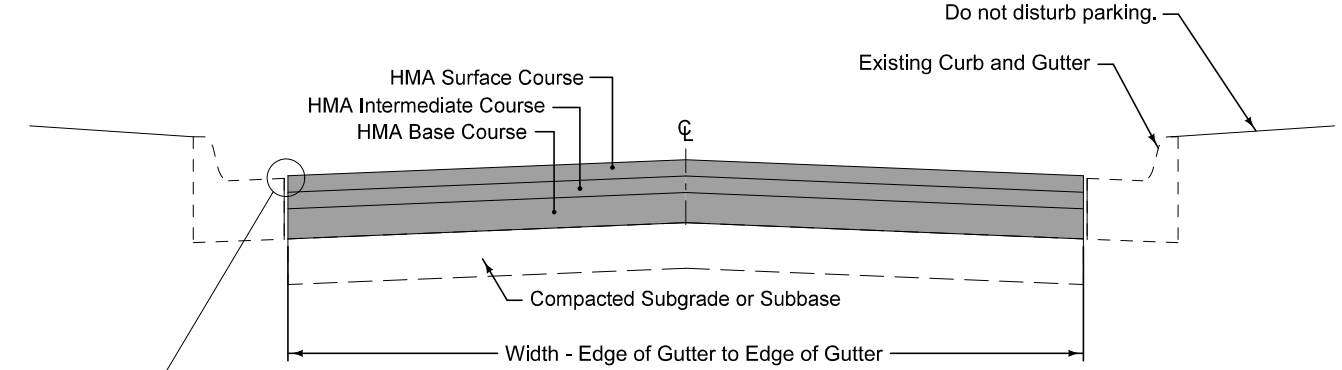
SUDAS | IOWADOT | REVISION 2 04-19-22

FIGURE 7020.201 | STANDARD ROAD PLAN | PV-201 | SHEET 1 of 1

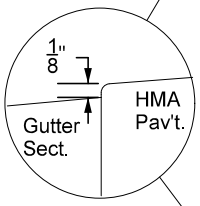
REVISIONS: Added note 12 inch minimum around casting.

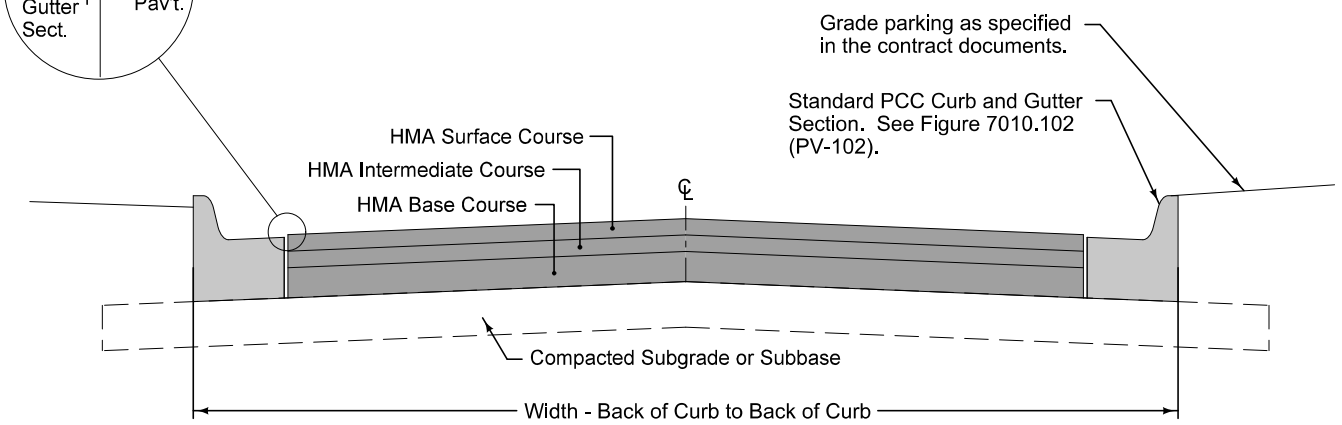
Paul D. Wigand, SUDAS DIRECTOR | Stuart Nicholson, DESIGN METHODS ENGINEER

MANHOLE BOXOUTS IN HMA PAVEMENT AND HMA OVERLAYS



HMA PAVEMENT SECTION
(With Existing Curb and Gutter)





HMA PAVEMENT SECTION
(With New Curb and Gutter)

FIGURE 7020.901

SHEET 1 OF 2

SUDAS

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New 10-19-10

7020.901

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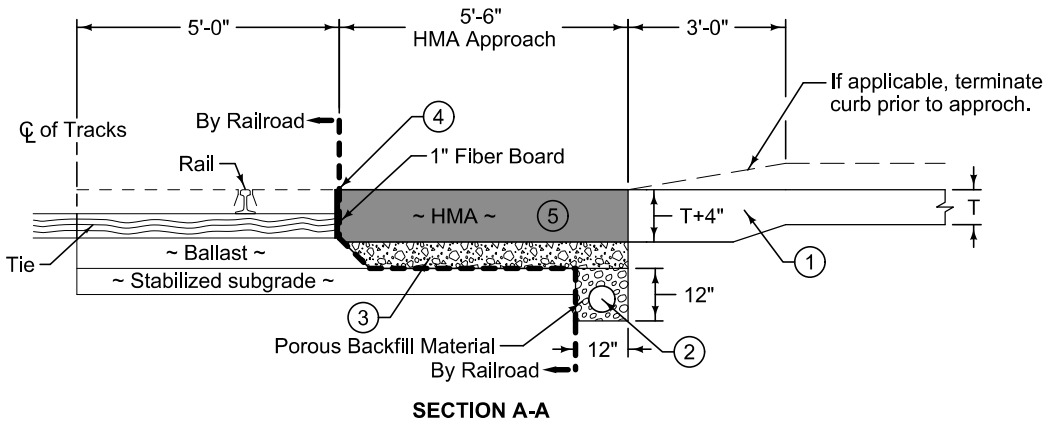
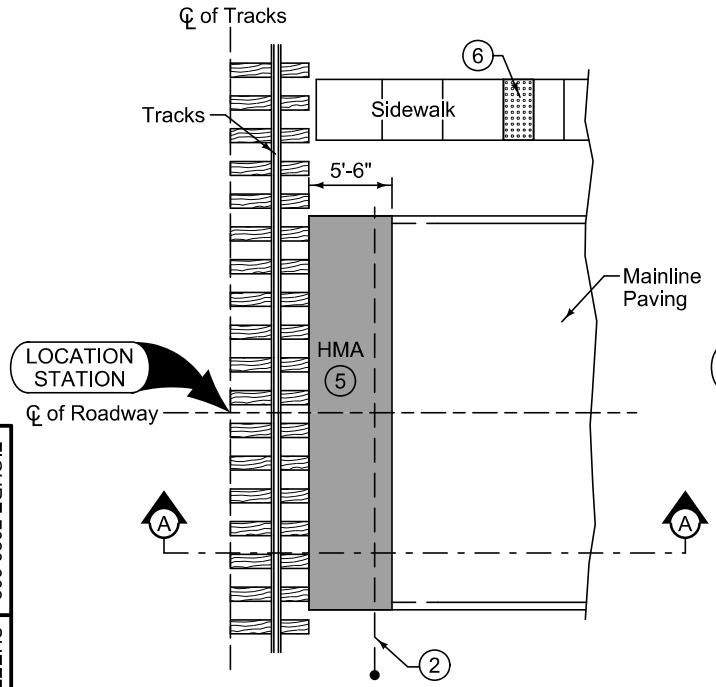
SUDAS Standard Specifications

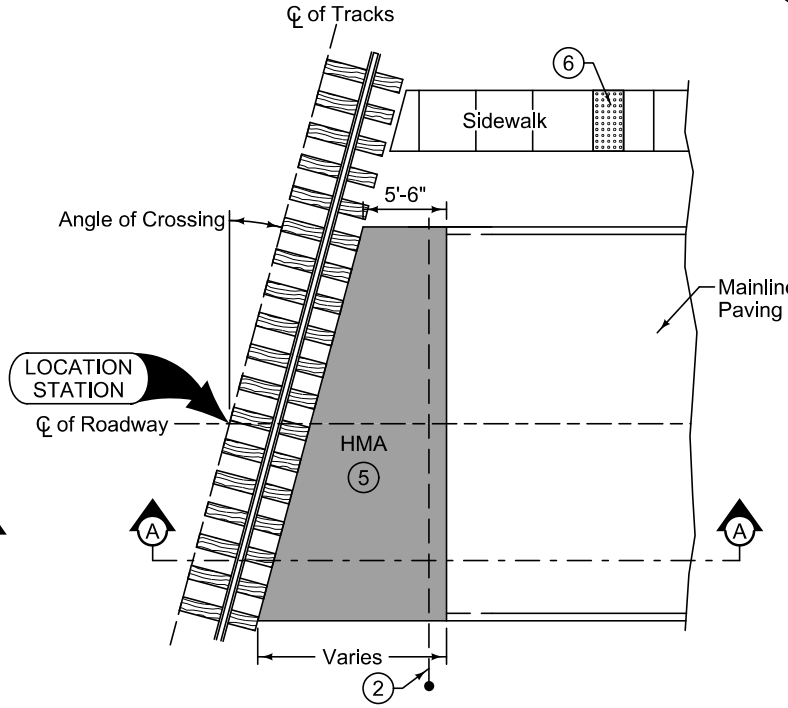
HMA PAVEMENT



SECTION A-A



PLAN VIEW - STRAIGHT CROSSING



PLAN VIEW - SKEWED CROSSING

1. HMA or composite mainline paving.
2. Install 6 inch perforated CMP subdrain, if specified. Include rodent guard per Iowa DOT Materials I.M. 443.01.
3. Granular subbase, modified subbase, or ballast meeting railroad specifications.
4. For new crossings, construct pavement 1/2 inch to 1 inch below top of rail. For existing crossings, construct pavement level to 1/2 inch below top of rail.
5. Construct HMA approach according to full depth HMA patch requirements, or requirements for mainline paving if constructed with HMA mainline.
6. Refer to Figure 7030.205 for detectable warning location.

FIGURE 7020.902

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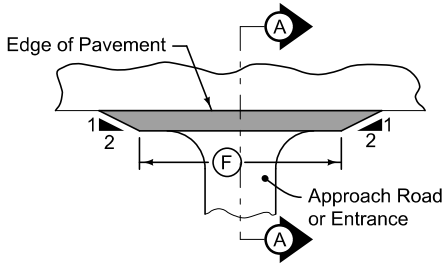
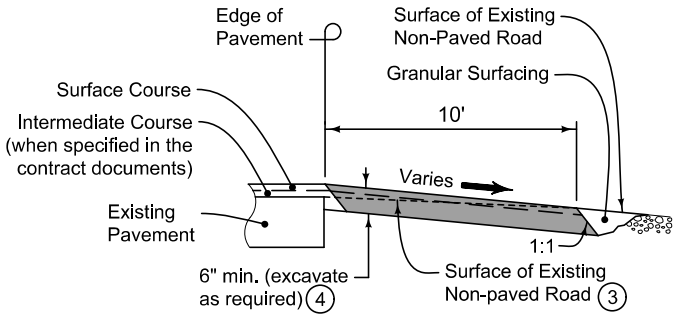
SUDAS Standard Specifications

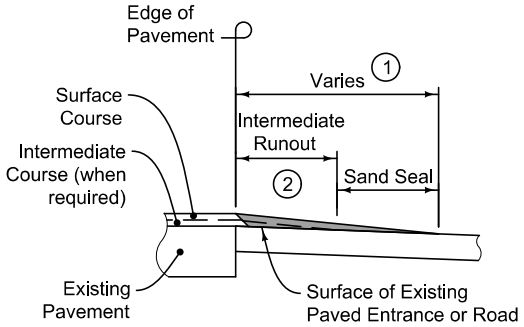
HMA RAILROAD
CROSSING APPROACH



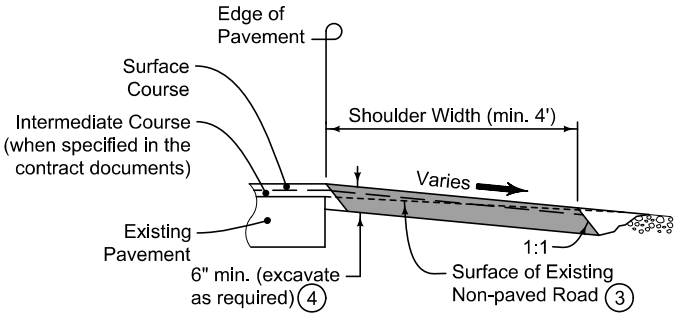
TYPICAL PLAN FOR FILLET AT ENTRANCE OR INTERSECTING ROAD



SECTION A-A
(Full Thickness Fillet - Non-paved Road)



SECTION A-A
(Wedge Shaped Fillet - Paved Entrance or Road)



SECTION A-A
(Full Thickness Fillet - Non-paved Entrance)

MINIMUM FILLET WIDTH		
TYPE OF ACCESS	PRIMARY ROADS (F) ft.	SECONDARY AND LOCAL ROADS (F) ft.
Residential Entrance	40	12
Farm Entrance	60	18
Commercial Entrance	80	24
Non-paved Road	100	30
Paved Road	Variable (5)	Variable (5)

For temporary runouts and wedges, place subgrade paper, burlap, or similar material over adjacent surfaces to facilitate removal. Construct temporary runout at a length of 10 feet for each 1 inch of resurfacing thickness.

Construct wedge shaped asphalt fillets at all paved entrances and paved roads. Construct full thickness fillets at all non-paved entrances and non-paved roads.

1. Width of fillet is 4 feet for each inch of overlay thickness.
2. The runout length of the intermediate course is equal to the total runout length, multiplied by the intermediate course thickness, divided by the total resurfacing thickness.
3. Excavate and shape road or entrance as required to accommodate proposed fillet.
4. For existing fillets at non-paved roads and entrances, construct a wedge shaped fillet matching the thickness of the resurfacing.
5. Match width and shape of existing pavement.

FIGURE 7020.903

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SHEET 1 of 1

SUDAS Standard Specifications

DETAILS FOR ASPHALT PAVING

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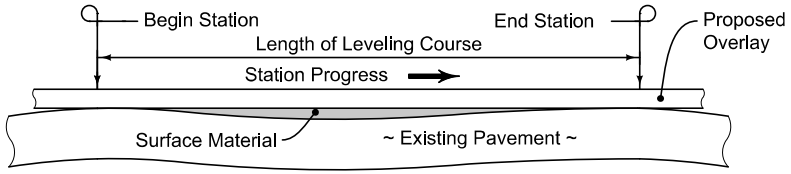
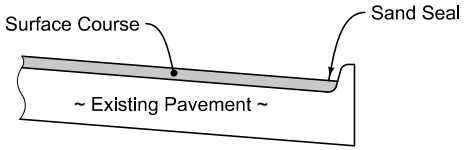
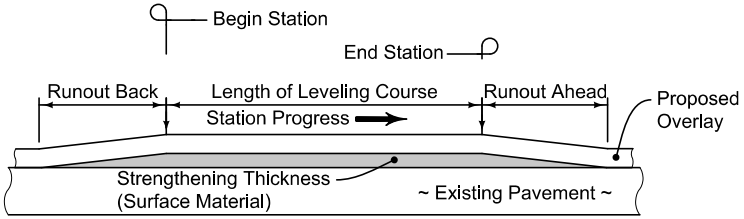


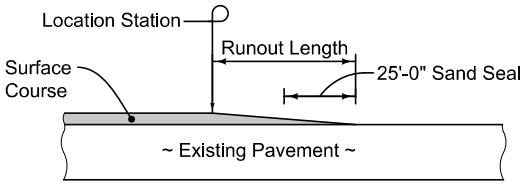
TYPICAL LEVELING COURSE



GUTTERLINE EDGE - MATCH

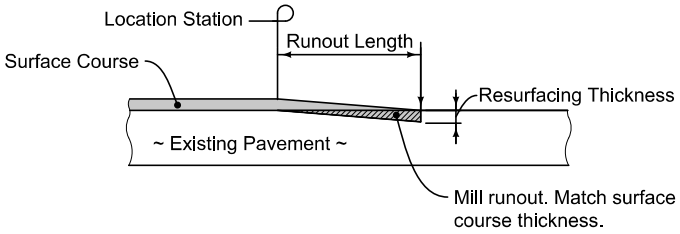


TYPICAL STRENGTHENING COURSE

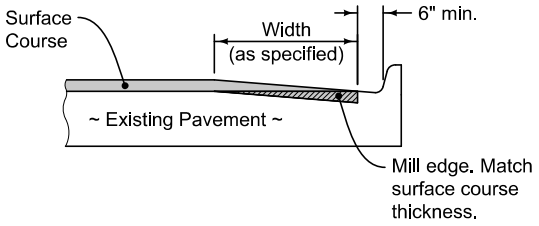


WEDGE SHAPED RUNOUT
(When Milling is not Specified)

RUNOUT LENGTH	
POSTED SPEED LIMIT (mph)	RUNOUT RATIO (ft. per inch)
45 or More	50
20 to 45	25



MILLED SURFACE NOTCH FOR RUNOUT



GUTTERLINE EDGE - NOTCH

SINGLE COURSE RESURFACING

FIGURE 7021.101

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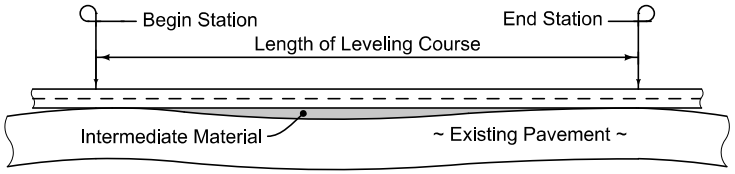
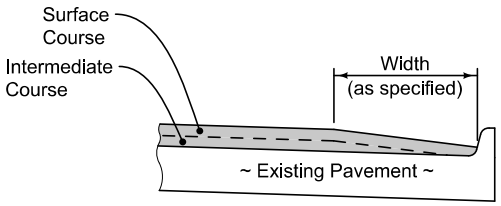
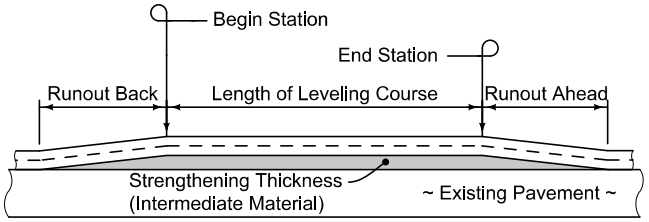
DETAILS FOR ASPHALT RESURFACING



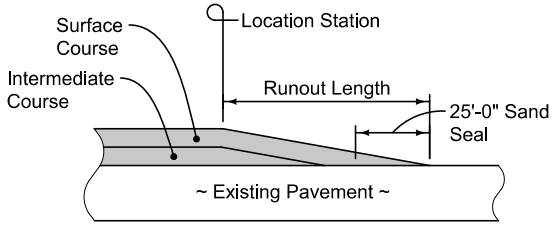
TYPICAL LEVELING COURSE



GUTTERLINE EDGE - MATCH

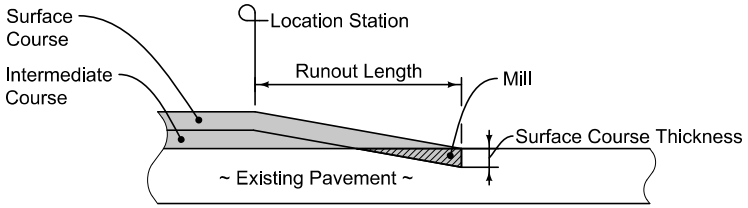


TYPICAL STRENGTHENING COURSE

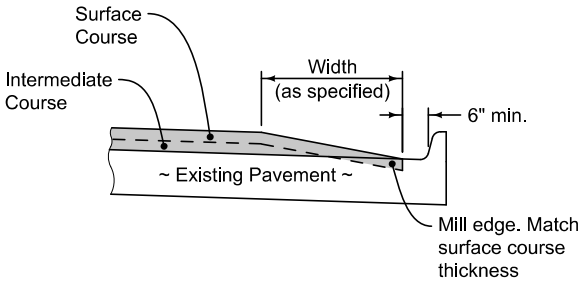


WEDGE SHAPED RUNOUT
(When Milling is not Specified)

RUNOUT LENGTH	
POSTED SPEED LIMIT (mph)	RUNOUT RATIO (ft. per inch)
45 or More	50
20 to 45	25



MILLED SURFACE NOTCH RUNOUT



GUTTERLINE EDGE - NOTCH

DOUBLE COURSE RESURFACING

FIGURE 7021.101 SHEET 2 OF 2

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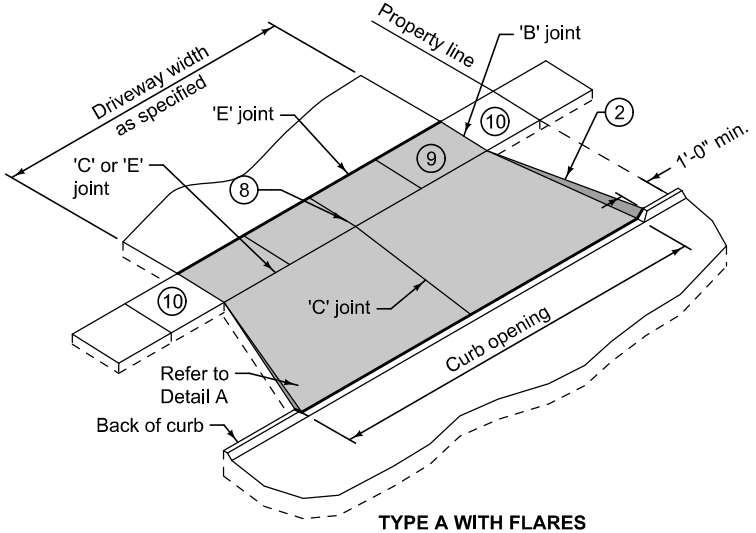
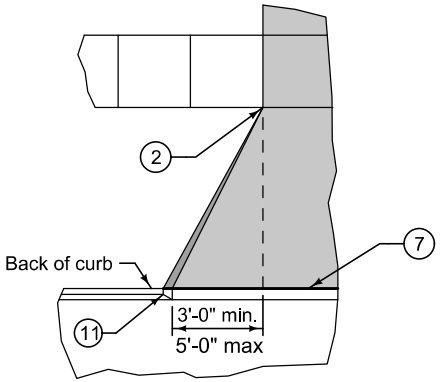
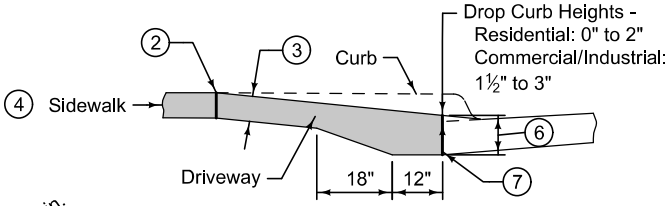
DETAILS FOR ASPHALT RESURFACING



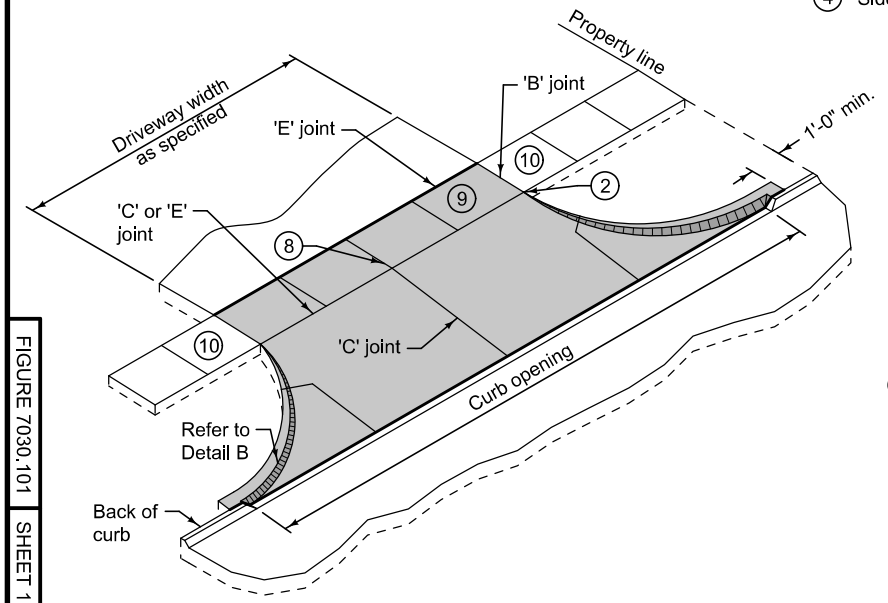
TYPE A WITH FLARES



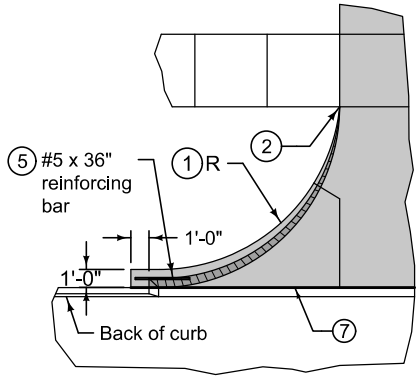
DETAIL A
(Residential/Agricultural Only)



TYPICAL SECTION



TYPE A WITH RADII



DETAIL B

1. Driveway radius (R).
   Residential: 10 foot minimum,15 foot maximum.
   Commercial and industrial: As specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb across sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. Center reinforcing bar vertically in the pavement.
6. Match thickness of adjacent roadway, 8 inches minimum.
7. Provide 'E' joint at back of curb unless 'B' joint is specified.
8. For alleys, invert the pavement crown 2% toward center of alley.
9. Target cross slope of 1.5% with a maximum cross slope of 2.0%. If specified in the contract documents, construct the sidewalk through the driveway 5 feet wide to serve as a passing space.
10. If cross slope of adjacent sidewalk panel exceeds 2.0%, remove and replace to transition from existing sidewalk to sidewalk through driveway. If elevation change requires a curb ramp, comply with Figure 7030.205; verify need for detectable warning panel with Engineer.
11. Transition street curb at minimum 1:1 slope to meet driveway curb.

