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 Program Coordinator, at 515-294-2869 or brich@iastate.edu.
Please replace the following: the small business card on the spine with the card titled "2018 Edition," the Contributors and Acknowledgments page, and the general Table of Contents. You might also find it helpful to keep this sheet behind the information contained within the Overview tab.


| 6 | Table of Contents | i | Updated to reflect changes made in Division 6. |
| :---: | :---: | :---: | :---: |
|  | 6010 | ALL | Replace ENTIRE SECTION with enclosed pages (INCLUDING figures). Changed "invert" to "concrete fillet"; added a cored opening option for storm sewer connections to existing manholes or intakes; added a 4 inch curb height option to the open-throat curb intake figures; replaced SUDAS and lowa DOT logos. |
|  | 6030, 3.04 | ALL | Minor corrections. |
| 7 | Table of Contents | ALL | Updated to reflect changes made in Division 7. |
|  | 7010 | ALL | Replace ENTIRE SECTION with enclosed page (EXCLUDING figures). Removed overlay information; removed the restriction for use of fly ash and slag only with ready mix concrete; added the use of laser guided screeds and concrete pumping; added stringless paving; added intermediate aggregate; expanded mix design to add C-SUD mixes. |
|  | Figure 7010.101 (PV-101) | 1 | Corrected notes 22 and 23 to align with industry standards. |
|  | 7011 (new) | ALL | Added new section for PCC overlay projects. |
|  | 7020 | 3-10 | Removed overlay information. |
|  | 7021 (new) | ALL | Added new section for HMA overlay projects. |
|  | 7030, 3.04, A \& 3.08 | 7-12 | Added criteria for when the Engineer would check form work; added testing requirements. |
|  | 7040 | ALL | Replace ENTIRE SECTION with enclosed pages (INCLUDING figures). Updated information on partial depth patches; added a subsection and figure on dowel bar retrofit for PCC pavements. |
|  | 7080, 1.07, A | 1-4 | Revised to reflect recent changes in lowa law. |
| 8 | Table of Contents | iii-iv | Added new pages to table of contents for addition of Section 8030. |
|  | 8010, 2.05, C, 3 | 13 | Revised to reflect current manufacturing. |
|  | Figure 8010.102 (TS-102) | 1-2 | [Begins on the back of Figure 8010.101]. Revised to reflect current manufacturing. |
|  | 8020, 3.01, B, 4 | 6 | Minor correction. |
|  | 8030 (new) | ALL | Added a new section to provide standard temporary traffic control layouts. Figures included! |
| 9 | Table of Contents | i-ii | Updated to reflect changes made in Division 9. |
|  | 9010, 2.07-3.05 | 13-21 | Revised language to match current practice and the lowa DOT. |
|  | 9040, 2.20-3.13 | 13-20 | Updated requirements to reflect current construction practices and made other minor revisions. |
|  | Figure 9040.102 | 1 | Updated requirements to reflect current construction practices. |
|  | 9050, 1.08, C | 2 | Updated reference. |
|  | 9070, 1.08, D, E, \& F | 2 | Updated reference. |
|  | 9071, 1.08, B, D, \& E | 2 | Updated reference. |
|  | 9072, 1.08 \& 2.01 | 1-2 | Updated reference. |
|  | 9080, 2.01, A | 3 | Updated reference. |
| 11 | 11,010, 1.01 \& 1.03 | 1-2 | Deleted qualification requirement per recent change in lowa law. |
|  | 11,010, 3.03, F | 8 | Added stringless paving. |

## Contributors and Acknowledgments

In 2017, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2018 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

## Division 1 General Provisions and Covenants

Section 1010 Definitions
Section $1020 \quad$ Proposal Requirements and Conditions
Section 1030 Approval for Award and Award of Contract
Section 1040 Scope of Work
Section 1050 Control of Work
Section $1060 \quad$ Control of Materials
Section 1070 Legal Relations and Responsibility to the Public
Section $1080 \quad$ Prosecution and Progress
Section 1090 Measurement and Payment
Division 2 Earthwork
Section 2010 Earthwork, Subgrade, and Subbase
Division $3 \quad$ Trench and Trenchless Construction
Section $3010 \quad$ Trench Excavation and Backfill
Section 3020 Trenchless Construction