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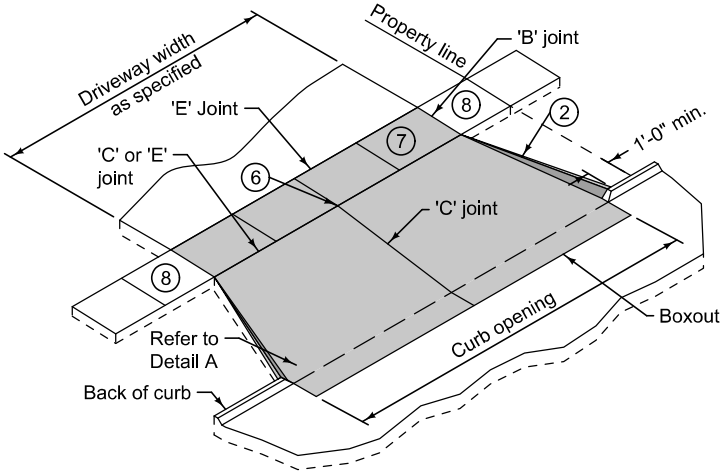
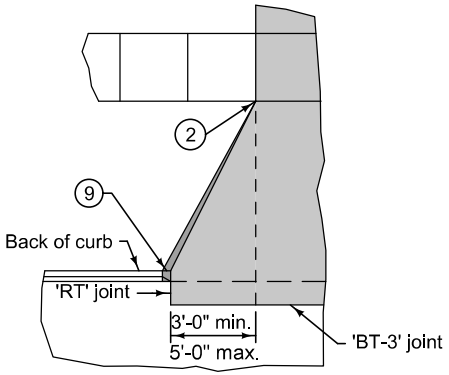
CONCRETE DRIVEWAY, TYPE A

FIGURE 7030.101 | SHEET 1 OF 1

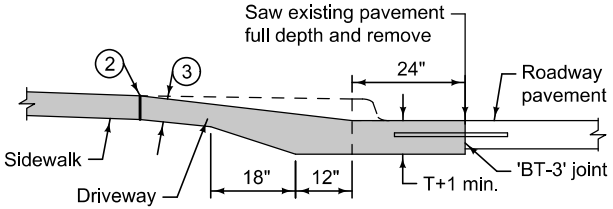


TYPE B WITH FLARES

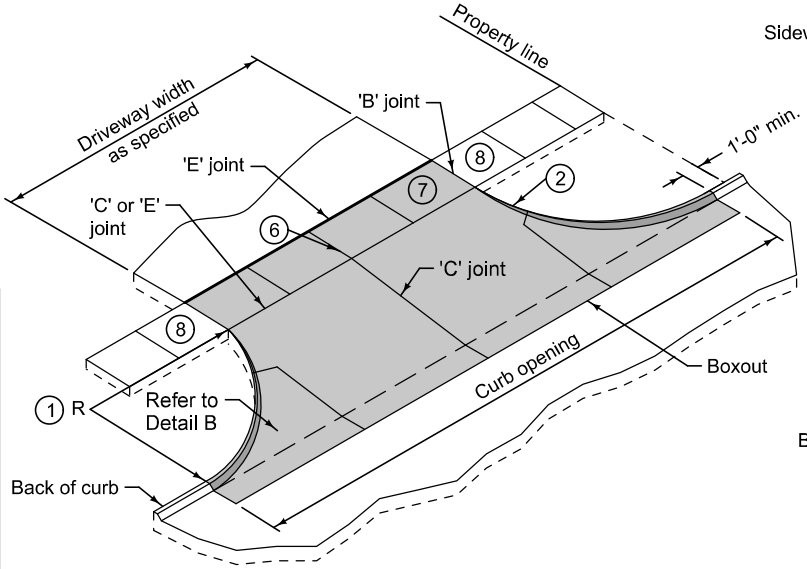


DETAIL A

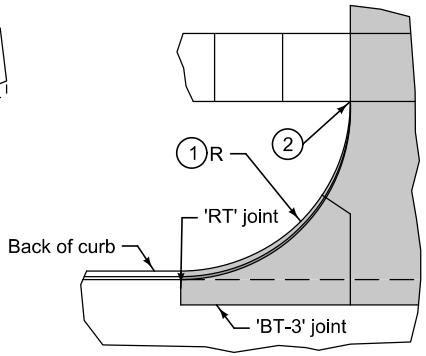
(Residential/Agricultural Only)



SECTION A-A



TYPE B WITH RADII



DETAIL B

1. Driveway radius (R).
   Residential: 10 foot minimum, 15 foot maximum.
   Commercial and industrial: As specified in the contract documents.
2. Transition the curb height to 0 inches at end of taper/radius or at the front edge of sidewalk. Do not extend raised curb cross sidewalk.
3. Pavement thickness.
   Residential: 6 inches minimum.
   Commercial and industrial: 7 inches minimum.
4. Sidewalk thickness through driveway to match thickness of driveway.
5. If longitudinal joint is located 48 inches or less from the back of curb, extend boxout to joint line. Full depth saw cut is still required.
6. For alleys, invert the pavement crown 2% toward the center of the alley.
7. Target cross slope of 1.5% with a maximum cross slope of 2.0%. If specified in the contract documents, construct the sidewalk thorugh the driveway 5 feet wide to serve as a passing space.
8. If cross slope of adjacent sidewalk panel exceeds 2.0%, remove and replace to transition from existing sidewalk to sidewalk through driveway. If the elevation change requires a curb ramp, comply with Figure 7030.205; verify need for detectable warning panel with Engineer.
9. Transition street curb at minimum 1:1 slope to meet driveway curb.

FIGURE 7030.102 | SHEET 1 OF 1

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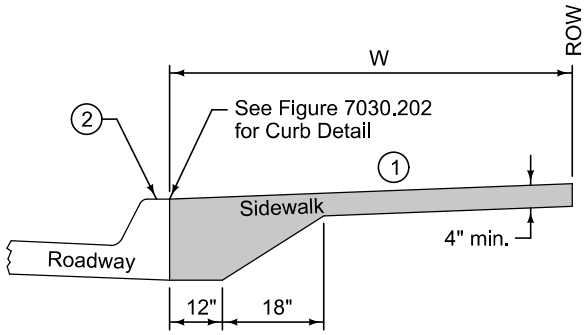
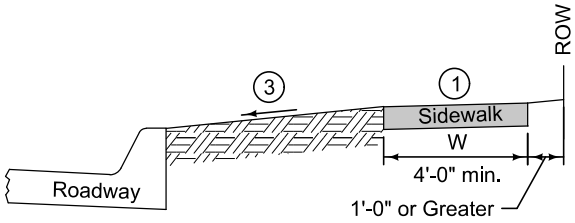
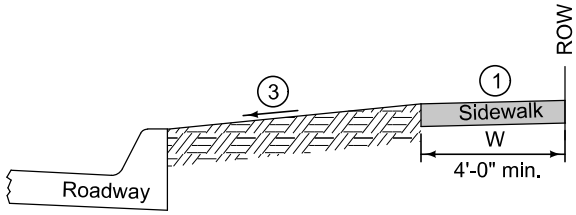
CONCRETE DRIVEWAY, TYPE B



CLASS A SIDEWALK
(Sidewalk extends from
back of curb to ROW)



CLASS B SIDEWALK



CLASS C SIDEWALK

(1) Target cross slope of 1.5% with a maximum cross slope of 2.0% (including sidewalk through driveway).

(2) Ensure top of curb slopes to street for drainage.

(3) Parking Slopes:
If parking width is less than 10 feet wide, slope at ¼ inch per foot.

If parking width is 10 feet wide and greater, slope at ½ inch per foot.

Special grade may be specified in the contract documents.

W = Sidewalk width as specified in the contract documents.

FIGURE 7030.201 | SHEET 1 OF 1

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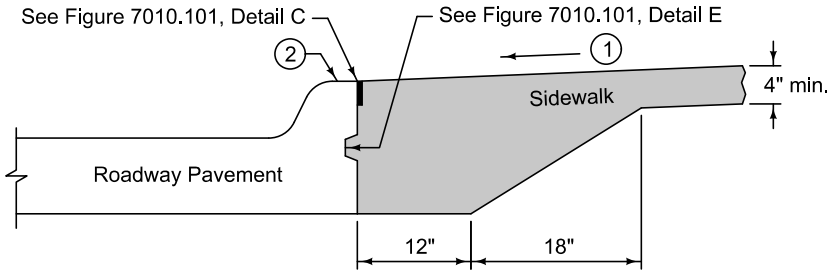
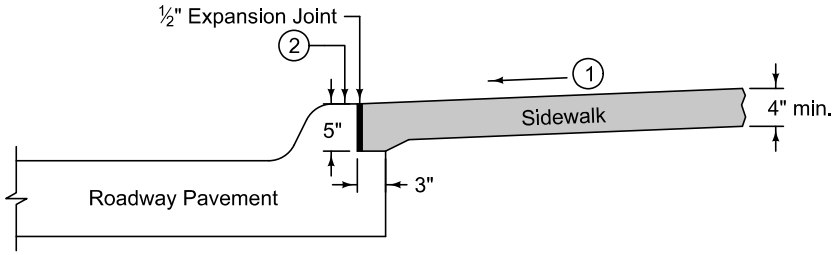
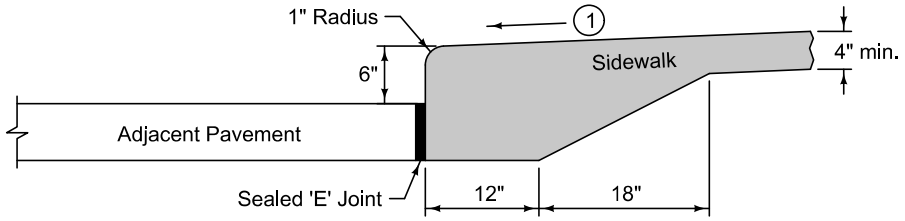
CLASSES OF SIDEWALKS



DETAIL 1



DETAIL 2



DETAIL 3

For new sidewalk with new curb and gutter, comply with Detail 1 or Detail 2. Comply with Detail 3 for new sidewalk adjacent to existing pavement or when specified in the contract documents.

(1) Target cross slope of 1.5% with a maximum cross slope of 2.0%.

(2) Ensure top of curb slopes to street for drainage.

FIGURE 7030.202

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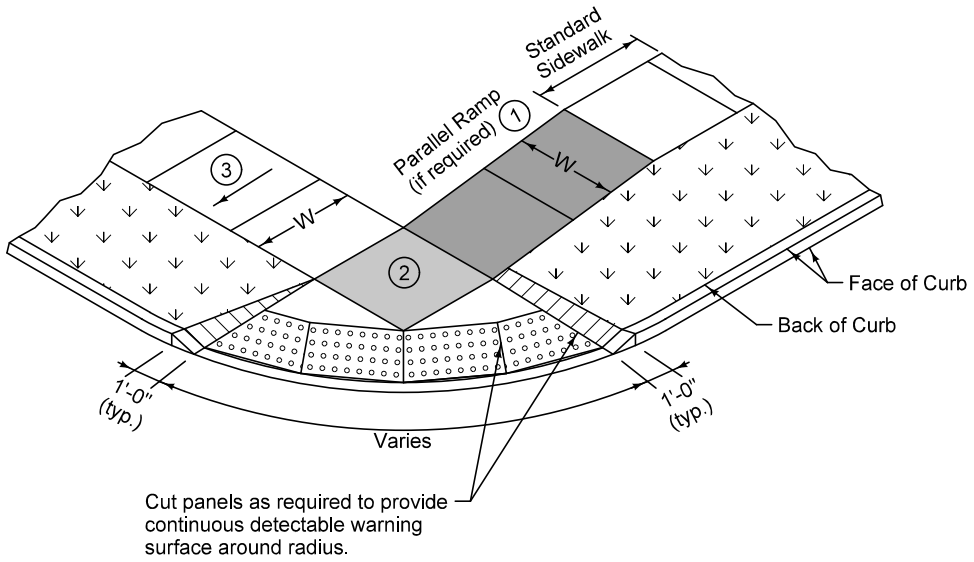
CURB DETAILS FOR CLASS A SIDEWALK



1. Parallel Curb Ramp: If normal sidewalk elevation cannot be achieved with the perpendicular ramp between the street and landing due to limited ramp length, provide a parallel ramp to make up the elevation difference between the landing and the standard sidewalk.

   The length of the parallel ramp is not required to exceed 15 feet, regardless of the resulting slope. Do not exceed 8.3% slope for parallel ramps shorter than 15 feet.

2. Turning Space: Target slope of 1.5% with maximum slope perpendicular to the direction of travel of 2.0%. Minimum 4 feet by 4 feet.

3. Target cross slope of 1.5% with a maximum cross slope of 2.0%.

Key

- Curb Ramp
- Turning Space
- Detectable warning
- Grass

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ALTERNATIVE CURB RAMP FOR CLASS B OR C SIDEWALK

FIGURE 7030.208 | SHEET 1 OF 1

3.02 FULL DEPTH PATCHING (Continued)

5. Smooth the final lift with a steel-tired finish roller. Ensure the final compacted surface is level with, or no more than 1/8 inch above, the adjacent pavement and has a smooth riding surface. If the patch becomes distorted for any reason, smooth the surface by blading, scraping, grinding, filling, or other approved means.

6. Do not extend patch material beyond the edge of the existing pavement; remove patch material that extends outside the patch limits.

7. Do not open to traffic until the mixture has cooled sufficiently to provide stability.

3.03 PARTIAL DEPTH PATCHING

A. Pavement Removal:

1. Ensure all patches are square or rectangular in shape.

2. For removal by the saw and chip method, cut at the designated removal limits to a minimum depth of 2 inches and a maximum depth of T/2 or the top of the dowels in PCC pavement. For PCC patches, taper the sides of the removal area 30 to 60 degrees from vertical using a pneumatic hammer to eliminate the polished face.

3. Using a 15 pound maximum size pneumatic hammer, remove the deteriorated pavement down to sound pavement. A 30 pound pneumatic hammer may be used if it does not result in damage to the patch area and edges.

4. In lieu of sawing and removal with a pneumatic hammer, the designated patch area may be milled to the prescribed depth. Milling equipment must provide tapered edges 30 to 60 degrees from vertical for PCC patches. Chip out secondary spalling resulting from milling at no additional cost to the Contracting Authority.

5. Remove pavement to the appropriate depth. Do not damage steel reinforcement during the removal process on PCC pavements. Damaged steel will be the responsibility of the contractor. If the end of a dowel bar is exposed, cut and remove the bar. Place duct tape, form oil, grease or use other method approved by the Engineer as a bond breaker on dowels not removed. If the required depth to sound pavement exceeds the maximum T/2 removal depth, construct a full depth patch.

B. PCC Patch Placement:

1. Clean removal area by sandblasting or water blasting, followed by airblasting, until the area is clean and dry. Ensure the compressed air used for cleaning is oil and moisture free. Place concrete the same day as cleaning.

2. Install preformed compression relief material in joints or cracks or tool the joint in the plastic concrete. Use material equal in width to the adjacent joint or crack at the patch boundary. For wide openings, use multiple thicknesses. Compression relief material is to extend at a minimum of 1/4 inch below the bottom of the patch so as to completely separate all patching material on both sides and 3 inches beyond the patch boundaries. If tooling of the joint is specified, complete a relief saw cut to the full depth of the patch plus 1/4 inch as soon as the concrete has reached proper set.

3. Thoroughly coat the bottom and sides of the patch area with a cement grout immediately prior to placement of concrete. Do not allow grout to set prior to placement of concrete. Remove grout set by sandblasting and reapply.

3.03 PARTIAL DEPTH PATCHING (Continued)

4. Deposit concrete in the patch; finish patch from the center outward. Ensure concrete does not infiltrate into existing cracks or joints.

5. Apply joint filler material to expansion joints. At the interface between the patch and the slab, apply sand-cement grout to fill and seal the edge. Position the grout so 1 inch is over the surrounding pavement and 3 inches are over the patch.

6. Texture the patch similar to the adjacent surface.

7. Cure patch according to Section 7040, 3.02.

8. Fill joints according to Section 7040, 3.06. Complete filling within 5 calendar days after patch is placed.

C. HMA Patch Placement:

1. Clean removal area by airblasting until the area is clean and dry. Ensure the compressed air used for cleaning is moisture free.

2. Cover the entire removal area with tack coat 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 with an adequately weighted pneumatic tire roller or by tamping with a mechanical tamper. Succeeding lifts may be placed as soon as the preceding lift has been properly compacted.

5. Smooth the final lift with a steel-tired finish roller. Ensure the final compacted surface is level with, or no more than 1/8 inch above, the adjacent pavement and has a smooth riding surface. If the patch becomes distorted for any reason, smooth the surface by blading, scraping, grinding, filling, or other approved means.

6. Do not open to traffic until the mixture has cooled sufficiently to provide stability.

3.04 DIAMOND GRINDING

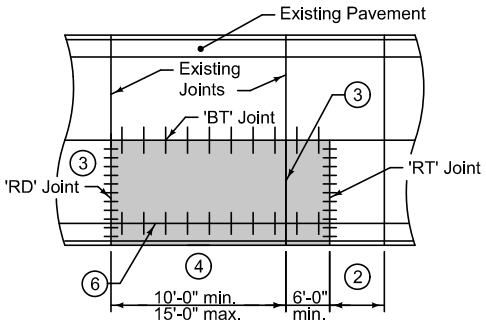
A. Use equipment complying with Iowa DOT Article 2532.03, A.

B. Grind and texture the entire surface of the pavement parallel to the centerline until the pavement surface on both sides of transverse joints and all cracks are in the same plane with no greater than 1/16 inch difference between adjacent sides of joints and cracks and the pavement surface meets the required smoothness. Feather grind into existing structures such as manholes and water valves in a manner that eliminates abrupt edges or drops and provides a uniform texture.

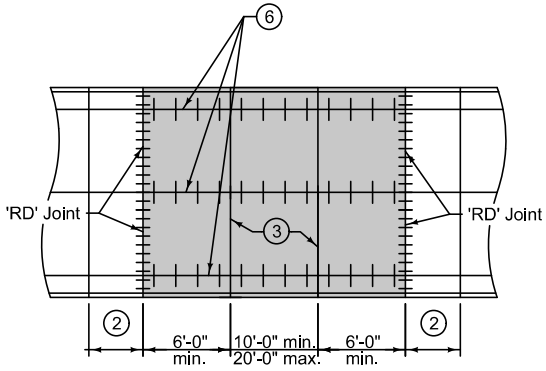
C. Ensure the ground surface is of uniform texture. In each lane, ensure at least 95% of the area in each 100 foot section has a newly textured surface. Depressed pavement areas due to subsidence or other localized causes and areas containing feathering due to pavement structures will be exempted from texturing requirements.

D. Except at joints and cracks, ensure grinding depth does not exceed 1/2 inch. At joints and cracks, ensure grinding depth does not exceed 3/4 inch.

GUTTERLINE JOINTING

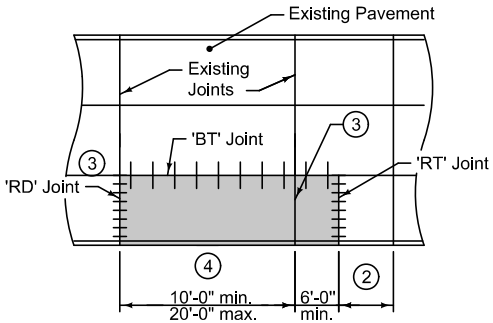


ONE PANEL WIDTH PATCH

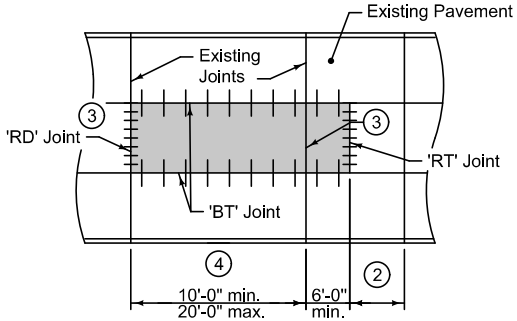


FULL ROADWAY WIDTH PATCH

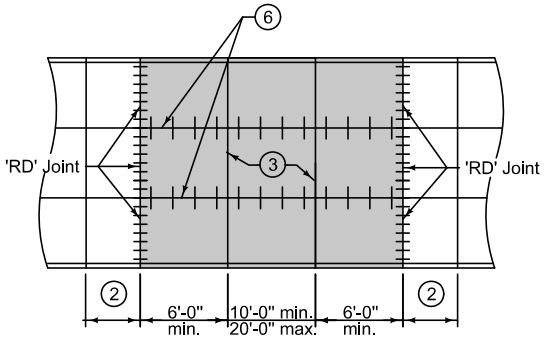
THIRD POINT JOINTING (1)



OUTSIDE PANEL PATCH



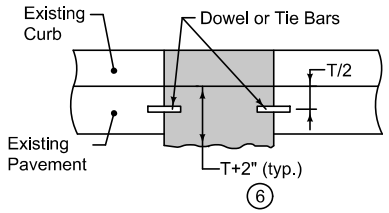
CENTER PANEL PATCH



FULL ROADWAY WIDTH PATCH

1. Patches on roadways with quarter point jointing will be similar to third point jointing details.
2. Minimum distance between existing joint and patch is 6 feet. If distance is less than 6 feet, extend patch to existing joint.
3. Match existing joint type and locations. If specified, replace existing 'C' joints with 'CD' joints.
4. If existing joint spacing is greater than 20 feet, add a 'CT' joint at mid-panel.
5. If subgrade or subbase material is required below patch, bring material to a level 2 inches below bottom of existing pavement.
6. BT, KT, or L joint depending on pavement thickness and pouring sequence

LONGITUDINAL SECTION THRU PCC PATCH



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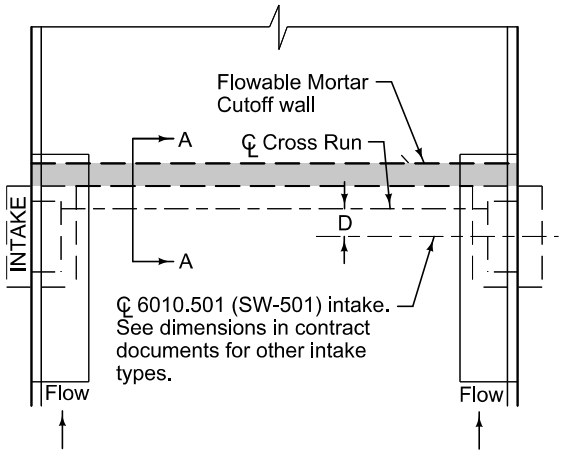
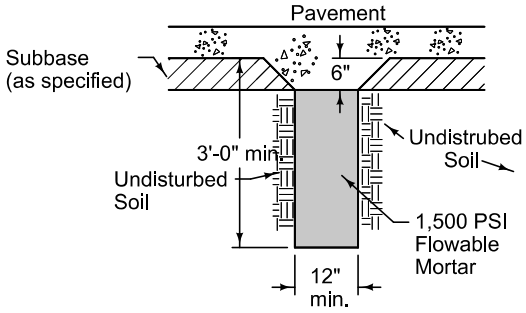
FULL DEPTH PATCHES GREATER THAN 15' LONG

FIGURE 7040.102 | SHEET 1 OF 1



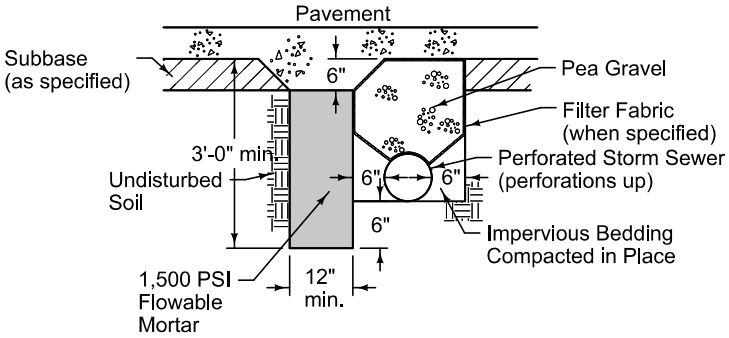
PLAN VIEW
(Flowable mortar cutoff wall and cross run location.)



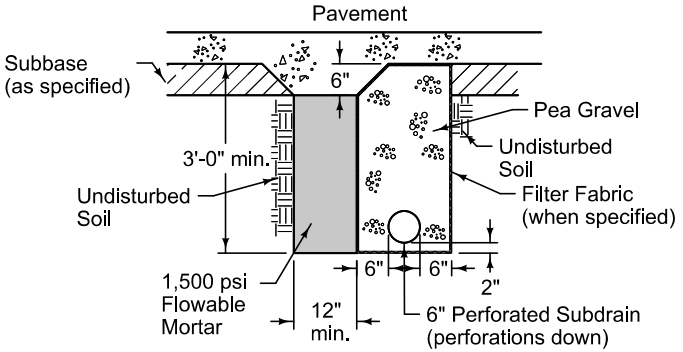
FLOWABLE MORTAR CUTOFF WALL
(Without Sewer)

Length of cutoff wall to be back of curb to back of curb.

DISTANCE FROM ℄ INTAKE TO ℄ CROSSRUN	
Size	D
15" RCP	0.7'
15" CMP	0.8'
18" RCP	0.5'
18" CMP	0.7'



SECTION A-A
(Flowable mortar cutoff wall and storm sewer)



FLOWABLE MORTAR CUTOFF WALL
(With Subdrain)

FIGURE 7040.105 | SHEET 1 OF 1

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FLOWABLE MORTAR CUTOFF WALL

CRACK AND SEAT EXISTING PCC PAVEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

Crack and seat of existing PCC pavement prior to overlay.

1.02 DESCRIPTION OF WORK

Full-depth saw cut along curbs and in the area of fixtures; cracking of existing PCC pavement; seating of the cracked pavement. Associated work could include subdrain installation; removal and replacement of curb and gutter; removal of existing asphalt overlay or large partial depth patches; vibration monitoring; installing crack control fabric between the leveling course and surface lifts over all full-depth saw cuts; milling of notches along the curb and at the ends of the project.

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

Notify all nearby affected parties 24 hours in advance that vibration generating activities will begin when the pavement cracking operation is ongoing. Report any specific concerns raised by adjacent parties to the Engineer.

1.08 MEASUREMENT AND PAYMENT

A. Crack and Seat of PCC Pavement:

1. **Measurement:** Measurement will be in square yards for the area cracked and seated.

2. **Payment:** Payment will be at the unit price per square yard of roadway cracked and seated.

3. **Includes:** Unit price includes, but is not limited to, notifying adjacent properties, providing traffic control and no parking signs; vibration monitoring if specified; cracking and seating of the designated PCC pavement to the specified pattern; watering to verify crack pattern; protecting existing fixtures; cleaning of slab prior to overlay; and final project site cleanup.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. Remove and Replace Curb and Gutter:

1. **Measurement:** Measurement will be in linear feet along the face of the curb for each type and size of curb and gutter replaced.

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

3. **Includes:** Unit price include, but is not limited to, full depth sawing; removing and disposing removed materials; furnishing and compacting subgrade material to bring to the proper elevation; all form work required; concrete; placing new curb and gutter; and final cleanup and backfill placement behind the new curb.

C. Full Depth Saw Cut:

1. **Measurement:** Measurement will be in linear feet for the length of full depth saw cut.

2. **Payment:** Payment will be made at the unit price per linear foot of full depth saw cut.

3. **Includes:** Unit price includes, but is not limited to, providing a concrete saw or other cutting device that will result in a full depth vertical edge and severing all tie or reinforcing steel.

D. Milling: Comply with Section 7040.

E. Subdrains: Comply with Section 4040.

F. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes (major and minor) and intakes (minor) and Section 5020 for adjustment of water valves.

G. Intake Adjustment, Major:

1. **Measurement:** Each existing intake adjusted to grade by removal of the boxout including any grate assembly and re-setting the grate or adjusting the open throat elevation of the intake will be counted.

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

3. **Includes:** Unit price includes, but is not limited to, sawing all three sides of the boxout; removing and replacing the boxout; furnishing and installing a new grate assembly or, if specified, removing and re-setting the existing grate assembly; removing existing open-throat intake grate; adjusting intake walls; furnishing and installing new intake grate or, if specified, re-setting existing intake grate; and furnishing, placing, and compacting backfill.

H. Joint Control Fabric:

1. **Measurement**: Measurement will be in linear feet of 12 inch wide joint control fabric placed.

2. **Payment:** Payment will be made at the unit price per linear foot of joint control fabric placed.

3. **Includes:** Unit price includes, but is not limited to, cleaning and preparing the surface, furnishing, placing, and adhering joint control fabric prior to placing surface lift.

1.08 MEASUREMENT AND PAYMENT (Continued)

I. Partial Depth Patch Removal:

1. Measurement: Measurement will be in square feet of partial depth patch removed.

2. Payment: Payment will be at the unit price per square feet of partial depth patches removed.

3. Includes: Unit price includes, but is not limited to, provide equipment and removing all designated partial depth patches down to the base PCC, cleaning of the former patch area; and disposal of the patch material.

J. Rock Interlayer:

1. Measurement: Measurement will be in tons of rock interlayer.

2. Payment: Payment will be at the unit price per ton of rock interlayer.

3. Includes: Unit price includes, but is not limited to, furnishing and placing the rock interlayer to the thickness specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Joint Control Fabric: Supply a polypropylene, needle punched, non-woven fabric coated with asphalt adhesive on one side and asphalt tack coat on the other meeting the following average roll values.

Property	Test Method	Unit	Minimum Value
Strip Tensile Strength	ASTM D882[1]	lbs/inch	45
Puncture Resistance	ASTM E154	lbs	175
Pliability	ASTM D146[2]	----	No cracks

[1] Use 12 in/min test speed and a 1 inch initial distance between grips

[2] Use 180° bend on 1/4 inch mandrel at -25°F

B. Rock Interlayer: Meet the requirements of Iowa DOT Section 4120 for Class A crushed stone.

PART 3 - EXECUTION

3.01 EQUIPMENT

A. Equipment:

1. **Cracking Equipment:** Provide a segmental type breaker capable of controlled forward and transverse movement and of fracturing the pavement to the full depth of the slab while maintaining the fractured face interlock of the aggregate. Do not use equipment that punches holes in the pavement or results in excessive spalling.

2. **Seating Equipment:** Use a pneumatic rubber tire roller with a minimum weight of 30 tons.

3.02 PREPARATION

Prior to initiating the crack and seat process, undertake the following tasks:

A. Identify and protect all affected utilities.

B. Set up all traffic control including parking restrictions.

C. Install subdrains if specified in the contract documents.

D. Remove all asphalt overlays.

E. Notify adjacent property owners.

3.03 FULL DEPTH SAW CUTS

Prior to initiating the crack and seat operation:

A. Complete full depth saw cuts along the curb line as shown the contract documents.

B. Complete full depth saw cuts at the edges of all manhole and intake boxouts. If manhole boxouts are not present, saw a 5 feet by 5 feet diamond shape around the manhole casting.

C. At water valves and other fixtures, complete a full depth saw cut in a square shape a minimum of 6 inches from the edge of the fixture.

3.04 PARTIAL DEPTH PATCHES

Remove partial depth patches that are not solid or sound and larger than 4 square feet according to Section 7040.

3.05 INTAKE ADJUSTMENT, MAJOR

A. Grate Type: Saw and remove existing boxout and intake grate assembly. If minor adjustments using adjustment rings is not possible, rebuild intake walls according to Section 6010 to the proper elevation and set new grate assembly. Existing intake grate assembly may be used when specified in the contract documents. Replace boxout to meet new elevations.