## Division 4 Sewers and Drains

Section 4010 Sanitary Sewers
Section 4020 Storm Sewers
Section $4030 \quad$ Pipe Culverts
Section 4040 Subdrains and Footing Drain Collectors
Section $4050 \quad$ Pipe Rehabilitation
Section $4060 \quad$ Cleaning, Inspection, and Testing of Sewers
Division $5 \quad$ Water Mains and Appurtenances
Section $5010 \quad$ Pipe and Fittings
Section $5020 \quad$ Valves, Fire Hydrants, and Appurtenances
Section 5030 Testing and Disinfection
Division $6 \quad$ Structures for Sanitary and Storm Sewers
Section $6010 \quad$ Structures for Sanitary and Storm Sewers
Section 6020 Rehabilitation of Existing Manholes
Section $6030 \quad$ Cleaning, Inspection, and Testing of Structures

| Division 7 | Streets and Related Work |  |
| :--- | :--- | :--- |
|  | Section 7010 | Portland Cement Concrete Pavement |
|  | Section 7011 | Portland Cement Concrete Overlays |
|  | Section 7020 | Hot Mix Asphalt Pavement |
|  | Section 7021 | Hot Mix Asphalt Overlays |
|  | Section 7030 | Sidewalks, Shared Use Paths, and Driveways |
| Section 7040 | Pavement Rehabilitation |  |
| Section 7050 | Asphalt Stabilization |  |
| Section 7060 | Bituminous Seal Coat |  |
|  | Section 7070 | Emulsified Asphalt Slurry Seal |
|  | Section 7080 | Permeable Interlocking Pavers |


| Division 8 | Traffic Control |  |
| :---: | :---: | :---: |
|  | Section 8010 | Traffic Signals |
|  | Section 8020 | Pavement Markings |
|  | Section 8030 | Temporary Traffic Control |
| Division 9 | Site Work and Landscaping |  |
|  | Section 9010 | Seeding |
|  | Section 9020 | Sodding |
|  | Section 9030 | Plant Material and Planting |
|  | Section 9040 | Erosion and Sediment Control |
|  | Section 9050 | Gabions and Revet Mattresses |
|  | Section 9060 | Chain Link Fence |
|  | Section 9070 | Landscape Retaining Walls |
|  | Section 9071 | Segmental Block Retaining Walls |
|  | Section 9072 | Combined Concrete Sidewalk and Retaining Wall |
|  | Section 9080 | Concrete Steps, Handrails, and Safety Rail |
| Division 10 | Demolition |  |
|  | Section 10,010 | Demolition of Building Structures |
| Division 11 | Miscellaneous |  |
|  | Section 11,010 | Construction Survey |
|  | Section 11,020 | Mobilization |
|  | Section 11,030 | Temporary Services During Construction |
|  | Section 11,040 | Temporary Sidewalk Access |
|  | Section 11,050 | Concrete Washout |

### 1.03 DEFINITIONS AND TERMS (Continued)

COMMENCEMENT OF WORK. Work will be considered commenced when the Contractor's operations are started on items of work covered by the contract documents, or when the Contractor notifies the Engineer, and the Engineer agrees, that the Contractor's equipment and personnel are available to the site but the operations are prevented by conditions outside the Contractor's control.

COMPETITIVE QUOTATION. A properly signed written offer of the Contractor according to lowa Code Chapter 26.

CONTRACT. The written agreement, between the Contractor and the Contracting Authority, setting forth the terms and conditions under which the work is to be performed. The contract includes all contract documents.

CONTRACT AMOUNT. The bid amount plus approved change orders.
CONTRACT DOCUMENTS. The contract documents consist of the following: The notice to bidders and notice of public hearing; the instructions to bidders; special provisions; standard specifications; general supplemental specifications; supplemental specifications; plans; addenda; proposal; contract; performance, payment, and maintenance bond; insurance certificate(s); Notice to Proceed; and change orders. These documents form the agreement whereby the Contractor will furnish all labor, equipment, tools, and materials, and perform all work necessary to satisfactorily accomplish the proposed improvement. The contract documents are complementary and what is called for by one shall be as binding as if called for by all.