B. Open-throat Type: Saw and remove existing boxout and intake top. Adjust intake walls according to Section 6010 to meet new elevations and install new intake grate. Existing intake grate may be reused when specified in the contract documents. Replace boxout to meet new elevations.

3.06 TEST SECTION

At the start of cracking operations, the Engineer will designate a 100 foot test section. Utilize varying energy and crack spacing until a satisfactory spacing is established. Furnish and apply water to the test section to allow visual verification of the cracking pattern. Apply water to the cracked sections at least once per day or when pavement depth changes to verify crack pattern is being maintained. If conditions change, the Engineer may order the development of a new test section.

3.07 CRACKING

A. Crack the existing pavement to produce full depth transverse hairline cracks with a spacing of 18 to 36 inches.

B. Do not induce cracking within 2 feet of an existing transverse joint or crack.

C. Prevent the formation of continuous longitudinal cracks.

D. Do not destabilize the subgrade.

E. Do not damage utility fixtures.

3.08 SEATING

A. Seat the cracked pavement with a minimum of two passes of the 30 ton pneumatic roller. If two passes are not sufficient, continue rolling until the Engineer determines seating is adequate.

B. Complete seating of all areas cracked each work day.

3.09 MILLING

If specified in the contract documents, complete notch and runout milling according to Figure 7021.101.

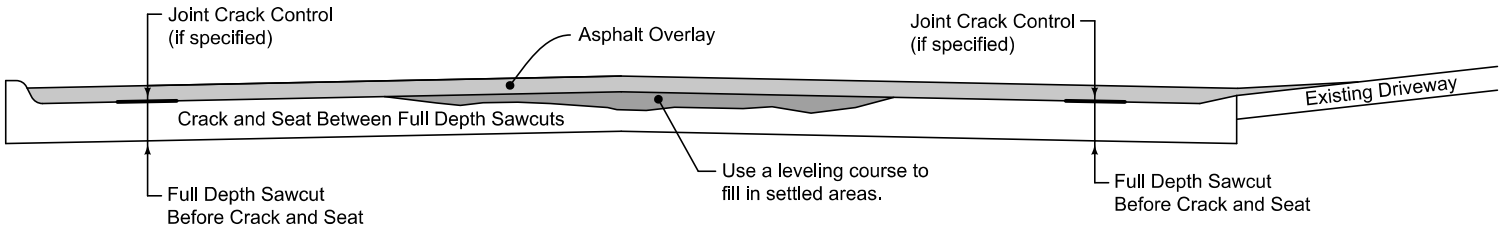
3.10 REMOVAL OF MATERIAL

Following the crack and seat process remove dirt, debris, and loose materials prior to opening the roadway to local traffic and again prior to placing the leveling course and surface lift.

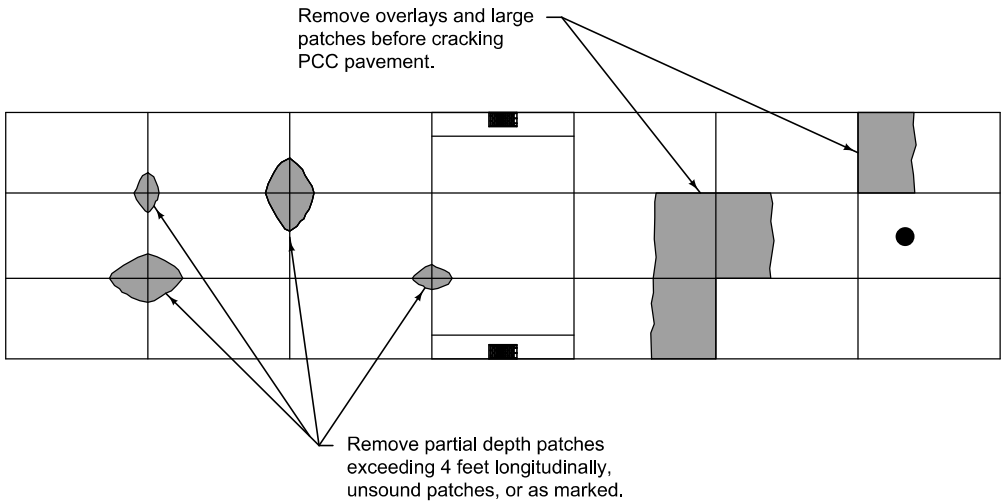
3.11 JOINT CONTROL FABRIC

Install joint control fabric over full depth saw cuts prior to final overlay lift according to the manufacturer's recommendations**.**

END OF SECTION



OVERLAY DETAIL



REMOVAL OF EXISTING ASPHALT

FIGURE 7092.101

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OVERLAY WITH CRACK AND SEAT

Table of Contents

TRAFFIC SIGNALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Underground

B. Detection

C. Communications

D. Cabinet and Controller

E. Poles, Heads, and Signs

1.02 DESCRIPTION OF WORK

This part of the specifications includes the furnishing of all material and equipment necessary to complete, in place and operational, traffic control signal(s) as described in the project plans.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the additional requirements listed below. All of the following must be submitted within 30 days after awarding of the contract for the project. Verify the method of submittal with the Jurisdiction.

A. Schedule of Unit Prices: Submit a completed schedule of unit prices. Estimates of the work performed on the project will be made by the Jurisdiction and the unit costs will be used to prepare progress payments to the Contractor.

B. Material and Equipment List: Submit a completed list of materials and equipment to the Jurisdiction for written approval before any equipment or materials are ordered.

C. Contractor Certification: Submit the name(s) and contact information of the International Municipal Signal Association (IMSA) Level II Certified Traffic Signal Technician(s) working on the project and a copy of their IMSA certificate.

D. Shop Drawings/Catalog Cuts: Submit PDF shop drawings file for traffic signal poles and structures to be furnished on the project. Submit single PDF of catalog cuts files and list manufacturer's specifications for all items in the project documents.

E. Fiber Optic Cable: Submit a splicing schematic.

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

A. Comply with the current edition of the MUTCD as adopted by the Iowa DOT.

B. Electrical equipment complying with current NEMA requirements.

C. Ensure materials and work conform to current NEC and IMSA requirements.

1.08 MEASUREMENT AND PAYMENT

A. Traffic Signal:

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

2. Payment: Payment will be at the lump sum price for traffic signal installation. Partial payment will be made according to the approved schedule of unit prices for those materials installed.

B. Temporary Traffic Signal:

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

2. Payment: Payment will be at the lump sum price for temporary traffic signal. 80% of the lump sum bid amount will be paid upon completion of the installation and successful initial operation of the signal; the final 20% will be paid upon removal of the temporary traffic signal and cleanup of the site.

3. Includes: Lump sum price includes, but is not limited to, furnishing, installing, maintaining, and removing poles; wiring; traffic signal control equipment including pedestrian equipment if specified; implement all modifications of signal timing, signal placement and display due to Contractor initiated changes in the construction staging plan established by the Contracting Authority; relocation of trailer mounted temporary traffic signal systems; placement in another physical location to address changes in construction staging; and all appurtenances.

C. Traffic Signal Removal:

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

2. Payment: Payment will be at the lump sum price for traffic signal removal.

3. Includes: Lump sum price includes, but is not limited to, removal of poles, concrete pads, foundations, wiring, traffic signal cabinet and equipment, pedestrian signal equipment, and handholes; delivery of removed materials to the location specified in the contract documents; furnishing, placing, and compacting backfill in all excavations; and restoring disturbed surfaces.

PART 2 - PRODUCTS

2.01 UNDERGROUND

A. Handhole:

1. General:

a. Cable Hooks: Unless otherwise specified, 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 has a minimum ANSI/SCTE 77 2017 Tier 15 rating. Provide a skid resistant surface on the cover. Provide two 3/8-16 UNC stainless steel hex head bolts with washers.

4. HDPE Handhole and Cover:

a. Size: Provide handhole and cover with a minimum inside diameter of 24 inches and a minimum of 24 inches in depth. Handhole to be conical in shape with the taper from bottom to top.

b. Loading: Ensure handhole, any extensions, and cover comply as a complete unit with ANSI 77 with a minimum Tier 15 rating.

c. Resin: HDPE resin to comply with ASTM D 790 for minimum flexural modulus of 142,000 psi and ASTM D 638 for minimum yield strength of 3,100 psi when using a Type IV specimen, 2 inch per minute test speed, and 0.075 inch thick molded sample.

d. Cover: Ensure cover has a skid resistant surface meeting PROWAG requirements with stainless steel bolts meeting manufacturer’s requirements. Ensure cover fits handhole to meet PROWAG vertical surface discontinuity requirements when placed in pedestrian walkways.

B. Conduit:

1. General:

a. Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings.

b. Use a manufactured conduit sealing compound that is readily workable material at temperatures as low as 30°F and will not melt or run at temperatures as high as 300°F.

2.01 UNDERGROUND (Continued)

c. Furnish flat polyester pull tape with a minimum pulling strength of 1,250 pounds and permanent sequential footage markings.

2. Steel Conduit and Fittings:
a. Comply with ANSI C80.1.
b. Use weatherproof expansion fittings with galvanized, malleable iron, fixed and expansion heads jointed by rigid steel conduit sleeves. As an option, the fixed head may be integral with the sleeve, forming a one piece body of galvanized malleable iron.
c. Provide steel bushings.

3. Plastic Conduit and Fittings:
a. PVC:
1) PVC Schedule 40 plastic conduit and fittings complying with NEMA TC-2 (pipe), NEMA TC-3 (fittings), and UL 651 for Schedule 40 heavy wall type.
2) Solvent welded, socket type fittings, except where otherwise specified in the contract documents.
3) Threaded adaptors for jointing plastic conduit to rigid metal ducts.
4) Provide bell end fittings or bushings.
b. HDPE:
1) Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), SDR 13.5.
2) Use the color specified in the latest NEC or approved by the owner.
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. Ethernet Cable: Provide outdoor use rated cable. Provide either Category 5E (CAT5e) or Category 6 (CAT6) cable.

5. 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), International Telecommunication Unit (ITU), and Telecommunications Industries Association (TIA).
c. Multimode Fiber:
Core Diameter: 62.5 µm ± 1.0 µm
Cladding Diameter: 125.0 µm ± 2.0 µm
Core Concentricity: ± 1%
Max. Attenuation: 3.50 dB/km @ 850 µm

2.01 UNDERGROUND (Continued)

d. Single-Mode Fiber: Meet attributes of ITU-T G.652.D Table 2 and/or ITU-T G.657.A1 for low loss bend as specified in the contract documents.
e. 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.
f. Buffer tubes of dual layer construction with a polycarbonate inner layer and polyester outer layer. Each buffer tube filled with a water-swellable yarn or tape. Buffer tubes stranded around the central member using reverse oscillation or “SZ” stranding process. Gel-free cable and buffer tubes.
g. Buffer tubes and fibers meeting TIA/EIA-598A, “Color coding of fiber optic cables,” with 12 fibers per buffer tube.
h. Cable tensile strength provided by a high tensile strength aramid yarn and/or fiber glass.
i. Dielectric cables, without armoring, or armored cables with corrugated steel tape armor as specified in the contract documents. Outer jacket of medium density polyethylene applied directly over the tensile strength members and flooding compound. Jacket or sheath marked in a contrasting color with the manufacturer's name and the words “Optical Cable,” the year of manufacture, and sequential meter or feet marks. Additionally, provide a durable weather proof label on the cable jacket showing the actual attenuation of each fiber expressed in dB/km.
j. Cable fabricated to withstand a maximum pulling tension of 600 pounds during installation (short term) and 135 pounds upon installation (long term).
k. Shipping, storing, and operating temperature range of the cable: -40° C to + 70° C. Installation temperature range of cable: -30° C to + 70° C.
l. Each fiber of all fiber optic cable tested by manufacturer at the 100% level for the following tests:
    - Proof tested at a minimum load of 50 kpsi (350 Mpa)
    - Attenuation
m. Meet the appropriate standard Fiber Optic Test Procedure for the following measurements:
    - Fluid Penetration
    - Compound Drip
    - Compressive Loading Resistance
    - Cyclic Flexing
    - Cyclic Impact
    - Tensile Loading and Bending
n. Make cable ends available for testing. Seal cable ends to prevent moisture impregnation.
o. Fiber Distribution Panel: Provide a fiber distribution panel capable of terminating the number of fibers as specified in the contract documents.
p. Fiber Optic Connectors:
    1) ST type connectors of ceramic ferrule and physical contact end finish to terminate multi-mode fibers to equipment.
    2) SC type connectors of ceramic ferrule and physical contact end finish to terminate single-mode fibers to equipment.
    3) ST or mechanical connectors not allowed for cable splices.
    4) Maximum attenuation per connector: 0.75 dB.
q. Fiber Optic Jumpers/Patch Cords: For connections in the cabinet, provide factory-assembled duplex pigtail jumpers with dielectric strength member, durable outer jacket and ST or SC compatible connectors. Provide adequate length for connections and 2 feet minimum slack.
r. Fiber Optic Breakout Kits: Provide breakout kits for separation and protection of individual fibers, with buffering tube and jacketing materials suitable for termination of the fiber and fiber optic connector.

2.01 UNDERGROUND (Continued)

s. Splices/ Splice Enclosures: Fusion splice continuous fiber runs or branch circuit connections in splice enclosures as allowed or specified in the contract documents. Provide environmentally protected outside plant splice enclosures with adequate number of trays to splice all fibers. Do not splice continuous fibers unless physical restraints require all fibers to be cut, unless approved by the Jurisdiction. Maximum attenuation per splice: 0.3 dB.

D. Footings and Foundations:

1. Use Class C structural concrete complying with Iowa DOT Section 2403.

2. Use uncoated reinforcing steel complying with Iowa DOT Section 4151.

E. Bonding and Grounding:

1. Ground Rods: Provide 5/8 inch by 8 foot copper clad, steel ground rod.

2. Bonding Jumper or Connecting Wire: Provide #6 AWG bare conductor, copper wire.

2.02 DETECTION

A. Inductive Loop Vehicle Detector: A detector consists of a conductor loop or series of loops installed in the roadway, lead-in (feeder) cable, and a sensor (amplifier) unit with power supply installed in a traffic signal controller cabinet.

1. Cables: All cables must be UL approved.
- **a. Tube Loop Detector Cable:** Comply with IMSA Specifications 51-5.
- **b. Preformed Loop Detector Cable:** As approved by the Engineer.
- **c. Loop Detector Lead-in Cable:** Comply with IMSA Specifications 50-2.

2. Detector Loop Sealant:
- a. Use a rapid cure, high viscosity, liquid epoxy sealant formulated for use in sealing inductive wire loops and leads embedded in pavement. Ensure the cured sealer is unaffected by oils, gasoline, grease, acids, and most alkalis.
- b. Use a sealant complying with Iowa DOT Materials I.M. 491.18.

3. Sensor (Amplifier) Unit:
- a. Use a sensor unit that is solid state, digital, providing detection channel(s) with an inductance range of 0 to 2,000 micro-henries. Output circuits of the sensor unit will be provided by relays. Vehicle presence will result in a continuous call indication.
- b. Provide a sensor unit with the following qualities:
  1) Sensitivity adjustment to allow as a minimum the selection of high, medium, or low sensitivity.
  2) Be capable of providing reliable detection of all licensed motor vehicles.
  3) Provide an indicator light for visual indication of each vehicle detection.
  4) Will not require external equipment for tuning or adjustment.
  5) Provide operation in the pulse mode or presence mode. Ensure mode switch is readily accessible.
  6) Provide a self tuning system that is activated automatically with each application of power. Provide automatic and continuous fine tuning to correct for environmental drift of loop impedance.
  7) Provide for fail-safe operation (continuous call) in the event of detector loop failure.
  8) Ensure each detector channel will respond to a frequency shift in an increasing or decreasing value as occurs with temperature shifts in the pavement without requiring a locked call.

2.02 DETECTION (Continued)

9) Use detector units with delay and extension timing. The delay feature is selected and adjusted externally on the sensor unit housing. Digitally derived timing is selectable in 1 second increments from 0 to 30 seconds. Ensure delay timing inhibits detector output until presence has been maintained for the time selected. Restart delay timer at each new detection.
10) Use a sensor unit capable of normal operation without interference and false calls between sensor units ("crosstalk") when installed in the physical environment of the controller cabinet and the electrical environment of the associated electronic equipment installed therein, including other detectors.

B. Pedestrian Push Button Detectors:

1. Assembly:
a. Ensure the entire assembly is weather tight, secure against electrical shock, withstands continuous hard usage.
b. Provide a removable contact assembly mounted in a die cast aluminum case.
c. Ensure contacts are normally open with no current flowing except at the moment of actuation.
d. Ensure the contacts are entirely insulated from the housing and operating button with terminals for making connections.
e. Provide housing with one outlet for 1/2 inch pipe.

2. Accessible Pedestrian Signals (APS) Push Button Stations:
a. Housing: Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
b. Audible and Vibrotactile Features: Audible walk indication tone, vibrotactile arrow, and locator tone complying with MUTCD.
c. Voice Messages: As specified in the contract documents and per MUTCD.
d. Speaker: Weatherproof with automatic volume adjustment to 5 dBA over ambient sound. Maximum volume 100 dB at 3 feet.
e. Push Button: Nonrusting metal alloy, ADA compliant, 2 inch diameter with tactile arrow and 3 pounds maximum operational force.
f. Switch: Solid state rated at 20 million operations minimum.
g. Program and Audio File Updates: USB or Ethernet.
h. Operating Temperature: -30 to + 165^{0}F.

3. Solid State Pedestrian Push Buttons (non-APS):
a. Housing: Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
b. Push Button: Nonrusting metal alloy, ADA compliant, 2 inch diameter with 3 pounds maximum operational force, with momentary LED visual confirmation and audible tone confirmation.
c. Switch: Solid state piezo-driven, rated at 20 million operations minimum.
d. Operating Temperature: -30 to + 165^{0}F.

4. Signs: Furnish signs complying with MUTCD.

C. Video Detection Camera System: Detects vehicles by processing video images and providing detection outputs to the traffic signal controller.

1. Video Detection System and Processors:
a. Processor to be card rack mounted, shelf mounted, or located within camera. Compatible with NEMA TS-1, TS-2, ITE ATC, and Type 170 and 2070 controllers and cabinets.

2.02 DETECTION (Continued)

b. Must be capable of the following:
   1) Shadow rejection without special hardware.
   2) Non-impaired operation under light intensity changes.
   3) Maintained operation during various weather conditions (e.g. rain, fog, snow).
   4) Anti-vibration, 5% rejection based on image change.
   5) Ability to select direction of flow parameters.
   6) Ability to properly detect directionally.
   7) Operate in presence mode with less than 4% error.
c. Provide user-defined detection zone programming via a graphical user interface (GUI) and any necessary equipment for future programming. Store detection zones in non-volatile memory.
d. Comply with NEMA TS-1 and TS-2 environmental and physical standards with an operating temperature of -34°C to +60°C, and 0% to 95% relative humidity.
e. Ensure a factory certified representative from the supplier provides on-site VDS programming and testing.

2. Video Cameras:
a. Meet NEMA-4 or NEMA-6P environmental standards.
b. Use camera cable(s) meeting the manufacturer's recommendations. Provide a continuous run, without splices, from the camera to the controller cabinet.
c. Camera per Approach or Advance Detection Camera:
   1) Provide a charge-coupled device (CCD) image sensor with variable focus color or black and white lens providing a minimum of 4 to at least a 40 degree horizontal field of view.
   2) Equipped with internal thermostatically controlled heater and external sunshield.
d. Single Stop Line Detection Camera:
   1) Provide a minimum 5 MP image sensor with power over ethernet and a fisheye lens capable of detecting multiple approaches from a single mounting location.
   2) Include the ability to count traffic.
   3) Provide necessary internal thermostatically controlled heater as needed.

D. Microwave/Radar Vehicle Detectors: Detects all vehicles moving within the field of detection at speeds from 2 to 80 mph.

1. Must be capable of the following:
   a. Minimum detection range from 3 to 200 feet for all vehicles.
   b. Pattern spread of the detection field no more than 16 degrees.
   c. Self-tuning and capable of continuous operation over a temperature range of -35°F to 165°F.
   d. Side-fire mount or overhead mount.
   e. Detecting directional traffic and the direction user selectable.

2. Microprocessor based using Doppler microwave at an operating frequency of 10.525 GHz.

3. FCC certification and tested to the applicable FCC specifications.

4. Enclosure constructed of aluminum or stainless steel and water resistant.

5. All user operated controls and adjustments must be clearly marked and easily accessible.

6. Relay detection output to the controller with a minimum 5 amp rating and designed to place a constant call to the controller in the event of any failure.

7. Easily accessible indicator showing activation of detection relay.

2.02 DETECTION (Continued)

8. Required wiring as recommended by the manufacturer.

9. Provide mounting hardware for the type of mounting specified in the contract documents and power supply equipment as recommended by the manufacturer.

E. Wireless Magnetic Sensors (Pod/Puck): Provide as specified in the contract documents in pavement sensors, access points, base stations, and repeaters, if necessary.

2.03 COMMUNICATIONS

A. Traffic Monitoring System: Provide as specified in the contract documents including, video camera in dome, dome mounting bracket and hardware, camera controller, cabling from camera to controller cabinet, and all accessories, software, and hardware necessary for a complete and operational system.

1. Pan/tilt/zoom (PTZ) color camera with automatic conversion to monochrome during low light levels, auto focus, auto-iris control, electronic image stabilization, privacy masking and progressive CMOS sensor. Minimum 1920 x 1080 maximum resolution. Minimum optical zoom: 25X. Minimum digital zoom: 12X.

2. Camera system provided in a NEMA 4X or IP66 certified rugged weather-resistant package.

3. Provide all required lightning protection for electronics control, power, and coax video outputs.

4. Operating temperature range: -40ºC to +50ºC.

5. Maximum cable length as specified by camera manufacturer.

6. Provide full 360 degree endless pan and 220 degree tilt under PTZ control.

7. Dome electronics capable of programming a minimum of 64 preset views and nine preprogrammed pattern sequences of preset views. All views selectable by the central office computer or a remote control device.

8. Provide encoder and decoder devices as needed to transmit video over existing or proposed communication systems at 30 frames per second (or more).

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

10. Provide ability to control PTZ and view video remotely. Includes installing necessary software/programming needed for agency to operate system.

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

C. Wireless Interconnect Network: Provides two-way data communication between the system control software and local traffic signal controllers.

1. Data Transceiver:
   a. Utilize a license-free spread spectrum radio frequency (902-928 MHZ) with frequency hopping technology.
   b. Completely programmable by software. Furnish software to the Jurisdiction.
   c. Built-in diagnostics capabilities.
   d. Configurable as master, slave, or repeater with store and forward capability.
   e. Maintains user selectable power output levels between 0.1 and 1 watt.

2.03 COMMUNICATIONS (Continued)

f. Operates with input voltages between 6 VDC and 30 VDC.
g. RS-232 interface with 115.2 kbps capability.
h. Operating temperature of -40°C to +75°C.
i. Receiver sensitivity of -108 to -110 dBm at 10^{-6} BER.
j. Protected from power surges.
k. Rack or shelf mounted in controller cabinet and connections for antenna, power, and controller.

2. Antenna:
a. Capable of transmitting and receiving data between intersections.
b. Mount near the top of the signal pole nearest the controller cabinet or as specified in the contract documents. Provide engineer-approved mounting hardware.
c. Connect to transceiver via appropriate cable from pole to signal cabinet in same conduit as traffic signal cable. Conceal cable within a watertight connection at antenna.

2.04 CABINET AND CONTROLLER

A. Controller, Cabinet, and Auxiliary Equipment: Comply with the latest edition of NEMA TS1 or TS2, CalTrans model 2070, or ITE advanced transportation controller (ATC) standards.

1. Controller:
a. Solid state modular design with digital timing and capable of accommodating at least eight phases.
b. Fully prompted, front panel keyboard with menu driven programmability.
c. Local time base scheduler including automatic accommodation for daylight savings time.
d. Local coordination control.
e. Local preemption control with at least four programmable internal preemption sequences.
f. Current software and documentation.
g. Data retained in a memory medium that does not require battery backup.

2. Cabinet:
a. Unpainted aluminum cabinet according to NEMA standards.
b. Aluminum cabinet riser with same dimensions as cabinet and 12 to 18 inch height, as specified in the contract documents.
c. ATC cabinet voltage category as specified in the contract documents.
d. Police door with auto/flash switch, manual/stop time switch, and on/off power switch for signal heads only. Controller to remain in full operation regardless of switch positions.
e. Maintenance panel on inside of the main door containing the following test switches.
1) Controller power switch.
2) Detector test switches.
3) Stop time switch.
4) Signal flash switch.
f. Heavy-duty clear plastic envelope attached to inside wall of cabinet or cabinet door, for cabinet wiring diagrams, 12 inches by 18 inches minimum.
g. GFI electrical outlet and lamp in accessible location near the front of the cabinet. GFI outlet fused separately from main AC circuit breaker. LED cabinet lamp connected and fused with GFI outlet.
h. Back panel positions to accommodate phasing and expansibility specified in the contract documents.

2.04 CABINET AND CONTROLLER (Continued)

i. Power protection devices including AC power circuit breakers, radio interference suppressors, and lightning and surge protectors.
   1) AC field service single pole, nonadjustable, magnetic breaker rated for 117 VAC operation, NEC approved.
   2) Radio interference suppressors (RIS) as required to minimize interference in all broadcast transmission and aircraft frequency bands.
   3) Lightning arrestor/surge protector capable of withstanding repeated (minimum of 25) 30,000 ampere surges.

j. Neatly train wiring throughout the cabinet and riser. Bundle and attach wiring to interior panels using nonconductive clamps or tie-wraps.

3. Auxiliary Equipment: Conflict monitor/malfunction management unit, flasher, load switches, terminals and facilities, and miscellaneous equipment and materials according to NEMA standards. For ATC cabinets, use serial interface unit, high density switch pack/flasher unit, cabinet monitor unit, cabinet power supply requirements, auxiliary display unit, sensor unit, and miscellaneous equipment materials meeting ITE standards.

B. Uninterruptible Power Supply Battery Backup System: Monitors 120VAC input from the electric utility source and automatically switches to/from a system consisting of batteries and electronics.

1. Include a maintenance bypass switch to allow operation of the traffic signal system while repairs are made to the battery backup system.

2. Designed to provide a minimum of 4 hours of normal operation.

3. Use cabinet equipment that is plug connected and shelf mounted.

4. Designed to cover a temperature range from -30°F to +165°F and include a surge suppressor.

C. Emergency Vehicle Preemption System: As specified in the contract documents.

2.05 POLES, HEADS, AND SIGNS

A. Vehicle Traffic Signal Head Assembly: Comply with current MUTCD and ITE standards.

1. Housing:
   a. Individual signal sections made of a durable polycarbonate. Use color specified in the contract documents. Color to be an integral part of the materials composition.
   b. Self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly and securely fastened together.
   c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
   d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.

2. Optical System: Designed to prevent any objectionable reflection of sun rays even at times of the day when the sun may shine directly into the lens.

3. Lenses: 12 inch diameter polycarbonate. Do not use glass lenses.

2.05 POLES, HEADS, AND SIGNS (Continued)

4. Visors:

a. Standard Installation:

1) Each signal lens is to have a visor with the bottom 25% open.
2) Minimum 0.1 inch in thickness and black in color.
3) Fits tightly against the housing door with no filtration of light between the visor and door.
4) Minimum length of 9 1/2 inches. Ensure the visor angle is slightly downward.

b. Optically Programmed Sections: Make sure the optical unit and visor are designed as a whole to eliminate the return of outside rays entering the unit from above the horizontal.

5. Terminal Block:

a. Three-section signal equipped with a six position terminal block.
b. Four- and five-section signal equipped with an eight position terminal block.

6. Backplate:

a. Manufactured one-piece, durable, black plastic or aluminum capable of withstanding 100 mph winds.
b. Provides 5 inches of black field around the assembly.
c. If specified, provide high visibility reflective tape with a minimum width of 1 inch.

7. Mounting Hardware:

a. Rigid: 1 1/2 inch aluminum pipe and fittings, natural aluminum finish or match the pole color if specified in the contract documents. Secure to pole with a minimum 5/8 inch wide stainless steel banding material.

b. Universally Adjustable: Rigid mounted, consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes. Provide galvanized steel cable material per manufacturer's recommendation.

8. LED Modules: Comply with current ITE standards and consistent with cabinet voltage requirements.

B. Pedestrian Traffic Signal Head Assembly: Comply with current MUTCD and ITE standards.

1. Housing:

a. Made of a durable polycarbonate. Use color specified in the contract documents. Color to be an integral part of the materials composition.
b. Self-contained unit capable of separate mounting or inclusion in a signal face containing one or more signal sections rigidly and securely fastened together.
c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.

2. Visor:

a. Egg crate or tunnel type visor, as specified in the contract documents, attached to the housing door by stainless steel screws or according to manufacturer's requirements.
b. Fit tightly against the housing door to prevent any filtration of light between the door and the visor.
c. Ensure the visor angle is slightly downward.

2.05 POLES, HEADS, AND SIGNS (Continued)

3. LED Module:

a. Provide a LED unit(s) for the filled upraised hand symbol, walking person symbol, and countdown timer.
b. Ensure immediate blank out of the countdown timer display upon recognizing a shortened “Walk” or a shortened "Flashing Don't Walk" interval.
c. Comply with current ITE standards and consistent with cabinet voltage requirements.

C. Traffic Signal Poles and Mast Arms:

1. General:

a. Use mast arm length and vertical pole height as specified in the contract documents.
b. Ensure the mast arms, poles, and supporting bases are galvanized on both interior and exterior surfaces according to ASTM A 123.
c. Use continuously tapered, round, steel poles of the transformer base type for poles with mast arms 60 feet or less. Fabricate poles from low carbon (maximum carbon 0.30%) steel of U.S. standard gauge.
d. For poles with mast arms greater than 60 feet or when a transformer base is not specified, provide a 6 inch by 16 inch handhole in the pole shaft for cable access. Provide a cover for the handhole. Secure the cover to the base with simple tools. Use corrosion resistant hardware.
e. Ensure minimum yield strength of 48,000 psi after manufacture. Supply base and flange plates of structural steel complying with ASTM A 36 and cast steel complying with ASTM A 27, Grade 65-35 or better.
f. Where a combination street lighting/signal pole is specified in the contract documents, ensure the luminaire arm is mounted in the same vertical plane as the signal arm unless otherwise specified. Use a luminaire arm of the single member tapered type. Fabricate the pole with a minimum 4 inch by 6 inch handhole and cover located opposite the signal mast arm.
g. If allowed by the Engineer, poles and mast arms may be fabricated by shop welding two sections together, resulting in a smooth joint as follows:
    1) Ensure a minimum of 60% penetration for longitudinal butt welds in plates 3/8 inch and less in thickness, except within 1 foot of a transverse butt-welded joint. Ensure a minimum of 80% penetration for longitudinal butt welds in plates over 3/8 inch in thickness.
    2) Ensure 100% penetration for longitudinal butt welds in poles and arms within 1 foot of a transverse butt-welded joint.
    3) Ensure 100% penetration for transverse butt welds by using a back-up ring or bar to connect the sections.
    4) Examine the full length of all transverse butt welds and 100% penetration longitudinal butt welds by ultrasonic inspection according to the requirements of ANSI/AWS D1.1.
    5) Comply with ANSI/AWS D1.1 except as modified by Iowa DOT Article 2408.03, B.
h. For mast arms over 50 feet length, two-piece mast arms with a slip-fit and bolt connection are allowed.
i. Provide non-shrink grout (complying with Iowa DOT Materials I.M. 491.13) or a rodent guard (complying with Iowa DOT Materials I.M. 443.01) for placement between the pole base and the foundation per the manufacturer’s requirements.

2. Pole Design: Comply with AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Use a 90 mph basic wind speed with a 50 year mean recurrence interval for strength design. Use Category II for fatigue design. Apply only natural wind gust loads (i.e. do not apply galloping loads, vortex shedding loads, or truck-induced gust loads) for fatigue design. Install vibration mitigation devices on all traffic signal pole mast arms over 60 feet in length as shown on the figures.

2.05 POLES, HEADS, AND SIGNS (Continued)

3. Hardware:

a. General:

1) Equip poles and mast arms with all necessary hardware and anchor bolts to provide for a complete installation without additional parts.
2) Furnish each anchor bolt with one leveling nut, one anchoring nut, and one jam nut (if required) on the exposed end and one of the following on the embedded end: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor bolts, nuts, and washers that comply with Iowa DOT Materials I.M. 453.08.

b. Anchor Bolts:

1) Use straight full-length galvanized bolts.
2) Comply with ASTM F 1554, Grade 105, S4 (-20°F).
3) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
4) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
5) Do not bend or weld anchor bolts.

c. Nuts:

1) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
2) Use heavy hex.
3) Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.
4) Nuts may be over-tapped according to the allowance requirements of ASTM A 563.
5) Refer to Section 8010, 3.05, B, 2 for tightening procedure and requirements.

d. Washers: Comply with ASTM F 436 Type 1.

e. Galvanizing: Galvanize entire anchor bolt assembly consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

D. Traffic Signal Pedestal Poles:

1. Materials:

a. Pedestal: The height from the bottom of the base to the top of the shaft as specified in the contract documents.

b. Pedestal Shaft: Schedule 80 with satin brush or spun finish aluminum tubing. Top of the shaft outer diameter to be 4 1/2 inches and provided with a pole cap. Supply base collar for poles with shaft lengths greater than 10 feet. Provide brackets to mount pedestrian signal on side of pole.

c. Pedestal Base: Cast aluminum, square in shape, with a handhole.

1) Handhole: Minimum of 3 1/2 inches by 5 1/2 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools.

2) Base: A breakaway base with a four bolt pattern uniformly spaced on a minimum of 6 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.

2. Anchor Bolts: Four 5/8 inch by 7 1/2 inch steel (minimum), hot dip galvanized anchor bolts complying with ASTM F 1554, Grade 36, meeting pole manufacturer requirements for installation, complete with all hardware required for installation. For pedestal pole sidewalk mounting, provide anchor bolts and hardware per pole manufacturer requirements.

2.05 POLES, HEADS, AND SIGNS (Continued)

E. Traffic Signs:

1. Sheet aluminum and retroreflective sheeting complying with Iowa DOT Section 4186.

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

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

PART 3 - EXECUTION

3.01 UNDERGROUND

A. Handhole:

1. Locations:
a. Do not construct in ditch bottoms, low areas where ponding of water may occur, or where they will be subject to normal vehicular traffic.
b. With Engineer approval, additional handholes may be placed, at no additional cost to the Contracting Authority, to facilitate the work.

2. Excavation: Excavate as necessary to accommodate the handhole and granular base.

3. Granular Base: Install 8 inch thick granular base extending a minimum of 6 inches beyond the outside walls of the handhole.

4. Placement:
a. In paved areas, install the handhole at an elevation so the casting is level and flush with the pavement. In unpaved areas, install the handhole approximately 1 inch above the final grade.
b. Verify ring placement. Invert rings when installed in paved areas.

5. Conduit:
a. Remove knockouts as necessary to facilitate conduit entrance.
b. Extend conduit into the handhole, through a knockout, approximately 2 inches beyond the inside wall. Conduit to slope down and away from the handhole.
c. Place non-shrink grout (complying with Iowa DOT Materials I.M. 491.13) in the opening of the knockout area after placement of conduit.

6. Cable Hooks:
a. Install cable hooks centered between the knockouts and the top of the handhole anchored within the handhole wall.
b. Place non-shrink grout (complying with Iowa DOT Materials I.M. 491.13) in the opening around the hook after placement of the hook.

7. Backfill: Place suitable backfill material according to Section 3010.

8. Casting: Place the casting on the handhole. Ensure the final elevation meets the handhole placement requirements.

B. Conduit:

1. General:
a. Place conduit to a minimum depth of 30 inches and a maximum depth of 60 inches below the gutterline, unless utility conflicts require deeper placement. When conduit is placed behind the curb, place to a minimum depth of 24 inches and a maximum depth of 48 inches below top of curb.
b. Change direction at handholes or by bending, such that the conduit will not be damaged or its internal diameter changed. Ensure bends are uniform in curvature and the inside radius of curvature of any bend is no less than six times the internal diameter of the conduit.
c. On the exposed ends of conduit, place bell-end fittings on PVC or HDPE conduit and bushings on steel conduit prior to installing cable. Extend all conduits a minimum of 2 inches and a maximum of 4 inches above the finished surface of any foundation, footing, or structural base.

3.01 UNDERGROUND (Continued)

d. When it is necessary to cut and thread steel conduit, do not allow exposed threads. Ensure conduits and fittings are free from burrs and rough places. Clean, swab, and ream conduit runs before cables are installed. Use nipples to eliminate cutting and threading where short lengths of conduit are required. Coat damaged galvanized finish on conduit with zinc rich paint. Use only galvanized steel fittings with steel conduit.
e. Install duct plugs in conduit ends or pack conduit ends with a conduit sealing compound.
f. Install pull tape in each conduit segment, including empty conduits, and secure to duct plugs at each end.

2. Trenched Installation:

a. Place backfill in layers not to exceed 12 inches in depth with each layer thoroughly compacted before the next layer is placed. Ensure backfill material is free of cinders, broken concrete, or other hard or abrasive materials.
b. Remove all surplus material from the public right-of-way as soon as possible.

3. Trenchless Installation:

a. When placing conduit under pavements, use the trenchless installation methods described in Section 3020.
b. If trenchless methods that compact soils in the bore path are used, provide sufficient cover to prevent heaving of overlying paved surfaces.
c. Do not allow pits for boring to be closer than 2 feet to the back of curb, unless otherwise specified in the contract documents.

C. Wiring and Cable:

1. Where practical, follow color codes so that the red insulated conductor connects to the red indication terminal, yellow to yellow, and green to green. Ensure cables are properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables. Label home runs for cables as follows: northwest corner is red, southeast corner is blue, northeast corner is green, and southwest corner is orange.

2. Install continuous runs of vehicle and pedestrian signal cables from the vehicle or pedestrian signal head to the handhole compartment of the signal pole base. Install continuous runs of vehicle and pedestrian signal cables from the handhole compartment of the signal pole base to the terminal compartment in the controller cabinet. Do not splice signal cables in underground handholes.

3. Install continuous runs for video detection and emergency vehicle preemption cables from the unit to the controller cabinet.

4. Install continuous runs of power lead-in cables from the service point to the meter socket and from the meter socket to the controller cabinet.

5. Install continuous detector cable from each detector loop to the first handhole adjacent to the loop. Ensure cables are properly labeled at the controller by durable labels, or other appropriate methods, attached to the cables. Install continuous homerun cable from the splice made in the first handhole to the terminal compartment in the controller cabinet. Attach the drain wire of the shielded cable to the ground in the controller cabinet.

6. Provide a minimum of 4 feet of additional cable at each handhole and loosely coil the extra cable on the handhole cable hooks. Provide a minimum of 2 feet of additional cable at each signal pole (measured from the handhole compartment in the pole to the end of the cable). Provide a minimum of 10 feet of additional cable at each controller base. For fiber optic cable, coil the specified length in a wheel shape and hang vertically.

3.01 UNDERGROUND (Continued)

7. Pull cables through conduit using a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables, and minimize dragging on the ground or pavement.

8. Install a tracer wire in all conduits with the exception of conduits between detector loops and handholes. Use a silicon-filled wire nut to splice the tracer wire in each handhole and at the controller to form a continuous run.

9. Fiber Optic Cable and Accessories:
   a. Use a suitable cable feeder guide between the cable reel and the face of the conduit to protect the cable and guide the cable directly into the conduit off the reel. During the installation, carefully inspect cable jacket for defects. If defects are found, notify the Engineer prior to any additional cable being installed. Take care when pulling the cable to ensure the cable does not become kinked, crushed, twisted, snapped, etc.
   b. Attach a pulling eye to the cable and use to pull the cable through the conduit. Use a pulling swivel to preclude twisting of the cable. Lubricate cable prior to entering the conduit with a lubricant recommended by the manufacturer. Use dynamometer or break away pulling swing to ensure the pulling tension does not exceed the specified force of 600 pounds or the cable manufacturer's recommendations, whichever is less. Do not allow the cable to twist, stretch, become crushed, or forced around sharp turns that exceed the bend radius or scar or damage the jacket. Manually assist the pulling of the cable at each pull point.
   c. Do not pull cable through any intermediate junction box, handhole, pull box, pole base, or any other opening in the conduit unless specified in the contract documents. Install cable by pulling from handhole or controller cabinet to the immediate next downstream handhole or cabinet. Carefully store the remaining length of cable to be installed in the next conduit run(s) in a manner that is not hazardous to pedestrian or vehicular traffic, yet ensures that no damage to the cable occurs. Storage methods are subject to Engineer approval.
   d. At each handhole, visibly mark or tag cable, “CITY (or COUNTY) FIBER OPTIC”
   e. Secure cables inside controller cabinet so that no load is applied to exposed fiber strands.
   f. Ensure the radius of the bend for static storage is no less than 10 times the outside diameter of the cable, or as recommended by the manufacturer. Ensure the radius of the bend during installation is no less than 15 times the outside diameter of the cable, or as recommended by the manufacturer.
   g. Provide cable slack in each handhole, junction box, and cabinet as specified in the contract documents. Where handholes or junction boxes lack sufficient area for cable storage or bend radius requirements, provide equivalent additional slack in adjacent facilities. Coil and bind slack cable at three points around the cable perimeter and support in its static storage position.
   h. Install fiber optic accessories according to the manufacturer’s recommendations and as specified in the contract documents.

10. Fiber Optic Cable Field Testing: Provide for each fiber strand both on-reel testing prior to installation and final testing after installation using a high-resolution optical time domain reflectometer (OTDR). Conduct measurements for single-mode fibers at 1310 nanometer and 1550 nanometer wavelengths. Conduct measurements for multimode fibers at 850 nanometer wavelength. Record the identification, location, length, and attenuation measurements of each fiber, and furnish test reports to the Engineer. Replace any cable that fails testing, at no additional cost to the Contracting Authority.
    a. On-reel Testing: Perform testing for attenuation and continuity using OTDR and a pigtail splice. Complete testing in one direction only. Acceptable test results will be within ± 3% of factory-supplied attenuation measurements. Except for access to and test preparation of one end of the newly furnished cable, preserve the cable in its originally-shipped condition. Furnish test reports to the Engineer prior to installation.

3.01 UNDERGROUND (Continued)

b. Post installation, test 100% of the new cables' fiber count bi-directionally with an optical time domain reflectometer (OTDR) at 1310 nm and 1550 nm; in addition, use an optical loss test set (OLTS) to test all fibers at both wavelengths. Also test existing fibers that are spliced to or re-spliced as part of this contract in both directions and at both wavelengths. Provide the Engineer with up to five copies of any software required for viewing electronic files of the OLTS and OTDR traces. Use test equipment equal to EXFO FTB-500 OTDR meter, and Fluke DTX-CLT OLTS meter.
c. Ensure all test equipment has been factory certified within the last year. Provide copies of the certification 10 days prior to testing.
d. Record test results through the meter manufacturer's software with data compiled in a PDF. Additional alteration using software beyond the meter manufacturer's software will not be allowed. Submit test results in a format approved by the Engineer. Provide completed test forms on each fiber to the Engineer. Also provide native test (electronic version) with no alterations and meter software for viewing of fiber traces. At a minimum, ensure test results show the following:
   - Cable and fiber identification (as approved by the Engineer)
   - Operator name
   - Date and time
   - Setup and test parameters including wavelength, pulse width, range, scale, and ambient temperature.
   - Test results for OTDR test in both directions for total fiber trace, splice loss/gain (dB), connector loss (dB), all events greater than 0.05 dB, measured length from cable markings, and total length from OTDR.
   - Test results for attenuation test including measured cable length (cable marking), total length (from OTDR test), number of splices (from as-built) and total link end-to-end attenuation in each direction, and the bidirectional average.
e. Ensure OTDR testing uses launch and receiving cables minimum 3,300 feet or greater than the dead zone for the OTDR used for this test.
f. Ensure all fiber connectors are cleaned and checked for dirt, scratches, or chips before installed in adapters and testing. Install all dust covers after testing is complete.
   - Ensure the fiber optic cable has a maximum attenuation of 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm when measured with an OLTS.
   - Ensure each connector has an averaged loss value of 0.25 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm.
   - Ensure each splice has an averaged loss value of 0.08 dB or less when measured bi-directionally with an OTDR at 1310 nm and 1550 nm.

D. Footings and Foundations:

1. Excavation: Excavate to the size, shape, and depth specified in the contract documents. Ensure the bottom of all foundations rest securely on firm undisturbed soil. Minimize over-excavation to ensure support and stability of the foundation. Notify the Jurisdiction and Engineer immediately if high water and/or poor soils are encountered during excavation. Provide circular forms if needed at no additional cost to the Contracting Authority.

2. Foundation: Provide a means for holding all of the following elements rigidly in place while the concrete is being placed.

a. Forms:

1) Set the forms level or sloped to meet the adjacent paved areas.
2) When adjacent to paved areas, shape the top 11 inches of the foundation to be square and flush with the surrounding paved area. Provide preformed expansion material between the foundation and paved areas.

3.01 UNDERGROUND (Continued)

3) When installed in an unpaved area, set the top of the foundation 2 inches above the surface of the ground.

b. Reinforcing Steel: Install reinforcing steel.

c. Conduit: Install conduit.

d. Anchor Bolts:

1) Set anchor bolts using a template constructed to accommodate the specified elevation, orientation, and spacing according to the pole and controller manufacturer's requirements.
2) Center the pole anchor bolts within the concrete foundation.
3) Protect the anchor bolts until poles are erected.
4) Orient controller footing with the back of the cabinet toward the intersection such that the signal heads can be viewed while facing the controller, unless otherwise directed by the Engineer.

e. Concrete:

1) Place concrete to form a monolithic foundation. Consolidate concrete by vibration methods.
2) Finish the top of the base level and round the top edges with an edging tool having a radius of 1/2 inch. Provide a rubbed surface finish on the exposed surface of the footing or foundation.
3) Allow the foundation to cure a minimum of 4 days prior to erecting the poles and 7 days prior to installing the mast arms. Times may be shortened if supported by strength test results.

3. Backfill: Place suitable backfill material according to Section 3010.

E. Bonding and Grounding:

1. Ensure the traffic signal installation is grounded as required by the National Electric Safety Code.

2. Install a ground rod at each signal pole foundation and controller footing.

3. Use PVC conduit within the foundation or footing to accommodate the connection between the top of the concrete and the ground rod.

4. Bond poles to ground rods with copper wire. Connect ground wires to ground rods with approved mechanical connectors.

5. Bond rigid steel conduit ends in handholes with copper wire and approved fittings.

3.02 DETECTION

A. Detector Loop Cable Installation:

1. Coordinate the location of the detector loop with the Engineer. Obtain the Engineer's approval prior to cutting the pavement.

2. Saw to ensure proper depth and alignment of the slot. Make a 2 inch deep clean, straight, well-defined 3/8 inch wide saw cut without damage to adjacent areas. Overlap the saw cuts where the detector loop changes direction to provide full depth at all corners. Do not use right angle or corners less than 90 degrees. Minimize crossing the number of pavement joints where possible. Route the sawcut from the loop to the edge of pavement perpendicular to the flow of traffic, maintaining at least 1 foot of clearance from parallel joints.

3.02 DETECTION (Continued)

3. Before installing the detector loop cable, check the saw cuts for the presence of jagged edges or protrusions and remove if present. Clean and dry the saw cuts to remove cutting dust, grit, oil, moisture, or other contaminants. Clean by flushing with a stream of water under pressure. Use oil-free compressed air to dry the saw cuts.

4. Install detector loop cable without damage. Place three turns of the detector loop cable into the saw cut. Seal the ends of the tubing at the time of placement to prevent entrance of moisture.

5. Ensure the detector loop cables are in the bottom of the saw cut. Place detector loop sealant within the saw cut area. Comply with the manufacturer's instructions for mixing and using the detector loop sealant.

6. Install preformed loop detector according to the manufacturer's recommendations.

7. Identify each detector loop cable in the handhole by phase and location. Wind loops that are physically adjacent in an individual lane or adjacent lanes with opposite rotation (i.e. #1 clockwise, #2 counter-clockwise, #3 clockwise, etc.). Rotation reversal can be accomplished by reversing leads at the handhole.

8. Twist, with at least five turns per foot, all lengths of loop wires and tubing that are not embedded in the pavement.

9. Identify all detector loop lead-in cables with appropriate detector numbers.

10. Use a detector loop cable splice kit for the electrical splice between the detector loop cable and the detector loop lead-in cable to the controller.
    a. Ensure splice kit provides a watertight protective covering for the spliced wire, the shielding on the detector loop lead-in cable, and the end of the tubing containing the detector loop cable.
    b. Use a manufactured electrical splice kit approved by the Engineer.

11. Test all loops and document by using the following procedures:
    a. Determine the insulation resistance of the loop wire using a "megger" with 500V applied to either loop wire to earth ground. The resistance is to be greater than 100 megohms.
    b. Determine the inductance of the loop using a loop inductance meter.

B. Pedestrian Push Button Detectors:

1. Install according to the manufacturer's recommendations.

2. Seal the wire entrance into the pedestrian push button assembly.

C. Video Detection Camera System: Install according to the manufacturer's recommendations and as specified in the contract documents.

D. Wireless Magnetic Sensors (Pod/Puck): Install according to the manufacturer's recommendations.

3.03 COMMUNICATIONS

A. Traffic Monitoring System: Install according to the manufacturer's recommendations and as specified in the contract documents, as well as the following:

1. Position camera dome on the pole as directed by the Engineer.

2. Test installed system under the supervision of the Engineer, and certify as fully-functional.

B. Fiber Optic Hub Cabinet: Install according to the manufacturer's recommendations and as specified in the contract documents.

3.04 CABINET AND CONTROLLER

A. Cabinet:

1. Install according to the manufacturer's recommendations and as specified in the contract documents.

2. Install on pre-placed caulking material on the concrete base. After the cabinet is installed in place, place caulking material around the base of the cabinet.

B. Controller and Auxiliary Equipment: Install according to the manufacturer's recommendations and as specified in the contract documents.

C. UPS Battery Backup System: Install according to the manufacturer's recommendations and as specified in the contract documents. Provide service outlet that is not connected to the battery backup system.

D. Emergency Vehicle Preemption System: Install according to the manufacturer's recommendations and as specified in the contract documents.

3.05 POLES, HEADS, AND SIGNS

A. Vehicle and Pedestrian Traffic Signal Heads:

1. Inspect each signal head assembly while still on the ground for the following:
   a. Physical defects
   b. Visor type
   c. LED wattage
   d. Lens orientation
   e. Wiring connections

2. Attach signal head mounting hardware according to the manufacturer's recommendations. Apply anti-seize compound to all mechanical fasteners.

3. Adjust each signal head both vertically and horizontally to approximate a uniform grade of all like signal heads.

4. During the course of construction and until the signals are placed in operation, cover signal faces or turn away from approaching traffic. Plumb and aim the heads. Confirm placement of signal heads with the Engineer.

3.05 POLES, HEADS, AND SIGNS (Continued)

B. Traffic Signal and Pedestal Poles:

1. Erect all poles vertically under normal load.

2. Securely bolt the bases to the cast-in-place concrete foundations using the following procedures. Perform this work only on days with winds less than 15 mph. Tighten all of the nuts. Once the tightening procedure is started, complete on all of the base plate nuts without pause or delay.
   a. Use properly sized wrenches or sockets, or both, designed for tightening nuts or bolts, or both, to avoid rounding or other damage to the nuts. Do not use adjustable end or pipe wrenches.
   b. Ensure base plates, anchor rods, and nuts are free of all dirt or debris.
   c. Apply stick wax or bees wax to the threads and bearing surfaces of the anchor bolt, nuts, and washers.
   d. Tighten top nuts so they fully contact the base plate. Tighten leveling nuts to snug tight condition. Snug tight is defined as the full effort of one person on a wrench with a length equal to 14 times the bolt diameter but not less than 18 inches. Apply full effort as close to the end of the wrench as possible. Perform tightening by leaning back and using entire body weight to pull firmly on the end of the wrench until the nut stops rotating. Perform a minimum of two separate passes of tightening. Sequence tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all of the nuts in that pass have been tightened.
   e. Tighten top nuts to snug tight as described for the leveling nuts.
   f. Match-mark the top nuts and base plate using paint, crayon, or other approved means to provide a reference for determining the relative rotation of the nut and base plate during tightening. Further tighten the top nuts tightened in two passes, as listed in Table 8010.01, using a striking or hydraulic wrench. Follow a sequence of tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all nuts in that pass have been turned. Do not allow the leveling nut to rotate during the top nut tightening.
   g. Lubricate the jam nuts, place, and tighten to snug tight.

Table 8010.01: Bolt Tightening

Anchor Bolt Size	First Pass	Second Pass	Total Rotation
Less than or equal to 1 1/2 inch diameter	1/6 turn	1/6 turn	1/3 turn
Greater than 1 1/2 inch diameter	1/12 turn	1/12 turn	1/6 turn

3. A torque wrench should be used to verify that a torque at least equal to the computed verification torque, T_v, according to paragraph 6.9 of FHWA *Guidelines for the Installation, Inspection, Maintenance, and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, is required to additionally tighten the top nuts. An inability to achieve this torque should be interpreted to indicate that the threads have stripped and should be reported to the Engineer.

4. After leveling the poles, use non-shrink grout or a rodent guard between the pole base and the foundation. When non-shrink grout is used, neatly finish exposed edges of grout to present a pleasing appearance, and place a weep hole in the grout.

5. Apply anti-seize compound to all mechanical fasteners on pole access doors.

6. Install pedestrian push button post caps with tamper-proof set screws per manufacturer's direction or by driving the cap a minimum of 1/2 inch onto the post.

C. Traffic Signs: Install signs using universally adjustable sign brackets banded to the pole. Apply anti-seize compound to all mechanical fasteners.

3.06 TEMPORARY TRAFFIC SIGNAL

Construct according to Figure 8010.107 and to the configuration specified in the contract documents. Remove the temporary traffic signal as directed by the Engineer.

3.07 SURFACE RESTORATION

A. Replace or reconstruct features removed as a part of the work, such as sidewalks, driveways, curbs, roadway pavement, unpaved areas, or any other items.

B. Complete restoration according the applicable sections of the SUDAS Standard Specifications or as directed by the Engineer.

3.08 SIGNAL TURN ON

Six days in advance of the scheduled signal turn on, place static signs or portable dynamic message signs (PDMS) on at least each of the major street approaches indicating day of week when the traffic signals will be active. If required, special Traffic Signal Ahead signs or PDMS with “Signal Active” message may be left in place for up to 7 days following activation.

3.09 TESTING

A. Notify the Engineer 2 working days in advance of the time and date the signal or signal system will be ready for turn on. Do not turn on the signal or signal system without authorization of the Engineer.

B. Ensure a representative from the manufacturer and/or supplier of signal controller or other authorized person is at the project site when the signal controllers are ready to be turned on to provide technical assistance including, as a minimum, programming of all necessary input data.

C. All required signal timing data will be provided by the Engineer.

D. A test period of 30 calendar days will start upon confirmation from the Engineer that the signal or signal system is operating consistent with the project requirements. Any failure or malfunction of the equipment furnished by the Contractor, occurring during the test period will be corrected by the Contractor at no additional cost to the Contracting Authority. Upon confirmation by the Engineer that any failure or malfunction has been corrected, a new test period of 30 calendar days will start, exclusive of minor malfunctions such as lamp burnouts. Repeat this procedure until the signal equipment has operated satisfactorily for 30 consecutive calendar days.

E. After signal turn on and prior to completion of the 30 calendar day test period, respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported.

3.10 DOCUMENTATION

A. Provide file documentation packages with each signal system, consisting of the following:

1. Complete cabinet wiring diagram.

2. Complete physical description of the equipment.

3. Controller printout or equal documentation of initial controller settings installed in the field or in the office.

3.10 DOCUMENTATION (Continued)

4. Product manuals for all cabinet equipment.

5. Standard industry warranties on equipment supplied.

6. Documentation of field cable labeling scheme.

7. Diagram of phasing and detector locations.

8. One set of as-built construction plans indicating changes from the original contract documents.

B. Supply two complete sets of documentation. One set to be placed in the controller cabinet and the other set (less construction plan) to be delivered to the Engineer. Electronic (PDF) submittal of the documentation is acceptable, if allowed by the Engineer.

3.11 TRAFFIC SIGNAL REMOVAL

A. Remove and salvage traffic signal and pedestrian poles and posts, including mast arms, signal heads, wiring, mounting hardware, and associated equipment.

B. Remove and salvage controller cabinet and controller, including associated equipment.

C. Remove and dispose of handholes and abandoned conduit as specified in the contract documents.

D. Remove concrete pads and foundations, including reinforcing steel to a depth of 4 feet below established grade. Furnish, place, and compact backfill according to Section 3010.

E. Restore disturbed surfaces to match adjacent areas.

F. Deliver salvaged materials to the location specified in the contract documents.

END OF SECTION

1. Shape top 11 inches with forms.
2. Bolt spacing and conduit locations as specified by the manufacturer.
3. Provide apron on three sides of cabinet if cabinet has front and back doors.