CONTRACTING AUTHORITY. The body, entity, board, commission, officer, or governmental entity having authority to award a contract.

CONTRACTOR. The individual, firm, partnership or corporation, and the heirs, executors, administrators, successors and assigns thereof, or the lawful agent of any such individual, firm, partnership, or corporation, or the surety thereof under the contract bond, constituting one of the principals to the contract and undertaking to perform the work herein specified. Where the pronoun "it" is used as referring to the word "Contractor" it shall mean the Contractor as defined above.

CONTROLLING ITEM OF WORK. The unique activity of a contract that will determine the duration of the construction period or if a working day is charged. The character of this work may change during the project. It is the work that could be in progress at any time that would have the greatest influence on the duration of the project.

DEPARTMENT OF TRANSPORTATION, (THE DEPARTMENT). The Department of Transportation, as defined in lowa Code Chapter 307.

EMPLOYEE. Any person working on the project mentioned in the contract of which these specifications are a part, and who is under the direction or control, or receives compensation from, the Contractor or subcontractor.

ENGINEER. For publicly owned projects, the Engineer is a Professional Engineer licensed in the State of lowa and is the authorized representative of the Contracting Authority. For privately contracted projects, with improvements that are to become publicly owned, the Engineer is the Professional Engineer licensed in the State of lowa and is the authorized representative of the Jurisdiction ultimately accepting ownership of the improvement. For all other projects, the Engineer is the Professional Engineer licensed in the State of lowa and is the owner's authorized representative. The Engineer may act directly or through duly authorized representatives.

### 1.03

DEFINITIONS AND TERMS (Continued)
EQUIPMENT. All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of the work.

EXTRA WORK. Work not provided for in the contract, as awarded, but deemed essential to the satisfactory completion of the contract and authorized by the Engineer. Extra work shall not include additional materials, equipment, and labor used due to natural variations in surface and subsurface conditions, except as specifically provided for elsewhere in the contract documents.

GENERAL SUPPLEMENTAL SPECIFICATIONS. Specifications approved by the Board of Directors for the lowa SUDAS Corporation subsequent to publication of the latest edition of the SUDAS Standard Specifications. They involve changes in the SUDAS Standard Specifications and apply only when specified in the contract documents.

GOVERNMENTAL ENTITY. As defined in lowa Code Chapter 26.
IMPROVEMENT. Shall mean any public improvements as defined in lowa Code Chapter 26 and shall also include highway, bridge, or culvert projects.

INCIDENTAL ITEMS. Materials, equipment, or labor essential for the proper completion of the work that are not specified as bid items in the contract documents and the cost of which shall be included in other bid items.

IOWA DEPARTMENT OF TRANSPORTATION (DOT) STANDARD SPECIFICATIONS. The lowa Department of Transportation Standard Specifications for Highway and Bridge Construction and the General Supplemental Specifications effective at the date of publication of the Notice to Bidders unless a different effective date is identified in the contract documents.

JOINT VENTURE. The joining of two or more contractors for the purpose of combining equipment, personnel, and finances in order to submit a bid on a single project.

JURISDICTION. A governmental entity or the lowa Department of Transportation, acting through its governing body, or through the authorized representatives of such governing body when so authorized.

JURISDICTIONAL ENGINEER. See Engineer.
LABORATORY. The testing laboratory of the Jurisdiction, or any other testing laboratory which may be designated by the Engineer.

LIQUIDATED DAMAGES. The dollar amount established by the Contracting Authority and set forth in the contract documents as compensation for the damage to the Contracting Authority, or public, for delay in completion of the work, to be paid to the Contracting Authority, or to be deducted from any payments due or to become due the Contractor.

LUMP SUM. Unit of measurement for a bid item where no direct measurement will be made. The bid item amount is complete payment for all work described in the contract documents and necessary to complete the work for that item. The estimated quantities of lump sum work shown in the contract documents are approximate.