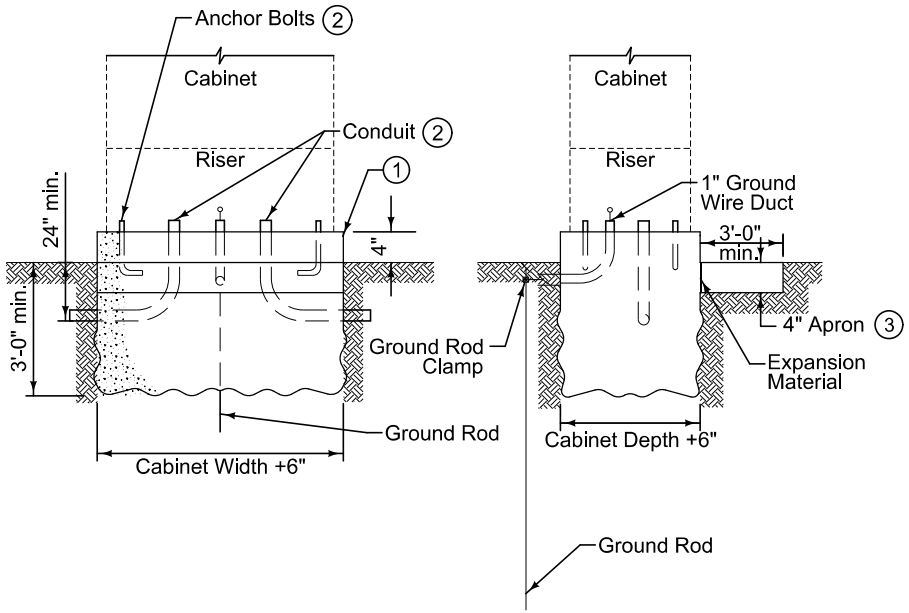

FIGURE 8010.101 | SHEET 1 OF 1

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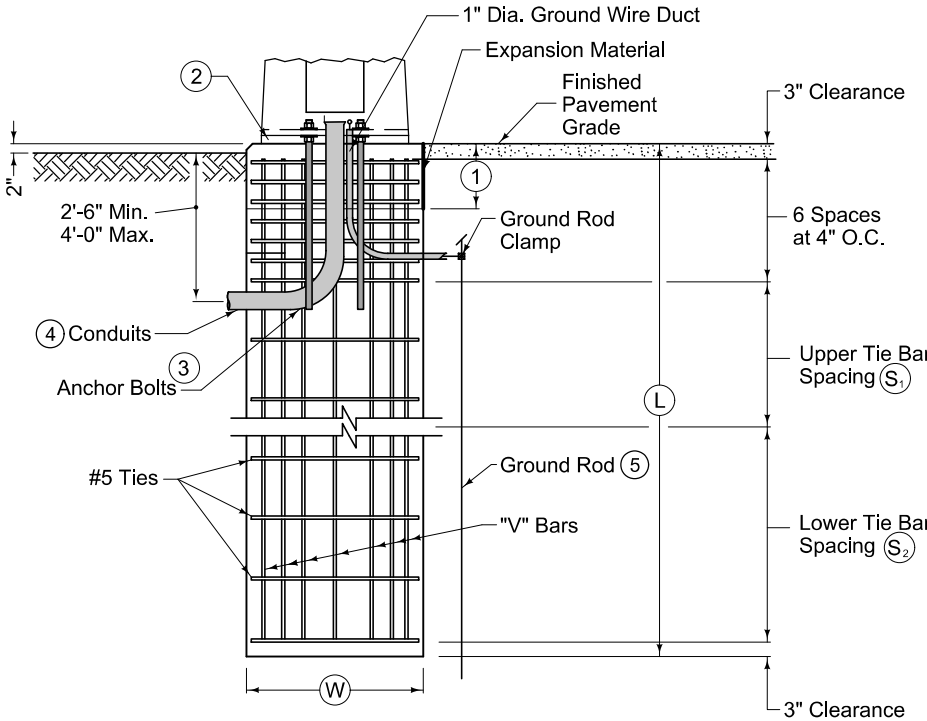
REVISION
1 | 2022 Edition

8010.101

SHEET 1 of 1

SUDAS Standard Specifications

CABINET FOOTING DETAILS

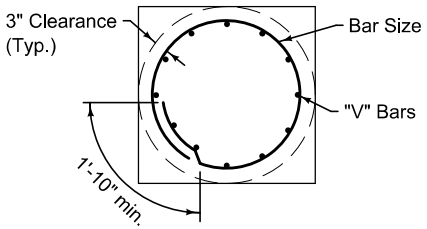


MAST ARM POLE FOUNDATION IN SOIL
TYPE A FOUNDATION

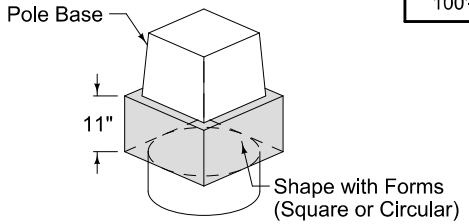
The Type A Foundation is the normally required foundation construction. Where rock is encountered, the Engineer may approve the use of the Type B or C Foundation. Prior to installing a foundation in rock, obtain a subsurface investigation certified by a geotechnical engineer licensed in the State of 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.
4. Provide conduits as per plans.
5. Install ground rod adjacent to foundation or in adjacent handhole.

Max. Mast Arm Length	Foundation		"V" Bars			Tie Bars				
	W	L	Count	Size	Length	Count	Upper Spacing		Lower Spacing	
							# Spaces	S_1	# Spaces	S_2
35'-0"	3'-0"	12'-0"	12	#8	11'-6"	17	9	12"	N/A	N/A
45'-0"	3'-0"	14'-0"	12	#8	13'-6"	19	11	12"	N/A	N/A
55'-0"	3'-0"	16'-0"	12	#8	15'-6"	25	12	8"	5	12"
60'-0"	3'-0"	18'-0"	13	#8	17'-6"	28	15	8"	5	12"
70'-0"	3'-6"	18'-0"	12	#10	17'-6"	28	15	8"	5	12"
80'-0"	3'-6"	21'-0"	14	#10	20'-6"	40	28	6"	4	12"
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'

FIGURE 8010.102 | SHEET 1 OF 4

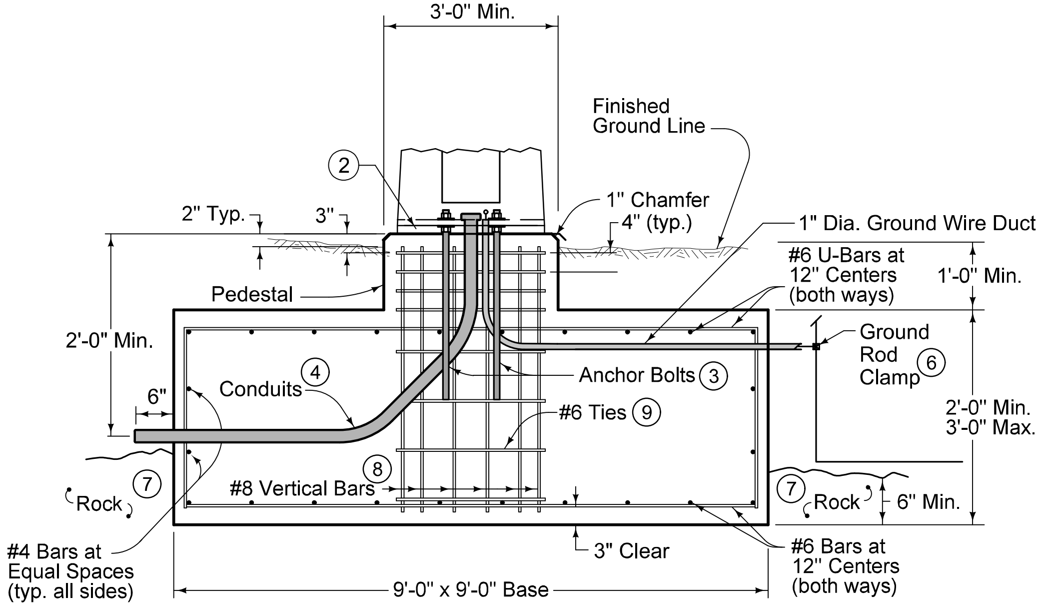
SUDAS | IOWA DOT | REVISION 5 04-19-22

FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 1 of 4

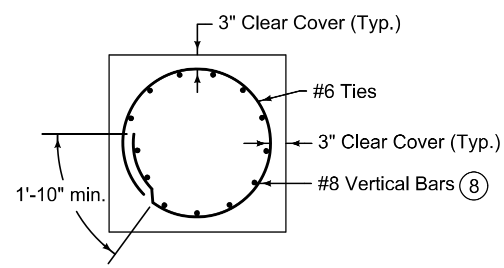
REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

Paul D. Wigand, SUDAS DIRECTOR | DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION



MAST ARM POLE FOUNDATION IN ROCK
TYPE B FOUNDATION



PLAN VIEW

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) Provide conduits as per plans.

(6) When in contact with rock, place ground rods as specified in National Electrical Code, current edition, adjacent to foundation or in adjacent handhole.

(7) Cast foundation concrete against competent rock. If foundation is formed, place backfill with concrete cast against rock.

(8) Place 13 equally spaced #8 vertical bars.

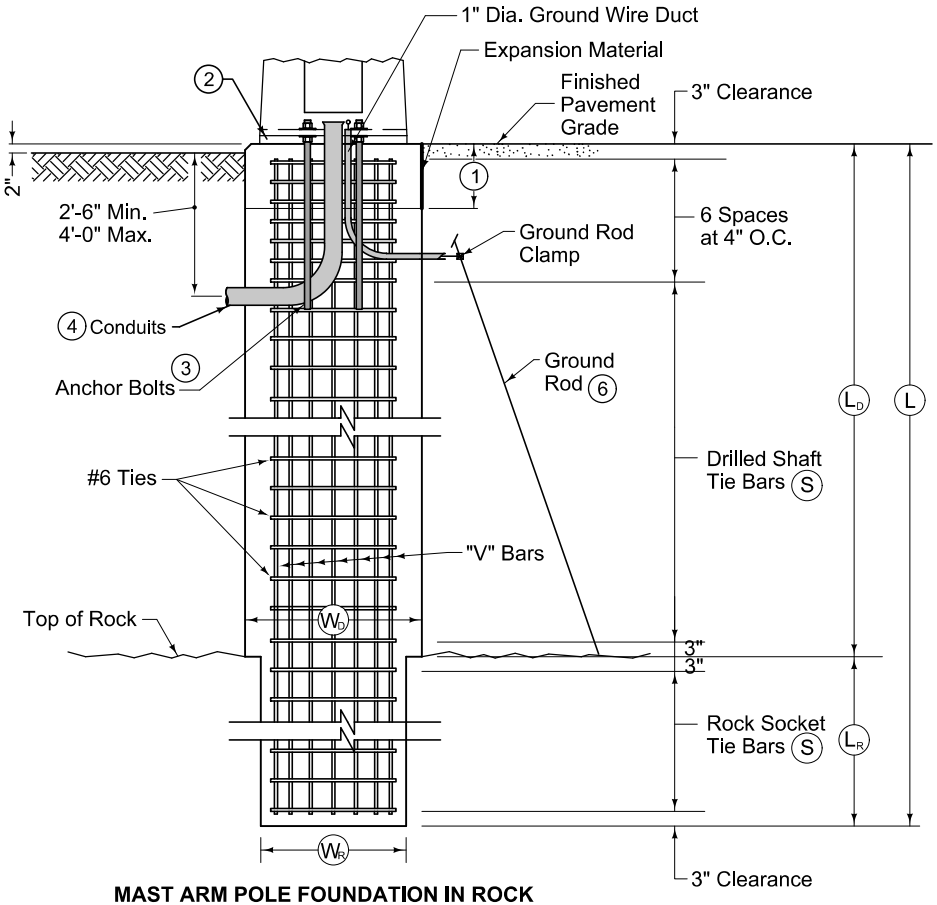
(9) #6 bars spaced at 8 inch maximum. Ties may be welded to vertical bars.

SUDAS	IOWA DOT	REVISION 5 04-19-22
FIGURE 8010.102	STANDARD ROAD PLAN	TS-102 SHEET 2 of 4

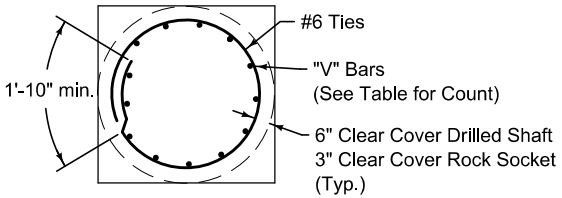
REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

SUDAS DIRECTOR DESIGN METHODS ENGINEER

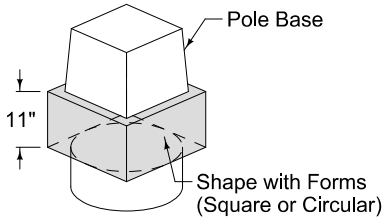
TRAFFIC SIGNAL POLE FOUNDATION



MAST ARM POLE FOUNDATION IN ROCK
TYPE C FOUNDATION



PLAN VIEW



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.
4. Provide conduits as per plans.
6. When in contact with rock, place ground rods as specified in National Electrical Code, current edition, adjacent to foundation or in adjacent handhole.

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.

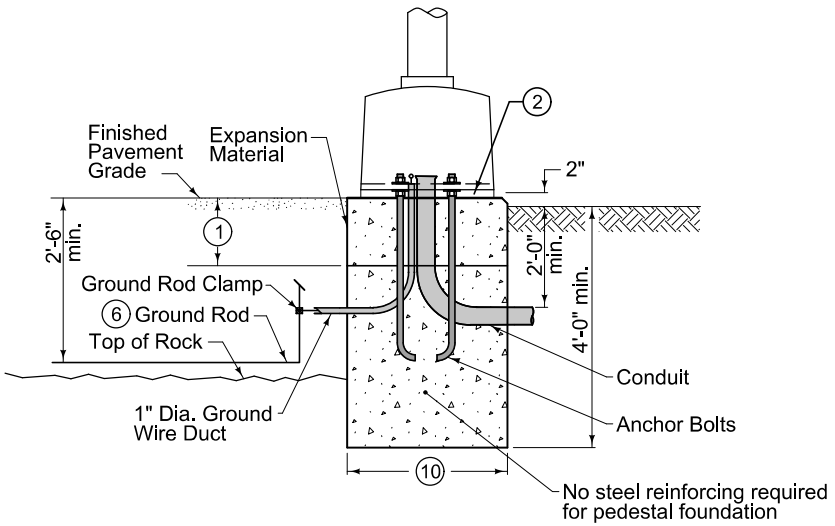
SUDAS | IOWA DOT | REVISION 5 04-19-22
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 3 of 4

REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

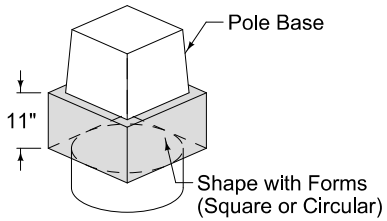
SUDAS DIRECTOR — DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION

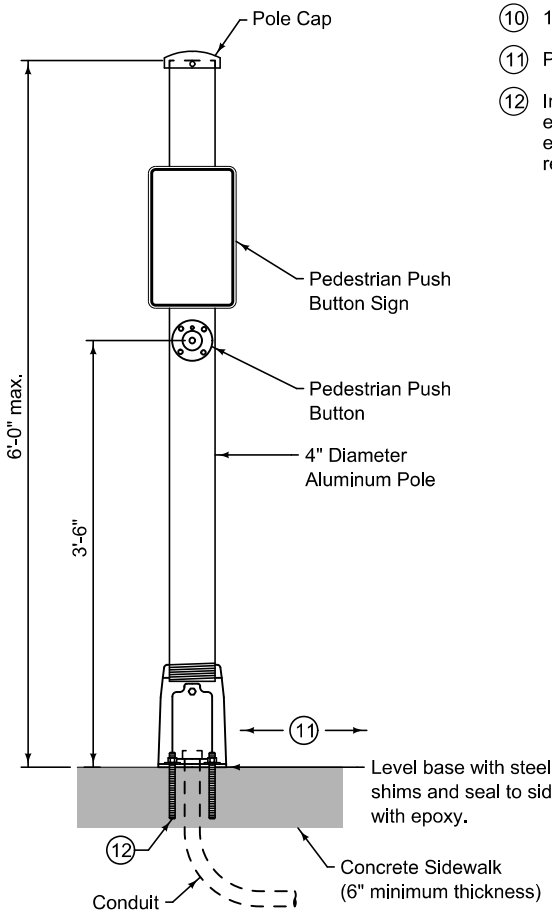
FIGURE 8010.102 | SHEET 3 OF 4



PEDESTAL POLE FOUNDATION IN SOIL OR ROCK



DETAIL 'A'



ALTERNATE PUSH BUTTON POLE SIDEWALK MOUNTING

(1) Shape top 11 inches with forms. See Detail 'A'.

(2) Install rodent guard or non-shrink grout with weep hole.

(6) When in contact with rock, place ground rods as specified in National Electrical Code, current edition, adjacent to foundation or in adjacent handhole.

(10) 12 to 24 inch diameter as shown in contract documents.

(11) Provide 4 foot accessible path adjacent to push button pole.

(12) Install four anchor bolts, washers, and nuts in new or existing concrete sidewalk by drilling and anchoring with epoxy adhesive. Provide bolts according to manufacturer's recommendations.

FIGURE 8010.102 | SHEET 4 OF 4

SUDAS | IOWADOT

REVISION 5 04-19-22

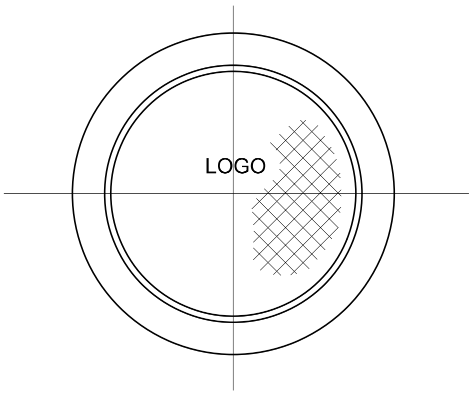
FIGURE 8010.102 | STANDARD ROAD PLAN | TS-102 | SHEET 4 of 4

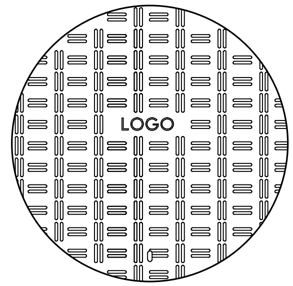
REVISIONS: Removed hooks from foundation reinforcing. Updated notes for conduit installation. Clarified placement of ground rod.

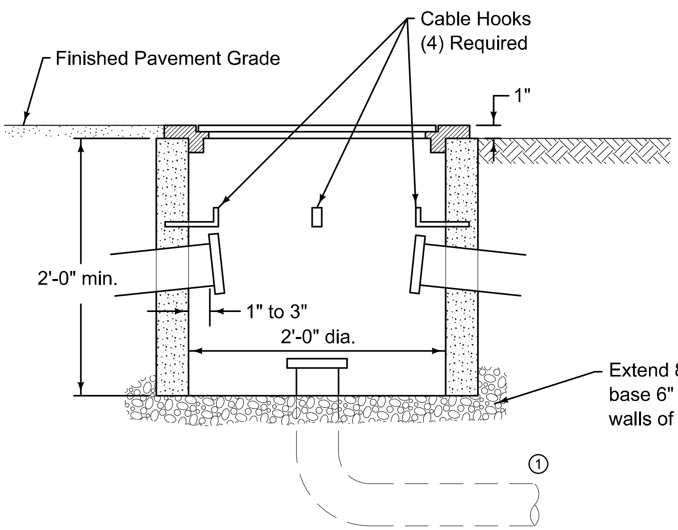
SUDAS DIRECTOR | DESIGN METHODS ENGINEER

TRAFFIC SIGNAL POLE FOUNDATION

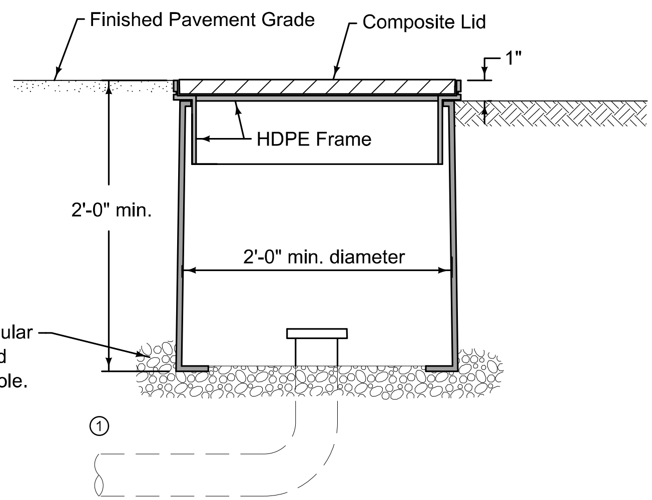
① Potential conduit entry through bottom of handhole.







Extend 8" granular base 6" beyond walls of handhole.



PRECAST CONCRETE HANDHOLE (TYPE I)

HDPE HANDHOLE (TYPE V)

SUDAS	IOWA DOT	REVISION 2 04-19-22
FIGURE 8010.103	STANDARD ROAD PLAN	LI-103 SHEET 1 of 2

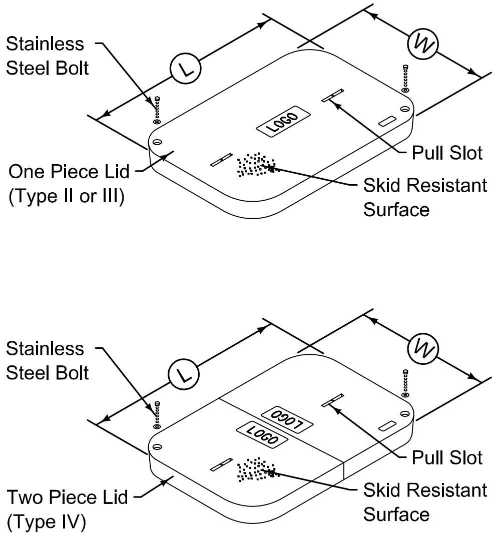
REVISIONS: Added option for conduit to enter through the bottom of handhole.

SUDAS DIRECTOR — DESIGN METHODS ENGINEER

CONDUIT AND PRECAST HANDHOLES

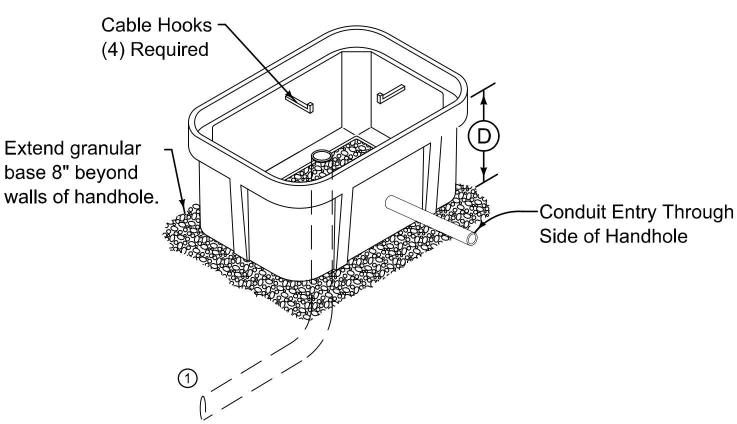
① Potential conduit entry through bottom of handhole.

② For conduit behind curb, place 24 to 48 inches below top of curb. For conduit under roadway, place 30 to 60 inches below the gutterline.

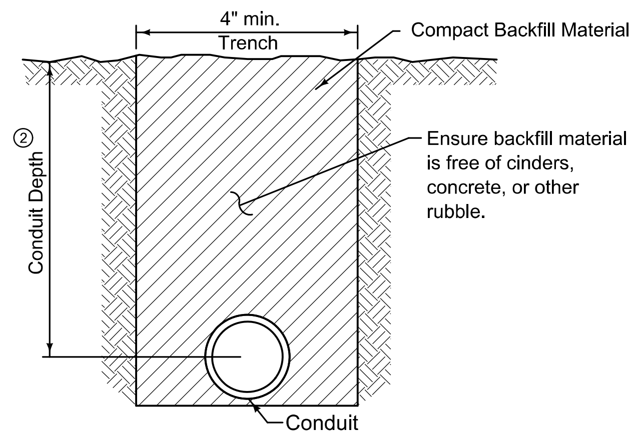


HANDHOLE DIMENSIONS TABLE (NOMINAL)

TYPE	L	W	D
II	30"	17"	24"
III	36"	24"	30"
IV	48"	30"	36"



PRECAST CONCRETE COMPOSITE HANDHOLE



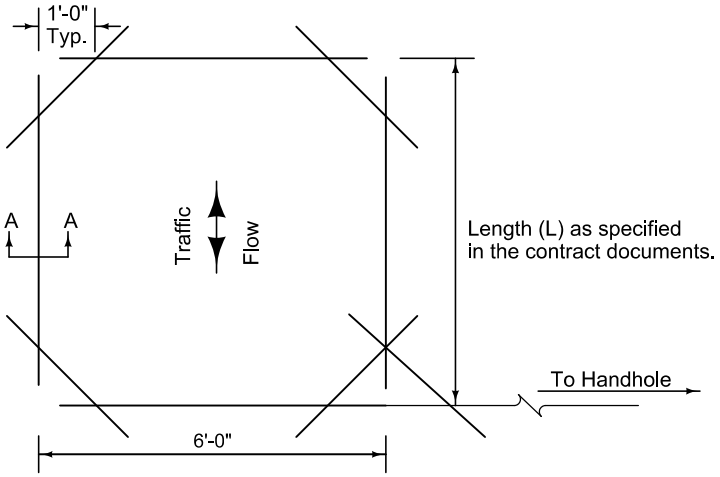
CONDUIT IN TRENCH

SUDAS	IOWADOT	REVISION 2 04-19-22
FIGURE 8010.103	STANDARD ROAD PLAN	LI-103 SHEET 2 of 2

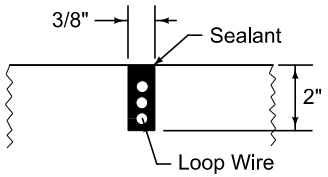
REVISIONS: Added option for conduit to enter through the bottom of handhole.