MATERIALS. Any substances specified for the use in the construction of the project and its appurtenances.

## PROPOSAL REQUIREMENTS AND CONDITIONS

### 1.01 QUALIFICATION OF THE BIDDERS

A. The Jurisdiction reserves the right to reject any bid that is not responsive to the proposal form or contract documents, or not submitted by a responsive, responsible bidder.
B. Upon request of the Engineer, the apparent lowest responsive bidder, whose bid is under consideration for award of a contract, shall submit evidence of its financial resources, construction experience, and organization available for performance of the proposed work. A bidder's ability to promptly secure the required bonds and insurance coverages for the proposed work, as well as the bidder's demonstrated ability to continuously maintain insurance coverages on past projects, may be considered an indication of financial responsibility and the bidder's qualification as a responsive, responsible bidder.

### 1.02 CONTENTS OF THE PROPOSAL FORMS

A. Each prospective bidder will be furnished with a proposal form showing the location and description of the proposed work, the approximate quantities of work to be performed for which bid prices are requested, and the completion provisions. The contract documents will contain any special provisions that shall apply to the work to be performed.
B. The purpose of the contract documents is to require the furnishing of highest quality equipment, material, and workmanship, and best accepted construction practice. The Bidder is expected to base its bid on materials and equipment complying fully with the contract documents. Each bidder, in submitting its bid, acknowledges its willingness to comply with the terms of these contract documents.

### 1.03 QUANTITIES AND UNIT PRICES

A. Bidders shall submit a lump sum bid or unit bid price, as required by the proposal for the work covered by the contract documents. Prices shall cover complete work and include all costs incidental thereto.
B. When unit prices are requested in the proposal form, the quantities indicated on the proposal form are approximate only, and do not constitute a warranty or guarantee by the Jurisdiction as to the actual quantities involved in the work. Such quantities are to be used for the purpose of comparison of bids and determining the amount of bid security, contract, and performance, payment, and maintenance bond. In the event of discrepancies between unit prices and unit price extensions listed in a bidder's proposal, unit prices shall govern and unit price extensions shall be corrected, as necessary, for agreement with unit prices. The Jurisdiction expressly reserves the right to increase or decrease the quantities during construction as outlined in Section 1040, 1.06 - Increase or Decrease of Work, and to make reasonable changes in design, provided such changes do not materially change the intent of the contract. The amount of work to be paid for shall be based upon the actual quantities performed.
C. The proposal may have a lump sum item for mobilization. The bidder will indicate its bid price in dollars, and this will be the contract price for mobilization.
D. Materials, equipment, or labor essential for the proper completion of the work that are not specified as bid items in the contract documents and are incidental, and the cost of which shall be included in other bid items.

### 1.04 EXAMINATION OF THE CONTRACT DOCUMENTS AND SITE OF WORK

A. By submission of a proposal on the work, the bidder represents that it has carefully examined the site of the proposed work; the plans, specifications, and all other contract documents; and that the bidder is fully informed concerning the requirements of the contract, the physical conditions to be encountered in the work, and the character, quality, and the quantity of work to be performed, as well as materials to be furnished. The Contractor will not be entitled to additional compensation if it subsequently finds that conditions require methods or equipment other than that anticipated by the Contractor in making its proposal, except as provided in Section 1040, 1.09-Changed Site Conditions.
B. The attention of the bidder is directed to the fact that contracts for work, other than the proposed work, may have been awarded or may be awarded in the future. Completion of the proposed work may be contingent upon certain work by others or covered by other contracts being performed on the project in advance of this work; likewise, completion of work by others or covered by other contracts may be dependent upon completion of the proposed work. The bidder is expected to become familiar with work already in progress or previously let on this project, the contract periods, the progress being made, and any other conditions regarding work that may affect the bid or the bidder's performance under this contract.
C. The bidder on this work acknowledges the facts set out in the proceeding paragraph and agrees it is in the public interest to have the work of other contracts and agencies performed concurrently rather than consecutively. The bidder further agrees to cooperate and coordinate the work with other contractors or agencies to the mutual interest of all parties doing work on the project.
D. By the submission of a bid on this work, the bidder acknowledges and agrees investigation and inquiry has been made regarding the contracts for work with which this work must be coordinated. In the event disputes arise between contractors or other agencies doing work on the project as to their mutual rights or obligations, the Engineer will define the rights of all interested parties regarding the work.
E. The Jurisdiction does not warrant, impliedly or explicitly, the nature of the work, the conditions that will be encountered by the bidder, the adequacy of the contract documents for the Contractor to perform the work, or the conditions or structures to be encountered under any surface. Any such data supplied on the plans or other contract documents, or interpretation thereof by the Engineer, are merely for the convenience of the prospective bidders, who are to rely upon their own explorations of latent or subsurface site conditions, before completing and filing their proposal, except as provided in Section 1040, 1.09-Changed Site Conditions.

### 1.05 INTERPRETATION OF THE CONTRACT DOCUMENTS

If any prospective bidder is in doubt as to the true meaning of any parts of the contract documents, the bidder may request an interpretation from the Engineer. Any interpretation of the contract documents will be made only by an addendum duly mailed or delivered to each prospective bidder who received, or in the future requests, contract documents from the Jurisdiction.

## APPROVAL FOR AWARD AND AWARD OF CONTRACT

### 1.01 ACCEPTANCE OR REJECTION OF PROPOSALS

A. The Jurisdiction reserves the right to accept the proposal that, in its judgment, is the lowest responsive, responsible bid; to award the contract by sections, if so specified in special provisions; to reject any or all proposals; to reject irregular or nonresponsive proposals as defined in Section 1020, 1.11-Irregular and Nonresponsive Proposals; and to waive irregularities and/or technical deficiencies in the proposals to the extent allowed by law.
B. An individual, firm, partnership, corporation, or any association under the same or different names shall not submit more than one proposal. When reasonable evidence exists that a bidder has submitted more than one proposal at any letting for the same work under the same or different names, said proposals may be rejected.
C. Any or all proposals may be rejected if there is reason to believe collusion exists among bidders. Proposals received from participants in such collusion may not be considered for the same work if re-advertised.
D. Proposals may be rejected if the apparent lowest responsive bidder has failed to promptly meet financial obligations undertaken in connection with other work under contract, or is in default on a previous contract, or has an unsatisfactory record of performance and cooperation on any such previous contract, or has failed to maintain satisfactory progress on work already under contract.
E. In the event the bid specifies the use of materials, workmanship, methods, or equipment not in conformance with the contract documents, the bid will be rejected. In the event the bid was based on, but did not specify, the use of materials, workmanship, methods, or equipment not in conformance with the contract documents, the bidder will be held responsible for furnishing or using materials, workmanship, methods, and equipment in conformance with the contract documents at no change in the bid price.
F. When a contract for a public improvement is to be awarded to the lowest responsible bidder, a resident bidder shall be allowed a preference as against a non-resident bidder from a state or foreign country if that state or foreign country gives or requires any preference to bidders from that state or foreign country, including but not limited to any preference to bidders, the imposition of any type of labor force preference, or any other form of preferential treatment to bidders or laborers from that state or foreign country. The preference allowed shall be equal to the preference given or required by the state or foreign country in which the non-resident bidder is a resident. In the instance of a resident labor force preference, a non-resident bidder shall apply the same resident labor force preference to a public improvement in this state as would be required in the construction of a public improvement by the state or foreign country in which the non-resident bidder is a resident. Application of the preference against a non-resident bidder shall be in accordance with the information filed with the proposal on the Bidder Status Form.
G. Promptly after the proposals are opened and evaluated, the Jurisdiction shall give careful consideration to its needs, available funding, and other project considerations; and shall either designate the lowest responsive, responsible bidder and proceed with award of contract, or reject all bids and reconsider the project.

### 1.02 RELEASE OF BID SECURITY

A. After the proposals are opened, verified, and duly considered, the Jurisdiction will promptly release the bid security of all except the lowest two bidders after the Jurisdiction's designation of the lowest responsive, responsible bidder. The bid security of the lowest two bidders will be promptly released after the Jurisdiction's approval of the contract executed by the lowest bidder. If all bids are rejected, all bid security will be promptly released.
B. Bid security shall be released to bidders, either by making such bid security available for retrieval by bidders, or, if requested by a bidder, by mailing the bid security to the bidder.