SUDAS DIRECTOR — DESIGN METHODS ENGINEER

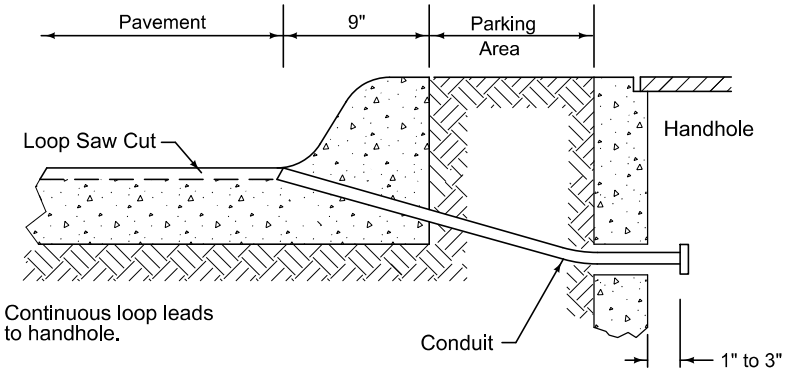
CONDUIT AND PRECAST HANDHOLES



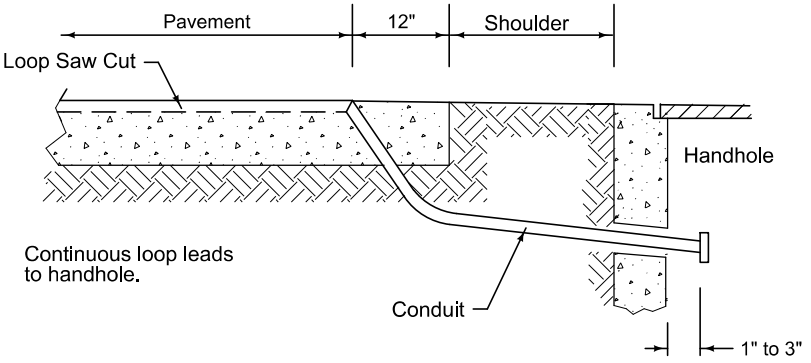
RECTANGULAR DETECTOR LOOP



SECTION A-A



CURB



NO CURB

DETECTOR CONDUIT ENTRY

FIGURE 8010.104

SHEET 1 OF 2

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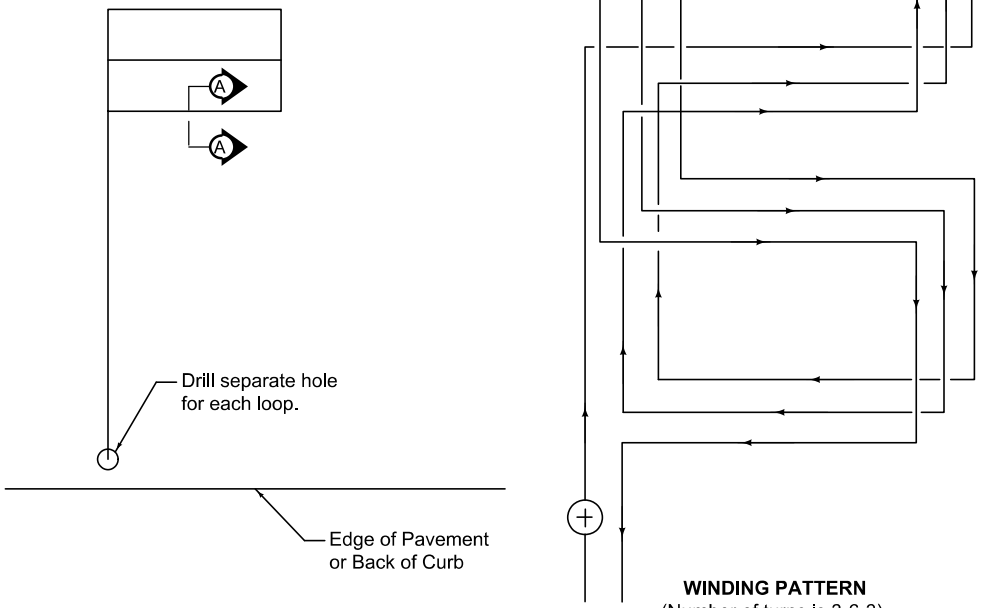
SHEET 1 of 2

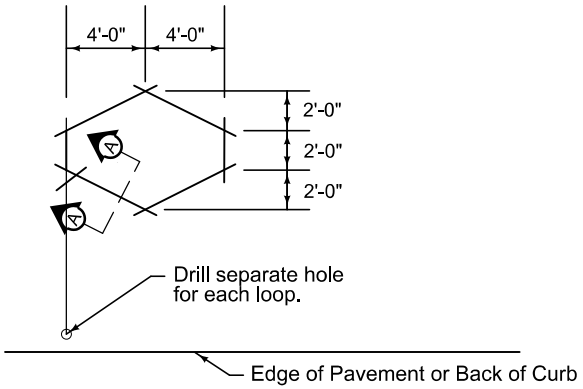
SUDAS Standard Specifications

INDUCTIVE LOOP VEHICLE DETECTORS

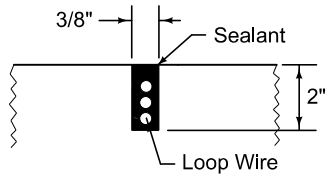


WINDING PATTERN
(Number of turns is 3-6-3)

BICYCLE QUADRUPOLE LOOP DETECTOR



MODIFIED DIAMOND DETECTOR LOOP



SECTION A-A

FIGURE 8010.104 SHEET 2 OF 2

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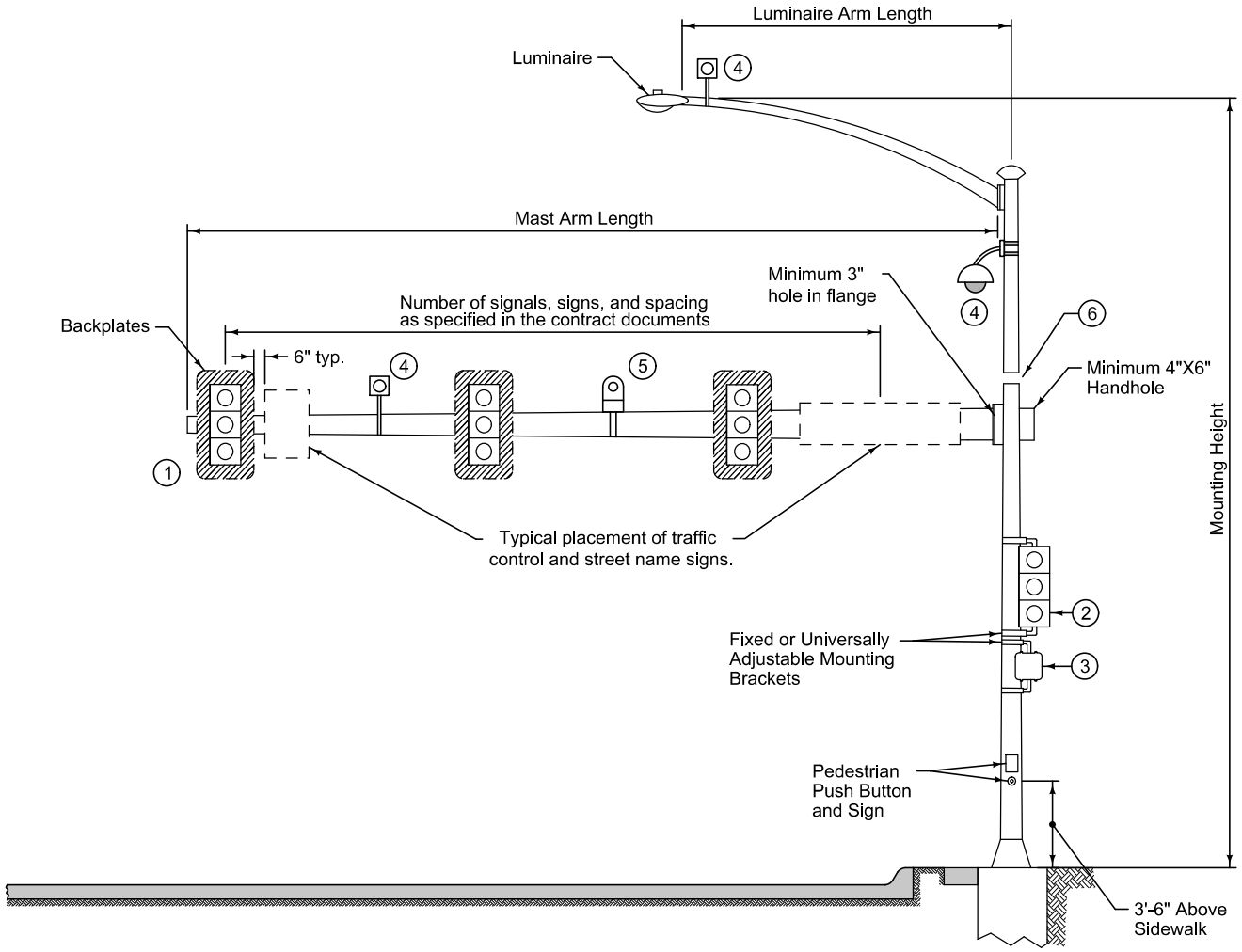
SHEET 2 of 2

SUDAS Standard Specifications

INDUCTIVE LOOP VEHICLE DETECTORS



STEEL MAST ARM POLE

1. Ensure the top of the signal housing is no more than 25.6 feet above the pavement. Ensure the bottom of the signal housing and related attachments are at least 15 feet above the pavement.
2. Ensure the bottom of the signal housing (including brackets) that is not located over a roadway is a minimum of 10 feet and a maximum of 19 feet above the sidewalk or, if there is no sidewalk, above the pavement grade at the center of the roadway.
3. Mount pedestrian signal heads with the bottom of the signal housing (including brackets) no less than 7 feet or more than 10 feet above the sidewalk level. Position and adjust heads to provide maximum visibility at the beginning of the controlled crosswalk.
4. Possible video camera location.
5. Possible EVP detector.
6. Pole cap if no luminaire extension.

FIGURE 8010.105

SHEET 1 OF 1

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8010.105

SHEET 1 of 1

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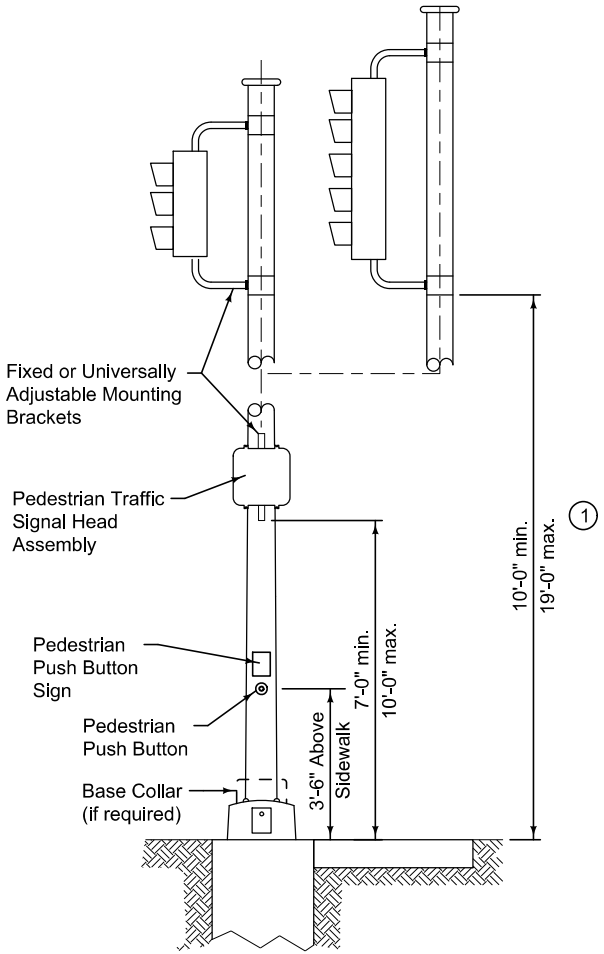
MAST ARM POLE DETAILS

(1) For signal head visibility and possible pedestrian head installation.



PEDESTAL POLE

FIGURE 8010.106 | SHEET 1 OF 1

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8010.106

SHEET 1 of 1

SUDAS Standard Specifications

PEDESTAL POLE DETAILS

(1) Possible video camera location.

(2) Possible EVP detector location.

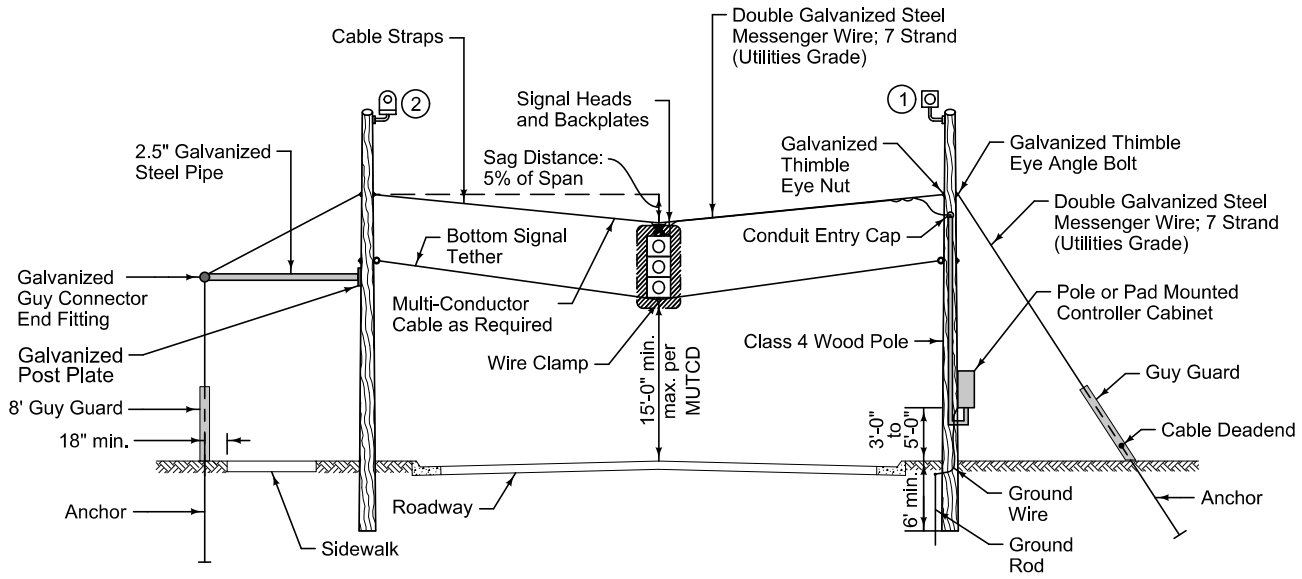

FIGURE 8010.107 | SHEET 1 OF 1

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8010.107

SHEET 1 of 1

SUDAS Standard Specifications

WOOD POST SPAN ASSEMBLY

PART 2 - PRODUCTS

2.01 GENERAL

Use products and materials complying with Part 6 of the MUTCD.

2.02 SIGNS

A. Material: Sheet aluminum, galvanized steel, plywood, or flexible roll-up material complying with Iowa DOT Article 4186.02.

B. Size and Type:

1. **Regulatory Signs:** As indicated in the contract documents or recommended in the MUTCD.
2. **Sidewalk Signs:** Minimum size 12 inch by 24 inch.
3. **Warning Signs:** Comply with Table 8030.01.

Table 8030.01: Warning Signs

Speed Limit (mph)	Minimum Sign Size	Minimum Uppercase Letter Size	Minimum Plaque Size
< 25	30” x 30”	4”	18” x 18”
25 - 35	36” x 36”	5”	18” x 24”
>35	48” x 48”	7”	24” x 30”

C. Retroreflective Sheeting: Comply with Iowa DOT Article 4186.03.

D. Posts:

1. **Wood Posts:** Comply with Iowa DOT Section 4164.
2. **U-Shaped Rail Steel Posts:** 3.0 pounds per foot.
3. **Perforated Square Steel Tube Posts:** 2 1/4 or 2 1/2 inch square 12 gage perforated steel tubing.

E. Portable Sign Stands: Crashworthy per the test and evaluation criteria of National Cooperative Highway Research Program (NCHRP) Report 350 or Manual on Assessing Safety Hardware (MASH). Must be stable in windy conditions.

2.03 CHANNELIZING DEVICES

Channelizing devices include cones, channelizers, tubular markers, vertical panels, drums, and barricades. Crashworthy per the test and evaluation criteria of NCHRP 350 or MASH-16.

A. Retroreflective Sheeting: Comply with Iowa DOT Article 4186.03.

B. Cones: Minimum height of 18 inches for daytime and speed less than or equal to 35 mph. Minimum height of 28 inches with retroreflective bands for nighttime or speed greater than 35 mph.

C. Channelizers: 42 inch height with retroreflective bands and 16 pound base.

D. Tubular Markers: Minimum diameter 2 inches with retroreflective bands. Minimum height 18 inches for daytime and speed less than or equal to 35 mph. Minimum height 28 inches for nighttime or speed greater than 35 mph.

2.03 CHANNELIZING DEVICES (Continued)

E. Vertical Panels: Minimum height 36 inches with 8 to 12 inch panel width and 24 inch minimum panel height.

F. Drums: Minimum width 18 inches. Minimum height 36 inches.

G. Barricades: Minimum rail length 2 feet for Type I or Type II barricades. Minimum rail length 4 feet for Type III barricades. Minimum height of top rail for Type I and Type II equals 3 feet and minimum height to top rail of a Type III is 5 feet.

2.04 MISCELLANEOUS PRODUCTS

A. Orange Mesh Safety Fence: Comply with Iowa DOT Article 4188.03.

B. Temporary Barrier Rail: Unless otherwise specified, use precast concrete units. Comply with Iowa DOT Standard Road Plan BA-401.

2.05 EQUIPMENT

A. Warning Lights:

1. For nighttime installation, provide Type A warning lights visible to both directions of traffic.

2. For 24 hour installations, provide Type B warning lights.

B. Arrow Boards: When required, provide Type A, B, or C arrow boards operating in sequential chevron mode.

C. Portable Dynamic Message Signs: Comply with Iowa DOT Article 4188.07.

D. Pilot Cars: Pickup trucks or automobiles with G20-4 signs reading: PILOT CAR - FOLLOW ME. Mount two signs on each vehicle, visible from both directions of traffic. Mount signs with bottom of signs at least 1 foot above the top of the vehicle's roof.

E. Vehicle Warning Lights: Supply amber, high-intensity rotating, flashing, oscillating, or strobe light.

2.06 FLAGGERS

A. General: Comply with the current Iowa DOT Flagger's Handbook for flagger operations, equipment, and apparel.

B. Lighting: Provide auxiliary lighting at flagger stations when nighttime flagging is required.

C. Training: For other than short time, emergency, or relief assignment of flaggers, provide flagger training to include the following:

1. Issuing a copy of the current Iowa DOT Flagger's Handbook to and review by each flagger.

2. Presentation of the current Iowa Professional Flagging Video to each flagger.

3. Issuing a flagger training card to each flagger, to be carried at all times and shown upon request. Include the following information on training card:
   a. Employee name
   b. Date of training
   c. Name of instructor
   d. Expiration date of December 31 of the year following the training date

PART 2 - PRODUCTS

2.01 SOD

A. Provide a well-established (no less than 12 months old), well rooted, healthy, nursery-grown sod blend of improved Kentucky Bluegrass with a uniform color, leaf texture, density, and varieties consisting of a minimum of two and no more than four cultivars selected from the following list:

Allowed Kentucky Bluegrass Cultivars:

4-Seasons	Bluenote	NuBlue
Arrowhead	Concerto	NuGlade
Award	Everest	Prosperity
Bewitched	Impact	Ridgeline
Beyond	Jackpot	Rubicon
Blue Chip Plus	Liberator	Rugby II
Blue Devil	Midnight	Skye
Blueberry		

B. Sod grown in peat bedded soil will not be accepted.

C. Ensure sod is free from objectionable grasses and broadleaf weeds, roots of trees or shrubs, stones, thatch, and other objectionable materials, nematodes and soil-born insects, and free from disease. Sod will be considered free of weeds if less than two such plants are found per 100 square feet of area.

D. Mow at a height of 2 inches prior to cutting.

E. Cut sod with a sod machine in strips of uniform width and length, with square ends. Cut to a uniform soil thickness of approximately 1/2 inch to 1 inch; thickness measurement excludes top growth.

F. Ensure sod is moist when placed.

2.02 FERTILIZER

Comply with Iowa DOT Article 4169.03.

2.03 STAKES

A. Softwood Stakes: 3/4 inch diameter and 8 inches long.

B. Steel Pins: Tee shaped with a 4 inch head and 8 inch leg.

2.04 WATER

Unless otherwise specified in the contract documents, provide water and watering equipment such as hoses and sprinklers. Provide water free of substances harmful to plant growth.

PART 3 - EXECUTION

3.01 PREPARATION OF SODBED

A. Limit preparation to areas that will be immediately sodded.

B. Where weed growth has developed, remove all weeds and weed debris.

C. Shape and fine grade sodbed to remove washes or gullies, water pockets, and irregularities. Provide an even surface, true to grade and cross-section.

D. Rototill and cultivate sodbed to a fine and mellow condition to a minimum depth of 3 inches. Clear the top 3 inches of soil lumps, stones over 3/4 inch, and foreign material using hand labor as required.

3.02 FERTILIZING - FIRST APPLICATION

A. Provide a guaranteed analysis of 20-26-6 commercial fertilizer or the equivalent units of nitrogen (N), phosphate (P), and potash (K) by weight at the rate of 200 pounds per acre.

B. Incorporate fertilizer into soil to a depth of 1 1/2 inches prior to placing sod.

3.03 SOD INSTALLATION

A. Do not install sod between the dates of June 15 and August 15, unless authorized by the Engineer.

B. Do not lay frozen sod; do not lay sod on frozen soil or when freezing conditions are forecasted within 24 hours.

C. Dampen dry soil prior to placing sod.

D. Firm or heal in soil along the edges of the sodded areas.

E. Carefully place sod in rows or strips evenly, with the longest edge parallel to the finished contours, and at right angles to the centerline of ditches and channels. On slopes, begin placing sod at the bottom and progress upward.

F. Minimize traffic on newly laid sod during installation. Provide plank or wood sheets to protect sod already laid from equipment and vehicles.

G. Tightly fit each strip against each other without voids. Do not overlap edges. Stagger joints at the ends of sod strips with adjacent strips of sod.

H. Finish sod edges at walks, curbs, planting, mulch edges, and other vertical surface by cutting and fitting tightly to edge.

I. Place sod mat approximately 1 inch below finished surface of walks, pavement, curbs, or other permanent features. Remove any sod not conforming to this requirement, adjust the subgrade, and re-lay the sod.

J. Where new sod joins existing lawns, cut straight and neatly into existing lawn and level subgrade to match height.

K. Stake sod on grades exceeding 4:1 and in drainage channels. Stake each roll at 2 foot intervals or as required to prevent movement during rainfall and stormwater runoff events.

L. Roll lightly-watered sod with a small mechanical or hand sod roller to sufficiently set or heal sod into soil and remove lumps. Roll as required to firm and level the sodded areas.

PLANT MATERIAL AND PLANTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Plant Material and Planting

B. Tree Drainage Wells

C. Warranty for Plant Material

1.02 DESCRIPTION OF WORK

A. Furnishing, preparing, and installing plant material.

B. Constructing tree drainage wells.

C. Maintaining and replacing plants for completed planting work.

1.03 SUBMITTALS

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

A. Submit copy of current certification that the Supplier is an Iowa Department of Agriculture and Land Stewardship Certified Nursery Dealer or Grower prior to starting work.

B. Prior to final acceptance, submit written maintenance instructions recommending procedures for maintenance of all plant material types, including watering, insect and disease control, fertilizing, pruning, tree protection, and staking.

C. When requested, provide certification stating container-grown material has been grown in the container for no less than 1 year.

D. Provide a sample of the proposed mulch for approval by the Engineer.

E. When requested, submit a schedule of unit prices for each size and variety of tree, shrub, and ground cover plant specified in the contract documents.

1.04 SUBSTITUTIONS

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

Where evidence is submitted that a specified plant cannot be obtained, substitution may be made upon approval of the Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

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

A. Protect plant root systems during transportation and storage, as necessary, with wet straw, moss, or other suitable material that will ensure root systems are maintained in a moist, healthy condition.

B. Protect all plants with a tarpaulin when being transported in an open vehicle.

C. When approved by the Engineer, temporary storage of plants on the project site may be allowed. When temporary on-site storage is not approved, provide such facilities and location at no additional cost to the Contracting Authority.

1.05 DELIVERY, STORAGE, AND HANDLING (Continued)

D. During temporary storage, heel-in plants and maintain them by providing moist straw, moss, or other suitable material to protect root systems; watering; and protecting from excessive sun, wind, and inclement weather conditions.

1.06 SCHEDULING AND CONFLICTS

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

Comply with the optimum planting dates specified in Section 9030, 3.01.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Plants, By Count:

1. **Measurement:** Each tree, shrub, or ground cover plant accepted in place will be counted.

2. **Payment:** Payment will be at the unit price for each tree, shrub, or ground cover plant. Payment will be made in increments according to the following schedule:
   a. 70% of unit price at acceptance.
   b. 30% of unit price at end of 1 year establishment period, upon installation of replacements.

3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment period; and replacements.

B. Plants, By Count, With Warranty:

1. **Measurement:** Each tree, shrub, or ground cover plant accepted in place will be counted.

2. **Payment:** Payment will be at the unit price for each tree, shrub, or ground cover plant. Payment will be made in increments according to the following schedule:
   a. 70% of unit price at acceptance.
   b. 15% of unit price at end of 1-year establishment period, upon installation of replacements.
   c. 15% of unit price at end of 2-year warranty period, upon installation of replacements.

3. **Includes:** Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment and warranty periods; and replacements.

1.08 MEASUREMENT AND PAYMENT (Continued)

C. Plants, Lump Sum:

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

2. Payment: Payment will be at the lump sum price for plants. Payment will be made in increments according to the following schedule:
a. 70% of lump sum price at acceptance.
b. 30% of lump sum price at end of 1 year establishment period, upon installation of replacements.

3. Includes: Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment period; and replacements.

D. Plants, Lump Sum, With Warranty:

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

2. Payment: Payment will be at the lump sum price for plants. Payment will be made in increments according to the following schedule:
a. 70% of lump sum price at acceptance.
b. 15% of lump sum price at end of 1 year establishment period, upon installation of replacements.
c. 15% of lump sum price at end of 2 year warranty period, upon installation of replacements.

3. Includes: Unit price includes, but is not limited to, delivery; excavation; installation; watering; placing backfill material; mulching; tree protection; staking or guying; pre-emergent herbicide, if specified; maintenance during the establishment and warranty period; and replacements.

E. Tree Drainage Wells:

1. Measurement: Each tree drainage well will be counted.

2. Payment: Payment will be at the unit price for each tree drainage well.

3. Includes: Unit price includes, but is not limited to, excavation, furnishing and placing rock, engineering fabric, and placing backfill material.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

A. General:

1. Ensure plant material meets the minimum requirements of size and grade as stated in the latest edition of American Standard for Nursery Stock, ANSI Z60.1.

2. Provide all plants true to name and tagged legibly as to name according to nursery standards of practice as recommended by the American Nursery and Landscape Association. Plant names indicated comply with the latest edition of "Standardized Plant Names" as adopted by the American Joint Committee of Horticultural Nomenclature.

3. Plants larger than those specified in the plant list with corresponding root system may be used upon approval of the Engineer.

4. Match plants planted in rows in form and size, unless otherwise specified in the contract documents.

B. Plant Material Quality:

1. Provide nursery plants suitable to and grown in the same USDA Plant Hardiness Zone as the project location.

2. One-sided branching plants from tightly planted nursery rows will be rejected.

3. Provide healthy specimens without objectionable deformities, voids, and open spaces, with well-developed branch and root systems. Ensure specimens are true to height, shape, and character of growth of the species or varieties. Provide plants showing appearance of good health and vigor.

4. Provide plants free of the following:
   a. Harmful insects, insect eggs, borers, and all forms of infestation
   b. Plant diseases and moldy or dried roots
   c. Damage to trunk, bark, branches, leaders, root systems, or cut-leaders
   d. Defects, disfiguring knots, sunscald injuries, and frost cracks
   e. Rodent damage to bark and buds

5. Plants with broken or cut back terminal leaders or with circling roots may be rejected.

C. Balled and Burlapped Plants:

1. Provide firm, moist, unbroken root balls of the specified size.

2. Broken or loose root balls will be rejected.

3. No manufactured or artificially produced or mudded-in root balls will be accepted.

4. A container grown plant, in lieu of a balled and burlapped root ball, will be accepted provided it meets the specified size, species, complies with American Standard for Nursery Stock, ANSI Z60.1, and meets criteria for container grown plants.

D. Container Grown Plants:

1. Grow plants in sufficiently sized container for a minimum of 1 year, with a root system developed to hold its soil together, firm, whole, and moist when taken from the container.

2.01 PLANT MATERIALS (Continued)

2. No loose root systems in the container, root-bound, or circling of the root system will be accepted (ANSI Z60.1).

3. Containers with holes, shaping, or made of fabric as a means of preventing root growth from reaching the sides of the container, or pruning, or training roots to grow laterally rather than encircling the container are acceptable (ANSI Z60.1).

E. Bare Root Plants:

1. Only use where specified in the contract documents or as approved by Engineer.

2. Ensure plants have substantially all of the root system intact, with clean cuts on roots. Root system is to be packed in moisture-retaining material and bagged to protect the root system from drying out.

3. Prior to planting, properly prune and sweat according to the nursery source instructions.

4. Ensure plants are dormant or breaking bud if sweated at the time of planting.

5. Do not plant later than May 15.

2.02 MULCH

Provide hardwood or softwood mulch complying with the following:

A. Shredded bark and shredded wood mixture containing no more than 50% wood chips.

B. Produced by a mechanical debarker and chipping machine.

C. Reasonably free from leaves, twigs, dust, toxic substances, and any other foreign material.

D. Not in an excessively wet or decomposed condition.

2.03 BACKFILL MATERIAL

A. Retain backfill material for plantings from soil excavated from the planting pit.

B. Ensure backfill material is loose, friable, and free of clods, sod, vegetation, and rocks 2 inches in diameter or larger. Do not use frozen or muddy soil as backfill material.

2.04 STAKING MATERIAL

A. Stakes: Comply with Iowa DOT Article 4154.09. Minimum length of 6 feet.

B. Trunk Support Strapping:

1. Breathable, flexible strap material or arbor tie or other material approved by the Engineer.
2. Provide strapping material of adequate length to prevent restriction of trunk, branches, or stems and contact of staking or guying wire with tree trunk.

C. Wire: Provide minimum 17 gauge, rust inhibitive wire to resist breaking during high winds and natural weathering conditions.

2.04 STAKING MATERIAL (Continued)

D. Manufactured Staking System: Upon approval of the Engineer, manufactured staking systems may be used in lieu of stakes, wire, and trunk support strapping.

2.05 GUYING MATERIAL

A. Earth Anchors:

1. Steel auger type with looped end; minimum 3/4 inch diameter, 36 inch long anchor shank, with 5 inch minimum diameter anchor disk.

2. Driven style earth anchors with a minimum 1,000 pound capacity in normal soils.

B. Trunk Support Strapping: Comply with Section 9030, 2.04, B.

C. Cable: 1/8 inch galvanized wire rope or equivalent cable with a minimum 1,500 pound capacity. Provide cable with ends clean and unfrayed.