### 1.03 AWARD OF CONTRACT

A. Contract Document Submittal: Within 10 calendar days after notification by the Engineer, unless otherwise provided in the contract documents, the Contractor shall present the signed and executed contract documents, including contract, performance, payment, and maintenance bond; certificate of insurance; and all other items required by the contract documents. The performance, payment, and maintenance bond and insurance certificate shall meet the requirements of Section 1070, Part 3 - Bonds and Insurance as required by the Jurisdiction. The Jurisdiction will thereupon receive and file such documents and award the contract.
B. Deferred Award: The Jurisdiction reserves the right to defer award of any contract for a period not to exceed 60 calendar days from the date of opening of proposals. No claims for compensable delay shall arise as the result of delay in the approval of award.
C. Failure to Execute the Contract: It is agreed by the bidder that upon its failure to enter into the contract and furnish the necessary insurance certificate and performance, payment and maintenance bond within 10 calendar days after notification by the Jurisdiction, the amount of the bidder's bid security may at the Jurisdiction's option be forfeited and shall become the property of the Jurisdiction, to be retained not as a penalty, but as liquidated damages. The award of the contract may then, at the discretion of the Jurisdiction, be made to the next lowest responsive, responsible bidder, or the work may be re-advertised or may be constructed by the Jurisdiction in any legal manner.

## D. Disclosure of Subcontractors:

1. The lowest responsive, responsible bidder shall be required to file a list of the names and subcontract amounts of all subcontractors who are expected to work on the project according to Section 1080, 1.01 - Subletting or Assignment of Contract.
2. If after award of the contract a subcontractor is replaced, or the subcontract price or the work under the subcontract is changed, the bidder shall disclose the name of the new subcontractor, the revised subcontract price, or the change in the scope of subcontract work.

If a new subcontractor is added after award of the contract, the Contractor shall disclose the name of the new subcontractor.

END OF SECTION

## SCOPE OF WORK

### 1.01 INTENT OF THE CONTRACT DOCUMENTS

A. These SUDAS Standard Specifications have been prepared to provide construction utilizing the best general practices and construction methods, utilizing first quality materials and work. The Contractor shall be responsible for providing or undertaking all work, labor, materials, equipment, tools, transportation, supplies, and activities included in these specifications, unless the responsibility for undertaking or providing same is specifically assigned to an identified party other than the Contractor.
B. The intent of the contract documents is to provide for the construction and completion in every detail of the work described or as may be amended. The Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work according to the plans, specifications, and terms of the contract documents. The apparent silence or omission of the contract documents as to any detail shall be regarded as meaning only the best general practice is to prevail and only first quality materials and work are to be used.
C. To prepare the plans, specifications, and contract documents, the Engineer may have performed exploratory work to gain information relative to surface and subsurface conditions. This information, when shown in the contract documents, represents a summary of conditions as of the date the survey was made; it is only an approximate estimation of the site conditions made for the Jurisdiction to identify construction conditions and quantities and classes of work. The appearance of this information in the contract documents will not constitute a guarantee conditions other than those indicated will not be encountered at the time of construction. The Contractor's bid shall be prepared based upon its examination of the site and its exploratory work.
D. Before making whatever additional investigations it feels are advisable, a bidder should contact the Engineer to determine available project area. If the Jurisdiction has not obtained right-of-entry for such investigation, the bidder shall be responsible to secure right-of-entry to any parcels where the Jurisdiction has not previously obtained right-of-entry before doing any investigation work. The bidder shall also be responsible for any traffic control necessary for any investigation work. The bidder shall further be responsible to obtain prior utility locates necessary to conduct such investigations.

### 1.02 CORRELATION OF THE CONTRACT DOCUMENTS

The plans and specifications are intended to supplement each other so any work shown on the plans and not mentioned in the specifications, or vice versa, shall be as binding and shall be completed the same as if that work was mentioned or shown on both and to the true intent and meaning of said plans and specifications.