D. Cable Clamps: Match size and strength of cable. Provide two for each end of cable.

E. Flagging Material: Brightly colored, minimum 12 square inches.

2.06 TREE PROTECTION

Install a correctly fitted mesh (corrugated or vinyl plastic) or corrugated or crepe paper, specifically manufactured for tree trunk protection, having qualities to resist insect infestation and to allow free air flow to trunk tissues, or similar material approved by the Engineer.

2.07 WATER

Provide water and watering equipment such as hoses, tanks, reels, bags or bladders, mobile equipment, nozzles, and sprinklers for the purpose of regular watering activities during the establishment period. Provide water free of substances harmful to plant growth. No fertilizers, pesticides, or growth regulators will be used in the water.

2.08 TREE DRAINAGE WELLS

A. Porous Backfill Material: Comply with Iowa DOT Section 4131.

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

2.09 HERBICIDE

Provide a granular pre-emergent herbicide as approved by the Engineer.

PART 3 - EXECUTION

3.01 ALLOWABLE PLANTING DATES

Install plant material during the following times:

A. Evergreen Plants: September 1 to September 30 and March 1 to April 30, but not after candles exceed 1 inch.

B. Deciduous Plants (Balled and Burlapped and Container): October 1 to November 30 and March 1 to May 15.

C. Deciduous Plants (Bare Root): In the spring prior to May 15.

D. Weather Restrictions: Planting may be conducted under unseasonable conditions, except in weather below 32°F or above 90°F. No variance from plant warranty or other requirements will be given for plants installed outside the specified periods.

3.02 PREPARATION

A. Provide notice to the Engineer 3 days prior to planting.

B. All plants will be inspected by the Engineer prior to planting. Plants may be inspected and approved at the place of growth by the Engineer for compliance with the specifications for quality, size, and variety. Such approval does not waive the right to reject any plant material after it has been delivered to the site and/or installed.

C. Provide barriers or fencing as approved by Engineer to protect the public from injury when planting installation is within the right-of-way.

3.03 LOCATION OF PLANTS

A. Mark the location of all plants with flags or lathe according to the contract documents. Mark trees individually. Stake the outline of bedded plants or shrub groups for the quantity on the plans without marking individual plants. The Engineer will approve the locations marked prior to excavation of planting pits.

B. Make field adjustments in plant locations where underground or overhead obstruction is encountered, or where changes have been made as approved by the Engineer.

3.04 EXCAVATION OF PLANTING PIT

A. Excavate the plant pit, centered at the location marks, cylindrical in shape with a diameter 3 times larger than ball or root condition, with sloped sides and flat bottom. Excavate plant pit to a depth to match the nursery grade of the root flare for all balled and container root systems with well-draining soils. Do not over excavate the pit for container or balled and burlapped plants. Excavate plant pit to a depth 6 inches deeper for bare-rooted systems.

B. Scarify sides of excavated pit.

C. If specified, following excavation of planting pit for all trees, fill the pit full of water; allow to stand (without adding water) for an 18 hour period to determine porosity of the soil.

D. If the soils are too impervious, provide a tree drainage well per Figure 9030.103 or plant 2 to 3 inches above the surrounding grade, per Figure 9030.101, as directed by the Engineer.

3.05 TREE DRAINAGE WELLS

Install drainage wells when specified in the contract documents or when directed by the Engineer due to the presence of impervious soils.

A. Locate the drainage well at the edge of the excavated planting pit.

B. Auger an 8 inch to 12 inch diameter hole to existing pervious soil or to a maximum depth of 10 feet. If pervious soil is encountered, extend hole a minimum of 12 inches into the pervious layer.

C. Fill the excavated hole with porous backfill material and cover the aggregate with engineering fabric.

D. Following completion of drainage well, fill the pit full of water; allow to stand for an 18 hour period to verify sufficient drainage exists. The Engineer will determine if the drainage is sufficient.

3.06 PLANTING

A. Bare Root Plants:

1. Remove all ties, ribbons, wrap, and other items except plant identification from the branch system.

2. Remove all root packing and prune broken roots to sound wood with clean cuts.

3. Build a firm cone-shaped mound of soil in the middle of the planting pit.

4. Place the plant centered, upright, plumb, and with desired orientation in the planting pit, with the root flare matching existing grade.

5. Spread and arrange roots in their natural position laterally away from the central trunk to prevent kinking or circling. Do not fold, crimp, or mat roots together.

6. Carefully place backfill material in layers, filling all voids and avoiding injury to the root system until two thirds of the planting pit is complete; fill the pit with water and allow the soil to settle.

7. Continue placing backfill material up to grade level. Water in the tree. Allow water to completely soak into soil.

B. Balled and Burlapped and Container Plants:

1. Ensure root systems are moist at the time of planting.

2. Remove all ties and wrap from branch system, except plant identification.

3. Container Plants:
   a. Remove plant root system carefully from container prior to planting without disturbance to root systems.
   b. Inspect root system and cut any circled (girdled) roots.
   c. Place plants centered, upright, plumb, and with desired orientation in planting pit with the root flare matching existing grade.

3.06 PLANTING (Continued)

4. Balled and Burlapped Plants:
   a. Place plants centered, upright, plumb, and with desired orientation in planting pit with the root flare at or slightly above existing grade or 2 to 3 inches above grade if in compacted clay or poorly drained soils.
   b. After plant placement, cut and remove the top 1/2 of the wire, burlap, and twine from root ball

5. Carefully place and lightly tamp a small amount of backfill material around the root ball base to stabilize the root ball.

6. Place loose excavated soil 2/3 of the depth of the planting pit. Water in the tree. Allow water to completely soak into soil.

7. Continue placing backfill material up to grade level. Lightly tamp but do not compact the soil around the plant. Water in a second time.

8. If specified, rototill soil in a 4 foot radius around the planting pit to break up compacted soil.

C. Planting on Slopes:

1. Place the top of the root flare at or slightly above the finished grade at the center of the planting pit.

2. For all plants planted on significant slope, form a saucer as a dam or shoulder on the downhill side to catch and hold water and to discourage erosion.

3.07 WATERING

A. Water each plant immediately after planting.

B. Water plants a minimum of 10 to 15 gallons per plant per week when less than 1 inch of precipitation is received in the immediate location. Apply sufficient water to soak the plant's root zone. Follow this watering procedure throughout the establishment period.

3.08 MULCHING

A. Dig edges of mulched areas to ensure the top of the mulch at the edge of the planting area matches the existing ground surface.

B. Place mulch 3 inches deep in the planting saucer within 2 calendar days of planting.

C. Mulch an area around tree trunks and shrub branch lines a minimum of 6 inches larger than the tree canopy.

D. Provide a continuous mulch area around plant groupings.

E. Following mulch placement, pull mulch back 6 inches from the base of all trees and shrubs to allow air circulation.

3.09 TREE PROTECTION

A. When specified in the contract documents, or when directed by the Engineer, protect the trunk of deciduous trees in the fall of the year in which the tree is planted.

B. Inspect the trunk for injuries and evidence of insect infestation prior to wrapping.

C. Protect trunk from the ground line to the height of the first branch. If plant has multiple stems, cover each stem separately.

D. Remove tree protection by April 1 of the next spring.

3.10 STAKING AND GUYING

A. General:

1. Maintain all plants in an upright and plumb condition.

2. Complete staking or guying by the end of the day in which they were installed for all single stem plants over 1 inch diameter.

3. Do not stake clump form plants and plants in paved pedestrian areas unless approved by the Engineer.

B. Staking:

1. Provide two stakes for each tree for trees 2 1/2 inches in diameter and smaller. Place one of the stakes on the southwest side of the tree, or as directed by the Engineer, and place the second stake directly opposite the first.

2. Provide three stakes for each tree for trees 2 1/2 to 4 inches in diameter. Locate one stake on the southwest side of the tree with remaining stakes equally spaced around the tree.

3. Locate stakes uniformly from the trunk of the tree at a distance equal to 1/4 to 1/3 of the height of the tree, or 2 feet minimum. Place stakes outside of the planting pit and within the mulch area.

4 Set posts vertically into unexcavated soil at a minimum 2 foot depth or until firm, providing a required post height above grade.

5. Attach wire with trunk protection to trunk at a minimum of 4 feet above grade or between one half and two thirds distance from finished grade to the top of the tree with slight slack in wire to allow for tree movement.

6. Secure wire to stakes at 6 inches from the top of the stake; mark all wire with flagging material.

7. Install manufactured staking system according to manufacturer’s published recommendations.

3.10 STAKING AND GUYING (Continued)

C. Guying:

1. Provide three earth anchors and cables for evergreen trees 10 feet and taller and deciduous trees over 4 inches in diameter. Locate one anchor on the southwest side of the tree with remaining anchors equally spaced.

2. Locate the anchor a distance from the trunk equal to 1/3 of the tree height.

3. Attach the cable with a trunk protector to the trunk between 1/3 and 1/2 of the tree height, or near the lowest main branches for deciduous trees.

4. Screw an auger style anchor into unexcavated soil until only the looped top is exposed. Install driven style anchors a minimum of 2 1/2 feet into the soil.

5. Secure cable to anchor with slight slack in cable; mark all anchor cables with flagging material.

6. Install manufactured staking system according to the manufacturer's published recommendations.

D. Removal: Remove all staking and anchoring materials from all plants at the end of the 1 year establishment period and remove from site.

3.11 PRUNING

A. General:

1. Provide proper and sharp pruning tools to provide a clean cut without injuring the branch collar.

2. Prune in such a manner as to retain the natural shape of the plant. Do not prune the terminal leader of a plant. Leave no protruding stubs, and prune to the closest outward growing bud.

3. Plant materials incorrectly pruned will be rejected.

B. Deciduous Trees:

1. Prune broken, damaged, or otherwise defective branches. Remove all branches that may not develop properly. Also, eliminate narrow crotches or competing leaders.

2. Prune to develop an upright leader that will promote the symmetry of the tree. Prune flowering or specimen trees to develop their natural form.

3. Prune all trees in Class A sidewalks or other paved pedestrian areas to provide a 7 foot height clearance, unless otherwise directed by the Engineer.

C. Evergreen Trees and Shrubs: Remove dead and broken branches.

D. Deciduous Shrubs: Remove dead or irregular branches. Prune to develop their natural form.

3.12 CLEAN UP

A. Perform cleaning during installation and upon completion of work.

B. Remove all excess materials, trimmings, branches, soils, debris, and equipment from the site.

C. Repair any damage resulting from planting operations.

D. Clean all paved areas with a broom.

E. Remove all tags and labels from plants following acceptance by the Engineer.

3.13 ESTABLISHMENT AND WARRANTY PERIODS AND ACCEPTANCE

A. Establishment Period: The plant establishment period is 1 year after the installation is accepted by the Engineer. A plant inspection will be made by the Engineer prior to the expiration of the establishment period.

B. Warranty Period: If a plant warranty is specified in the contract documents, the 1 year warranty period begins immediately after the expiration of the 1 year establishment period. Inspection of plants will be made by Engineer at the end of the 1 year establishment period and again prior to the expiration of the warranty period.

C. Maintenance: Care for all plants during the establishment or warranty period as required to keep plants in a live, healthy growing condition.

1. Prune plants to maintain a desirable shape and to remove any dead or broken limbs.

2. Remove weeds and grasses from planting beds and mulch areas. Apply a pre-emergent herbicide to control weed growth when directed by the Engineer.

3. Water as required to enhance early root growth and maintain a moist soil.

4. Adjust stakes and ties to maintain plant in an upright and plumb condition.

5. Re-set settled plants to proper grades and position. Restore planting saucer and mulch; add backfill material and mulch as may be required.

6. Apply appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.

D. Plant Condition: Ensure all plants are in a live, healthy, and growing condition both at the date of acceptance of the installation by the Engineer, at the end of the plant establishment period, and at the end of the warranty period.

E. Replacement: Replace all plants not found to be in a live, healthy, and growing condition during inspection at the 1 year establishment period and again at the warranty period (if specified) at no additional cost to the Contracting Authority.

1. Upon notice from Engineer, remove rejected plants from the site and replace with plant material of the same species and size as originally specified. Install replacement plants complying with the contract documents.

2. Plants damaged due to fire or flooding beyond the contractors control or ice storms, hail, tornados, or acts of vandalism do not require replacement.

END OF SECTION

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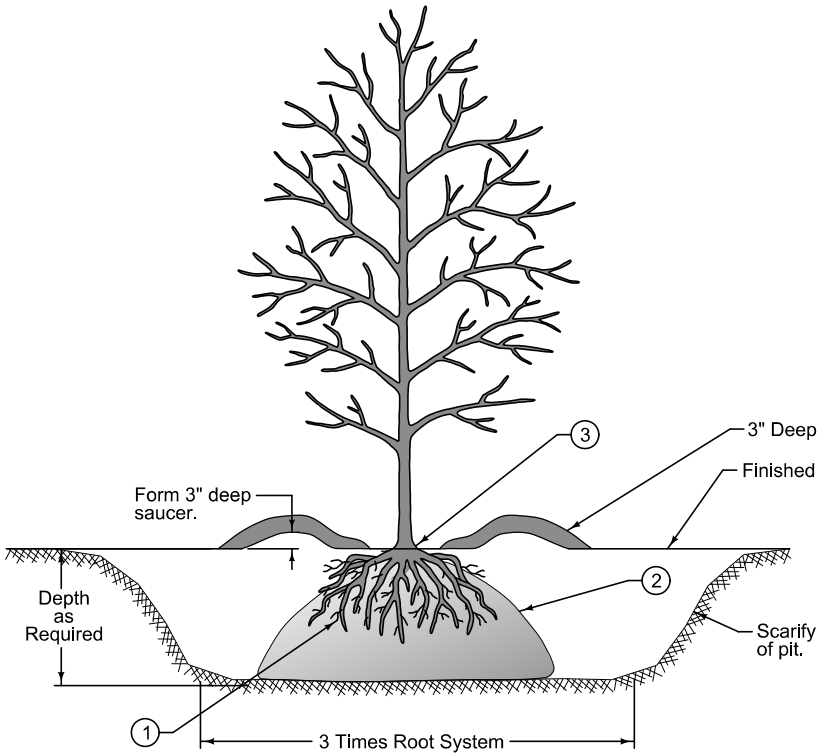
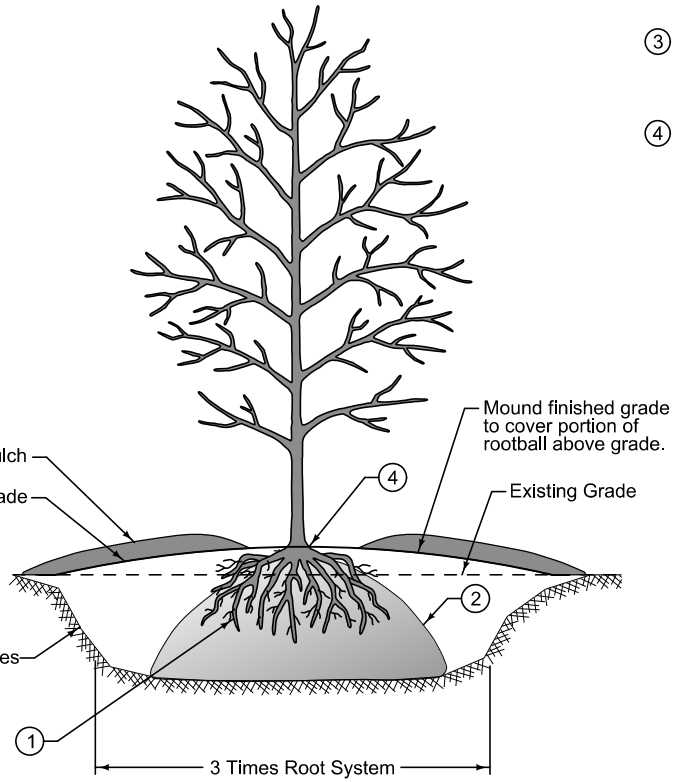
1. Spread root system in natural position with soil excavated from pit.
2. Build a firm cone-shaped mound of soil in the middle of the planting pit.
3. Install with root flare at or slightly above grade. Do not place mulch within 6 inches of trunk.
4. Install root flare 2 to 3 inches above grade. Do not place mulch within 6 inches of trunk.



PLANTING PIT
(Bare Root Plants)



PLANTING PIT
(Bare Root Plants on Poorly Drained Soils)

FIGURE 9030.101

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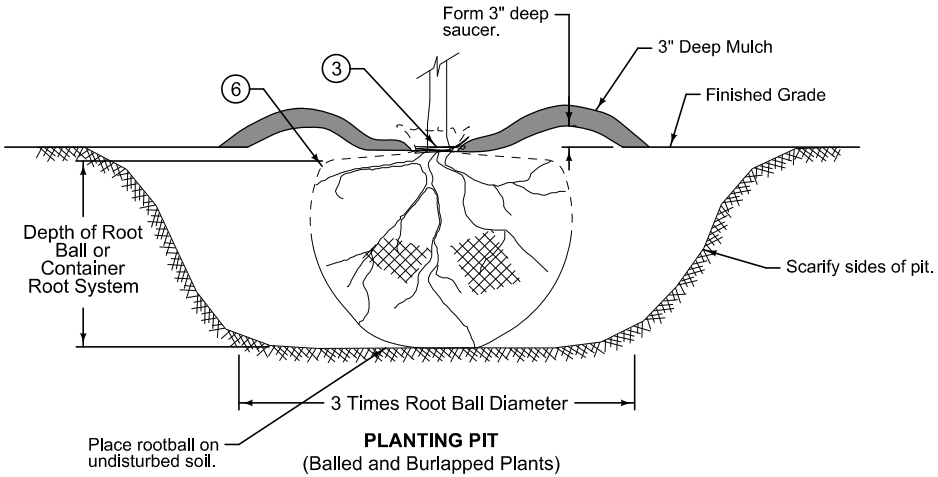
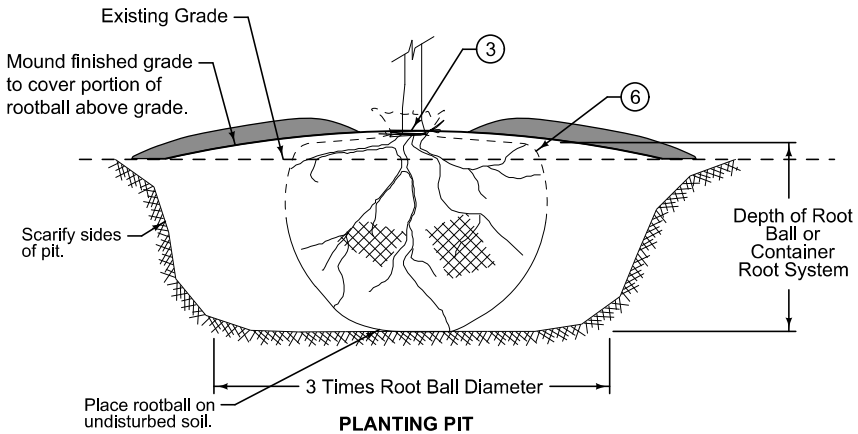
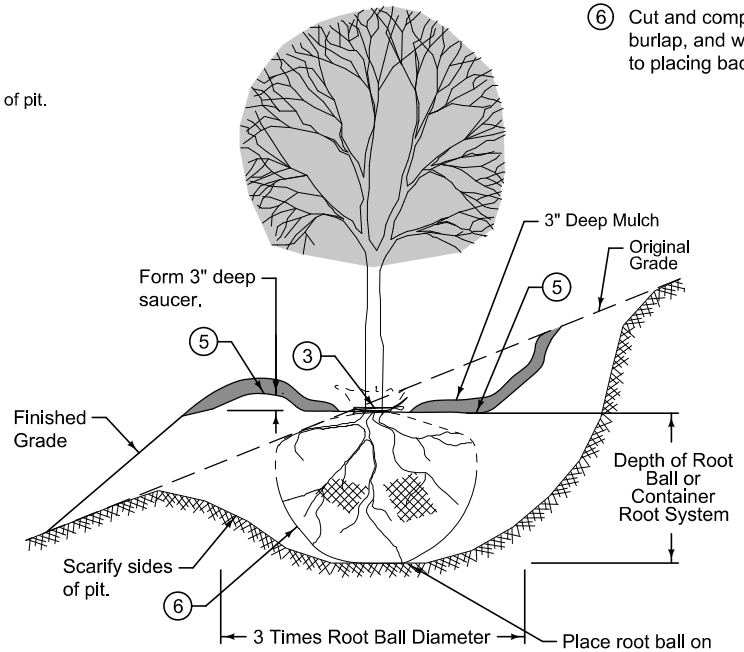
PLANTING PIT



PLANTING PIT
(Balled and Burlapped Plants)



PLANTING PIT
(Balled and Burlapped Plants on Poorly Drained Soils)



PLANTING PIT
(On Slopes)

3. Install with root flare at or slightly above grade. Do not place mulch within 6 inches of trunk.
4. Install root flare 2 to 3 inches above grade. Do not place mulch within 6 inches of trunk.
5. Begin transition at edge of root ball.
6. Cut and completely remove top 1/2 of twine, burlap, and wire baskets from root ball prior to placing backfill material.

FIGURE 9030.101 | SHEET 2 OF 2

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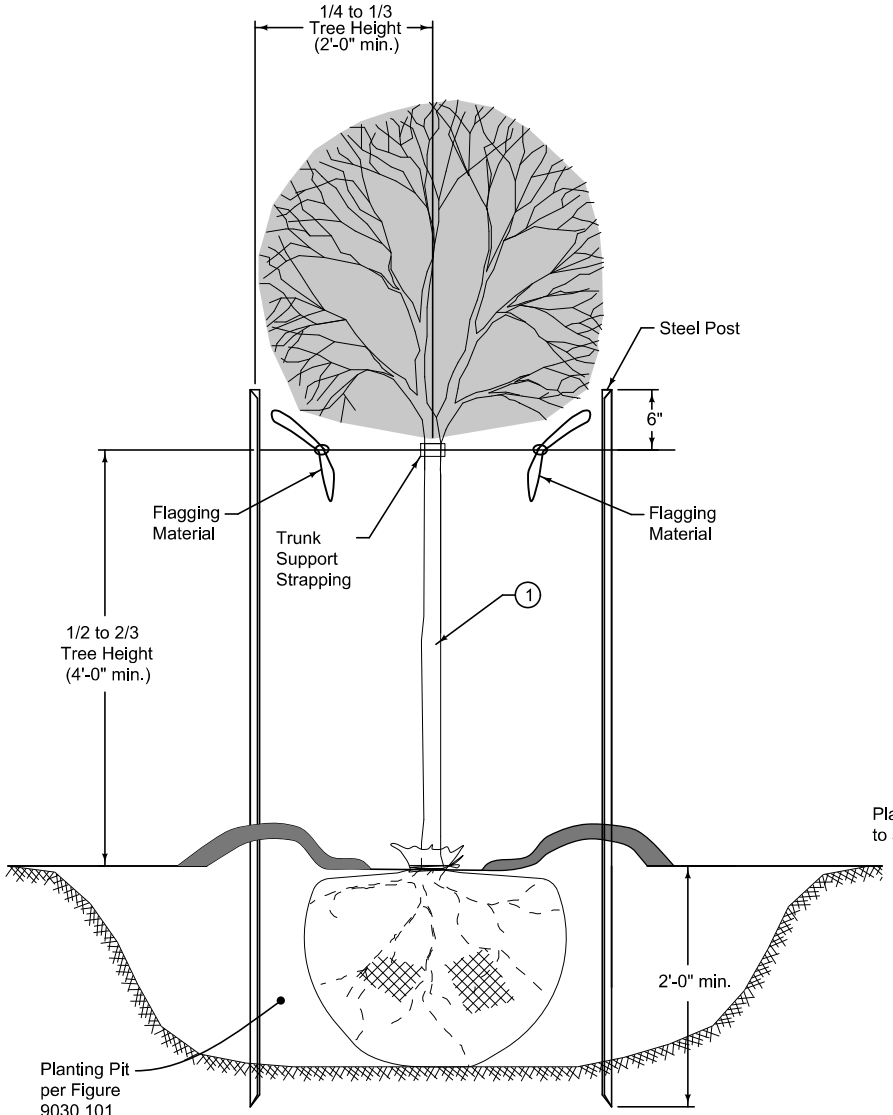
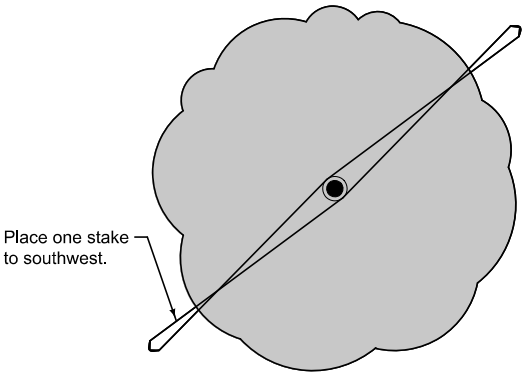
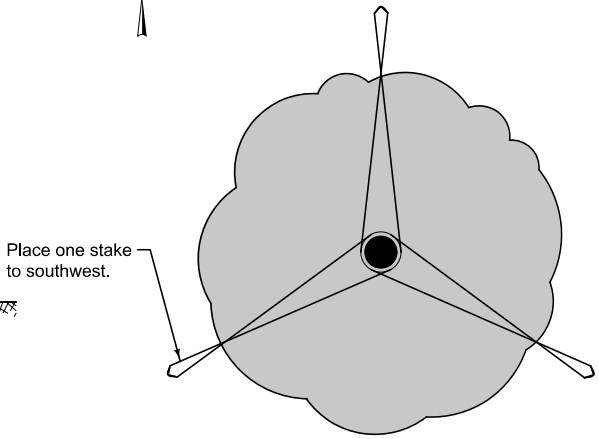
PLANTING PIT



STAKING



STAKING PLAN
(Trees 2 1/2 inch diameter or smaller)



STAKING PLAN
(Trees larger than 2 1/2 inch diameter)

1. Protect trunk from ground line to first branch when specified in the contract documents.

FIGURE 9030.102

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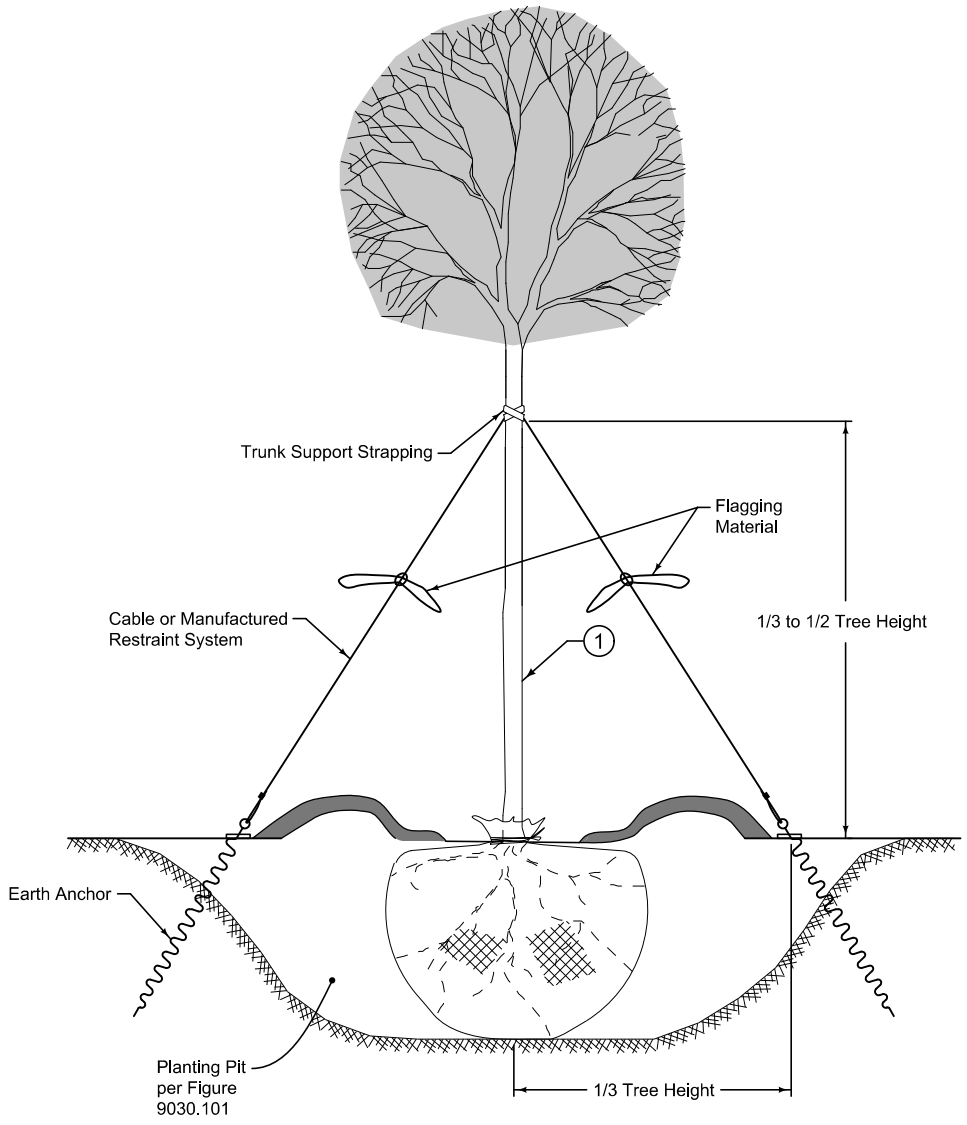
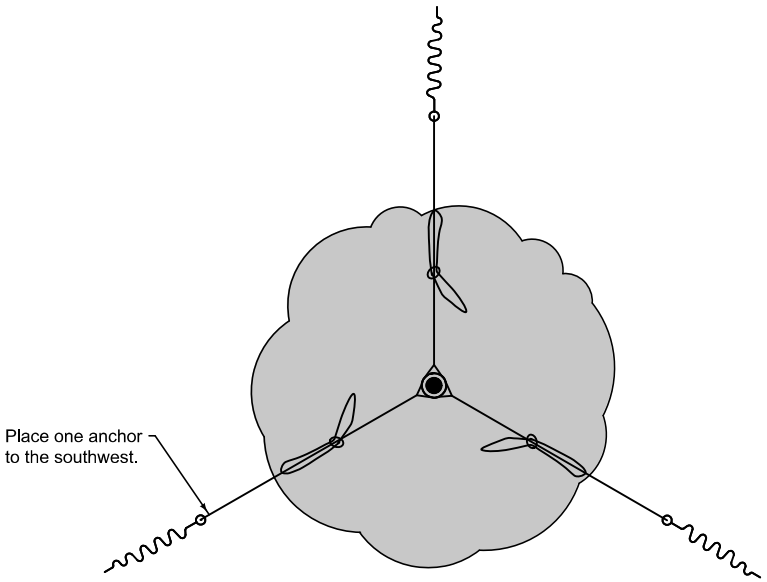
TREE STAKING, GUYING AND WRAPPING



GUYING

1 Protect trunk from ground line to first branch when specified in the contract documents.



GUYING PLAN

FIGURE 9030.102

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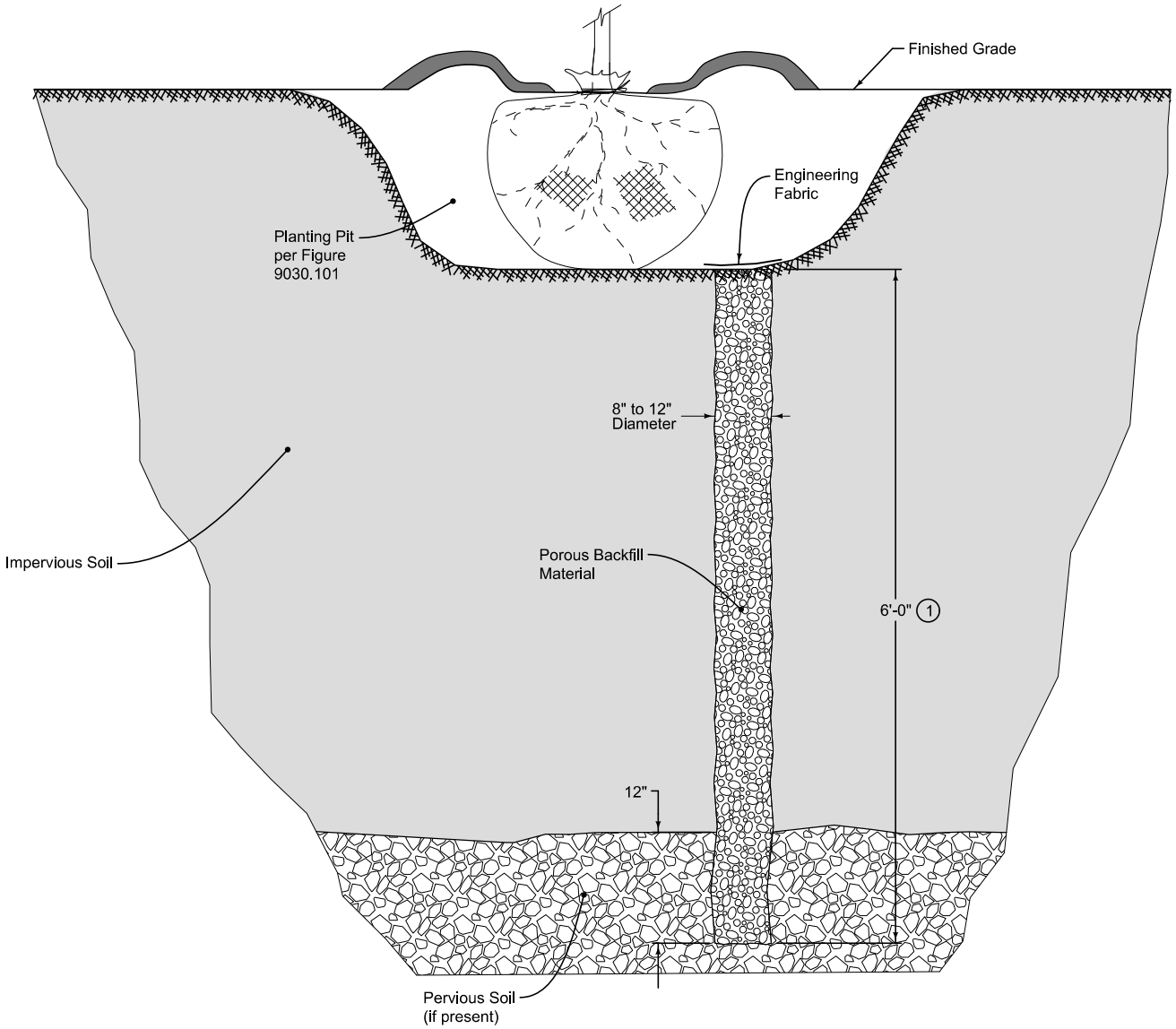
TREE STAKING, GUYING AND WRAPPING



(1) If pervious soil is encountered at a depth less than 6 feet, the drainage well may be terminated when the well extends a minimum of 12 inches into the pervious soil layer.

FIGURE 9030.103

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TREE DRAINAGE WELL

1.08 MEASUREMENT AND PAYMENT (Continued)

Q. Erosion Control Mulching:

1. **Conventional Mulching:**
   a. **Measurement:** Measurement will be in acres of conventional mulch.
   b. **Payment:** Payment will be at the unit price per acre of conventional mulch.

2. **Hydromulching:**
   a. **Measurement:** Measurement will be in acres for each type of hydromulch.
   b. **Payment:** Payment will be at the unit price per acre for each type of hydromulch.

R. Turf Reinforcement Mats (TRM):

1. **Measurement:** Measurement will be in squares for each type of turf reinforcement mat, each square containing 100 square feet.

2. **Payment:** Payment will be at the unit price per square for each type of turf reinforcement mat.

3. **Includes:** Unit price includes, but is not limited to, excavation, staples, anchoring devices, and material for anchoring slots.

S. Surface Roughening:

1. **Measurement:** Measurement will be in square feet of surface roughening, including directional tracking or grooving/furrowing.

2. **Payment:** Payment will be at the unit price per square foot of surface roughening.

T. Inlet Protection Device:

1. **Installation:**
   a. **Measurement:** Each type of inlet protection device will be counted.
   b. **Payment:** Payment will be at the unit price for each inlet protection device.
   c. **Includes:** Unit price includes, but is not limited to, removal of the device upon completion of the project.

2. **Maintenance:**
   a. **Measurement:** Each inlet protection device maintenance occurrence will be counted.
   b. **Payment:** Payment will be at the unit price for each inlet protection device maintenance occurrence.
   c. **Includes:** Unit price includes, but is not limited to, removal and off-site disposal of accumulated sediment.

U. Flow Transition Mat:

1. **Measurement:** Measurement will be in square feet of flow transition mat.

2. **Payment:** Payment will be at the unit price per square foot of flow transition mat.

3. **Includes:** Unit price includes, but is not limited to, anchoring devices.

V. End of Season Temporary Erosion Control:

1. **Measurement:** Measurement will be in acres of end of season temporary erosion control applied.

2. **Payment:** Payment will be at the unit price per acre for end of season temporary erosion control.

3. **Includes:** Unit price includes, but is not limited to, furnishing, placing, and maintaining the end of season temporary erosion control throughout the winter season.

PART 2 - PRODUCTS

2.01 COMPOST BLANKETS

Comply with Section 9010, 2.07, C for compost material requirements for compost blankets.

2.02 COMPOST BLANKET AND FILTER BERM TACKIFIER

A. Use a biodegradable, organic binding agent or polyacrylamide that can be mixed with, or injected into, compost or filter material as it is placed, which is not detrimental to the establishment of vegetation.

B. Use in filter berms or compost blankets when specified in the contract documents.

C. Apply at the rate recommended by the manufacturer.

2.03 FILTER MATERIAL

Material for use in filter socks, filter berms, and other areas, as specified in the contract documents.

A. Use material derived from wood, bark, or other, non-toxic vegetative feedstocks.

B. Use material with no visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.

C. Use material meeting the following particle sizes:

Sieve Size	Percent Passing[1]
2”	100
1”	90-100
3/8”	0-30

[1]The target flow rate of in-place material is 10 gal/min/lf. The Engineer may approve use of alternate materials meeting the target flow rate.

2.04 FILTER SOCK

A. For slope and sediment control applications, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 5 mil thickness, photodegradable HDPE.

B. For inlet protection, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 500 denier polypropylene.

C. Use 1 inch by 2 inch (minimum) hardwood stakes or stakes of equivalent strength.

2.05 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP)

Use temporary rolled erosion control products that are classified and have material properties according to the Erosion Control Technology Council’s (ECTC) guidelines as follows:

A. Material Classification:

1. **RECP Type 1 (Ultra Short-term):** Functional longevity of 3 months or less and classified as follows:
   a. **RECP Type 1.A:** Mulch control net, consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
   b. **RECP Type 1.B:** Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.

PART 2 - PRODUCTS

2.01 STEPS

A. Concrete: Class C concrete complying with Section 6010, 2.03.

B. Reinforcing Steel: Comply with Iowa DOT Section 4151 for epoxy coated reinforcement. Comply with ACI-318 for dowel bar substitutes.

C. Expansion Joint: Comply with Iowa DOT Section 4136.03, A.

D. Forms: Comply with Iowa DOT Section 2403.

2.02 HANDRAIL

1 1/4 to 2 inches in diameter; ensure post diameter matches handrail diameter.

A. Steel: Welded or seamless black steel pipe and posts complying with ASTM A 53, Grade A or B.

B. Aluminum: Aluminum-alloy extruded structural pipe complying with ASTM B 429, alloy 6061-T6 or 6063-T6, schedule 40 (if specified; for use with grouted connection only).

C. Bends: Provide manufactured pipe bends and connections for handrail. Do not field bend pipe.

2.03 SAFETY RAIL

A. Rails and Posts: Provide 2 1/2 inch by 2 1/2 inch tubular high strength steel with 1/4 inch minimum wall thickness. Comply with ASTM A 500, Grade B.

B. Pickets: Provide 1 inch by 1 inch tubular high strength steel with 1/8 inch minimum wall thickness. Comply with ASTM A 500, Grade B.

2.04 FINISH

A. Painted: Provide factory-mixed paint / primer.

1. Primer: Provide single component, water-based rust and corrosion resistant primer specifically designed for use on steel surfaces.

2. Paint: Provide water-based, abrasion-resistant paint specifically designed for use on steel surfaces.

B. Galvanized: When specified in the contract documents, galvanize handrail and safety rail.

1. Provide zinc coating complying with ASTM A 123.

2. Hot-dip galvanize components after fabrication.

3. For hot-dip galvanized components that will be powder coated, utilize the dry-kettle (pre-fluxing) process. Air cool galvanized components. Do not quench in water or chromate.

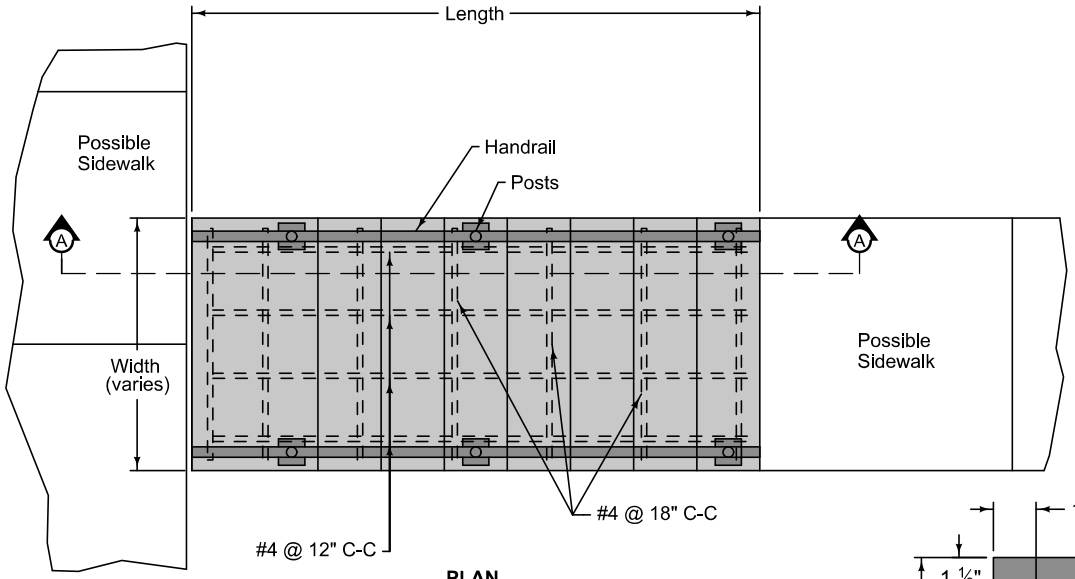
C. Powder Coated: Apply powder coat to steel, galvanized steel, or aluminum handrail and safety rail when specified in the contract documents. Comply with the manufacturer's recommendations for surface preparation, application of primer, and application of the powder coating, in addition to the following minimum requirements.

2.04 FINISH (Continued)

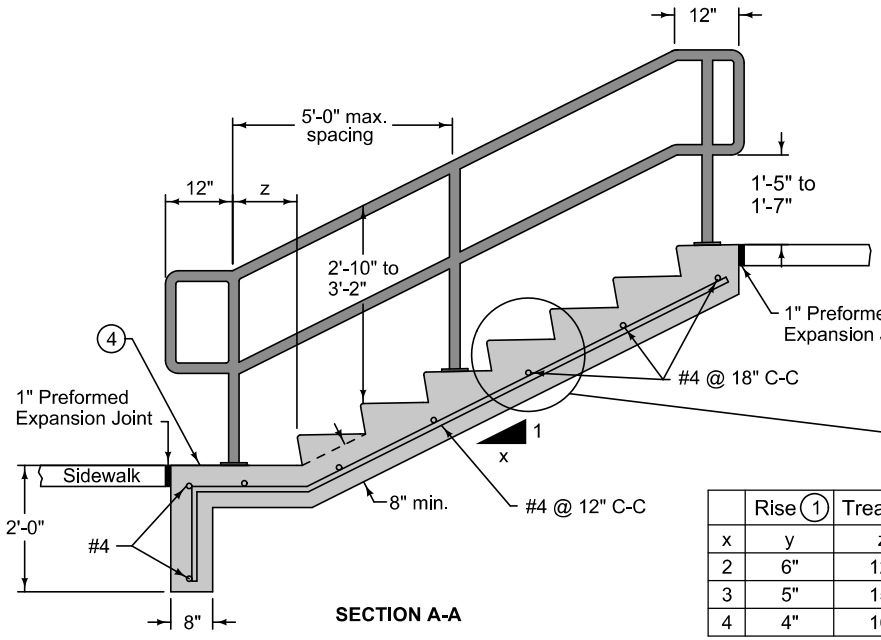
1. **Surface Preparation:**
   a. **Steel Substrate:**
      1) Remove oils and surface contamination by solvent cleaning. Comply with the requirements of SSPC-SP 1. Rinse thoroughly with hot water or water pressure and dry completely.
      2) Remove loose rust, loose mill scale, and other foreign substances by hand or power tool cleaning. Comply with SSPC-SP 2 or 3.
      3) Remove all dirt, grease, rust scale, mill scale, paint, slag, and other foreign substances by blast cleaning. Comply with SSPC-SP 6.
      4) Remove all blast cleaning products by means of vacuuming or compressed air.
      5) Chemically clean surface to remove residual contamination, apply conversion coating, and apply sealing agent to prepare the surface for powder coating.
      6) Begin powder coating as soon as possible after surface preparation to prevent the development of iron oxide on the surface of the steel.
   b. **Galvanized Steel Substrate:**
      1) Remove all tears, spikes, high spots, or other surface defects caused by the galvanizing process using hand or power tools.
      2) Apply an alkaline solution, with a pH between 11 and 12, to remove traces of oil, grease, and dirt.
      3) Remove residual zinc oxide by spraying surface with a mild acidic solution (pH of 3.5 to 4.5).
      4) Apply conversion coating to the surface and apply sealing agent to prepare the surface for powder coating.
   c. **Aluminum Substrate:**
      1) Clean surface by power washing to remove contaminants.
      2) Clean surface with an aqueous alkaline solution by immersion or scrubbing with a soft brush. Do not scrub with a steel bristle brush. Dry completely after cleaning.
      3) Remove oils and surface contamination by solvent cleaning. Comply with the requirements of SSPC-SP 1.
      4) Remove light deposits of aluminum reaction by-products by hand or power tool cleaning. Comply with SSPC-SP 2 or 3.
      5) Remove aluminum oxide by sweep blasting or chemical treatment:
         a) Sweep Blasting:
            i) Utilize oil-free compressed air to prevent contamination of cleaned surface.
            ii) Utilize blast media with a MOH hardness of 5 or less, or utilize organic media such as corn cobs or walnut shells. Do not roughen surface.
            iii) Powder coat surface within 60 minutes of sweep blasting to prevent re-formation of aluminum oxide.
         b) Chemical Treatment: Comply with ASTM D 1730 for Type B treatment.
      6) Chemically clean surface to remove residual contamination, apply conversion coating, and apply sealing agent to prepare the surface for powder coating.

2. **Priming:** Apply as recommended by coating manufacturer for specific substrate to all surfaces, unless specifically not required by coating manufacturer.

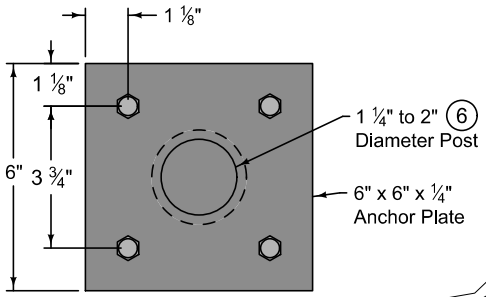
3. **Coating:**
   a. **General:**
      1) Provide complete multi-coat systems formulated and recommended by the manufacturer for the application indicated.
      2) Provide urethane, TGIC polyester, polyester wrinkle, or non-TGIC polyester based powder coatings as recommended by the powder coating manufacturer to provide long term exterior durability.



PLAN

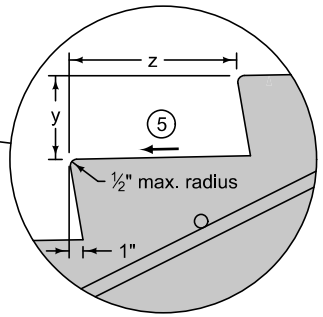


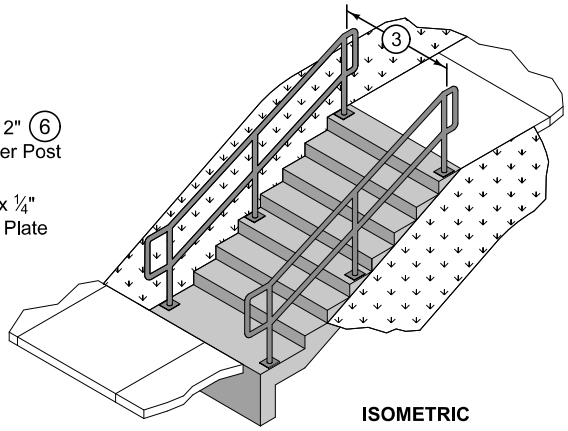
SECTION A-A



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.

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TYPE A CONCRETE STEPS WITH HANDRAIL

FIGURE 9080.101

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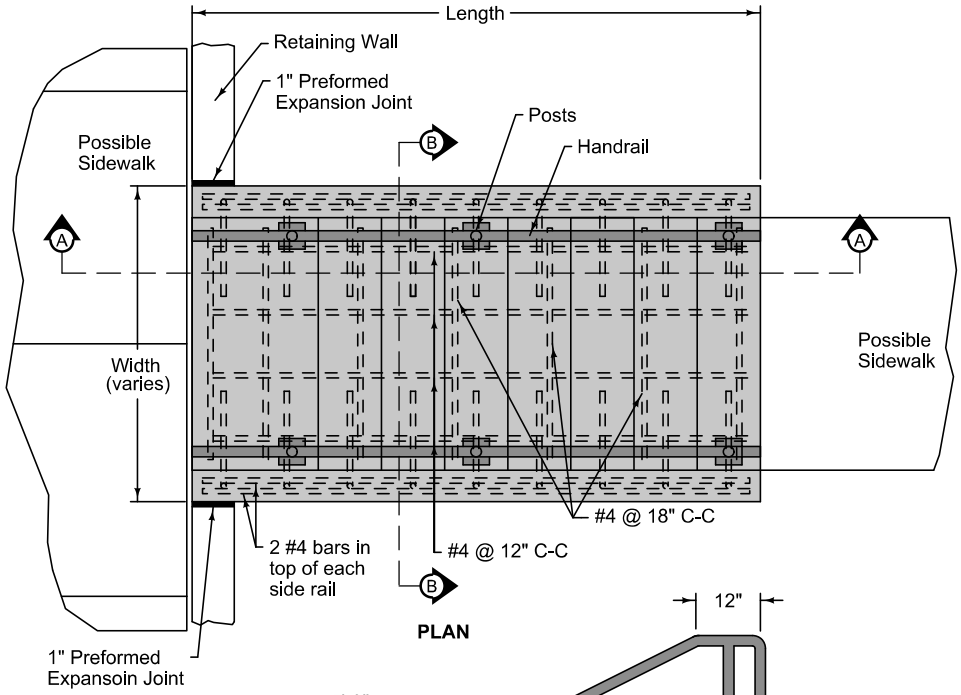
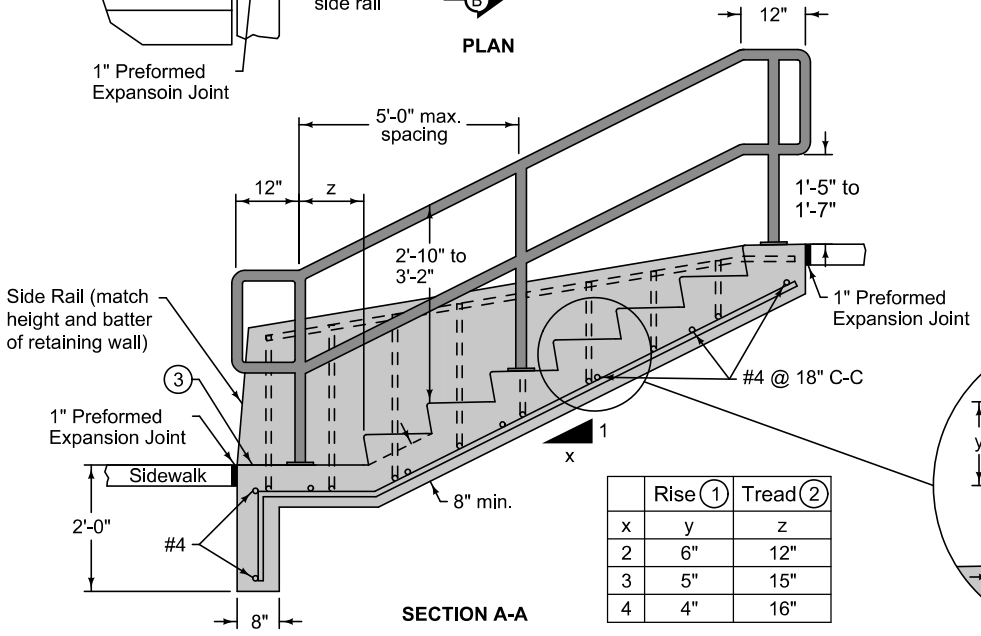
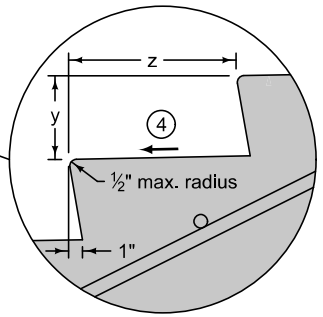


PLAN



SECTION A-A

	Rise (1)	Tread (2)
x	y	z
2	6"	12"
3	5"	15"
4	4"	16"



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.

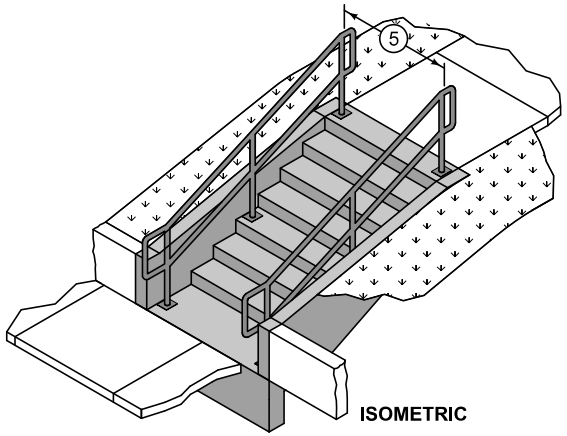
(1) Minimum riser height is 4 inches. Maximum riser height is 7 inches.

(2) Minimum tread depth is 11 inches.

(3) Construct cross slope of landing to match adjacent sidewalk.

(4) Slope tread 1% minimum to 2% maximum in any direction.

(5) Match existing sidewalk width.



ISOMETRIC

FIGURE 9080.102

SHEET 1 OF 2

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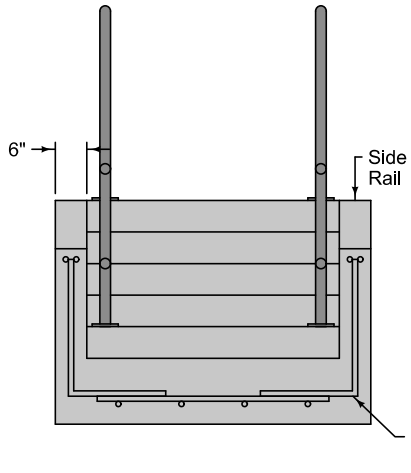
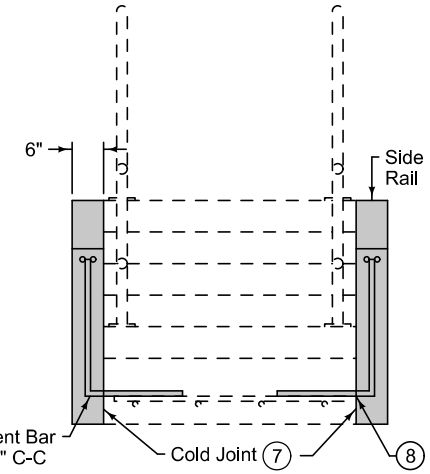
SHEET 1 of 2

SUDAS Standard Specifications

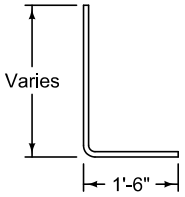
TYPE B CONCRETE STEPS WITH HANDRAIL



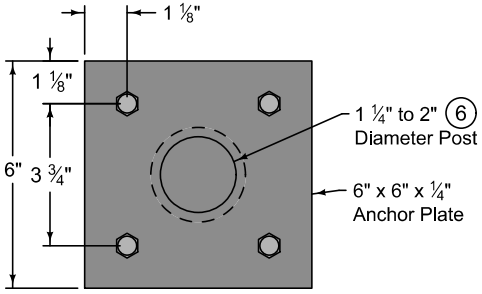
SECTION B-B
(Side Rails and Stairs Formed and Constructed Monolithically)



ALTERNATE SECTION B-B
(Side Rails and Stairs Formed and Constructed Separately)



BENT BAR



ANCHOR PLATE DETAIL

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.

(6) Weld post to anchor plate with 1/4 inch weld. Grind weld to provide smooth surface, free of burrs.

(7) Upon approval of Engineer, side rails may be formed and constructed separately from the stairs. Seal the cold joint between the side rail and stairs according to Section 7010.

(8) If side rails and stairs are constructed separately, dowel bar substitutes may be used for the bent bars connections between the side rails and the stairs.

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SUDAS Standard Specifications

TYPE B CONCRETE STEPS WITH HANDRAIL

FIGURE 9080.102 | SHEET 2 OF 2