### 1.03 COORDINATION OF SPECIFICATIONS, PLANS, AND SPECIAL PROVISIONS

A. In case of any discrepancy between the various items included in the contract documents, the items shall prevail, or govern, in the following descending order:

1. Change Orders
2. Addenda
3. Proposal and Contract
4. Special Provisions
5. Plans, including plan notes

### 1.03 COORDINATION OF SPECIFICATIONS, PLANS, AND SPECIAL PROVISIONS (Continued)

6. Supplemental Specifications (Jurisdictional document)
7. General Supplemental Specifications (SUDAS)
8. SUDAS Standard Specifications

In case of a discrepancy within any contract document, the following shall prevail, or govern, in descending order: written text, numerals, drawings.
B. The Contractor shall not take advantage of any apparent error or omission in the plans or specifications or of any discrepancy between the plans or specifications.

### 1.04 CONFORMITY WITH THE CONTRACT DOCUMENTS

A. Reasonably Close Conformity: All work performed and all materials furnished shall comply with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown in the contract documents. Where tolerances are not specified, work shall comply with reasonable and customary manufacturing and industry standards. The Engineer may, in the Engineer's sole discretion, accept variations beyond such requirements or tolerances where they will not materially affect the value or utility of the work and interests of the Jurisdiction.
B. Defective Work: Work not in reasonably close conformity with the contract documents, or requirements thereof that, in the sole discretion of the Engineer, has resulted in inferior or unsatisfactory work. Defective work shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.
C. Deficient Work: Work not in reasonably close conformity with the contract requirements but that, in the sole discretion of the Engineer, may be accepted and allowed to remain in place with a price adjustment and/or extended warranty period. In the event the Engineer agrees to accept deficient work with a price adjustment/extended warranty, the Engineer will document the basis of acceptance by contract modification making appropriate adjustments in the contract price for such work or materials.

## PLANS

The final plans on file in the Jurisdiction show the location, typical construction details, and dimensions of the work contemplated. The work shall be performed in conformity therewith, except in case of error or unforeseen contingency.

Electronic support files, if available, will be provided prior to letting and are for information only. Should there be a discrepancy between an electronic support file and a contract document, the contract documents shall govern. No guarantee is made that the data systems used by the Engineer will be directly compatible with the systems the Contractor uses.

Electronic information shall not be considered a representation of actual conditions to be encountered during construction. Providing the Contractor this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered, including, but not limited to, site visits and basing the bid on information obtained from these investigations and professional interpretations and judgment. The Contractor assumes the risk of error if the information is used for any purposes for which the information was not intended. Assumptions the Contractor makes from this electronic information or manipulation of the electronic information is at their risk.

If changes are made during construction, regardless if the change is initiated by the Contracting Authority or Contractor, it shall be the Contractor's sole responsibility to update electronic files that they will use.

### 1.06 INCREASE OR DECREASE OF WORK

A. The Jurisdiction reserves the right to make such alterations in the plans or in the quantities of work as may be considered necessary. Such alterations shall be in writing by the Engineer and shall not be considered as a waiver of any conditions of the contract documents or to invalidate any of the provisions thereof.
B. Unless such alterations, increases, or decreases materially change the character of the work to be performed or the cost thereof, the altered work shall be paid for at the same unit prices as other parts of the work. Quantity changes amounting to $20 \%$ or less of the total bid for an item shall not affect the unit price of that item. If, however, the character of the work or the unit costs thereof are materially changed, due to unforeseen events, an allowance shall be made on such basis as may have been agreed to in advance of the performance of the work.

### 1.07 CHANGE ORDERS

A. Oral Orders: The Engineer shall have authority to give oral orders for minor or incidental changes in the work not involving extra cost and not inconsistent with the proposed purpose of the work.
B. Written Orders: The Engineer may in his/her discretion, and subject to formal approval by the Jurisdiction, if required, issue written change orders changing the scope of the work and/or adjusting the amount to be paid to the Contractor for performing such work; however, the Engineer may, in case of emergency of endangering life or property, orally authorize such a change order without formal approval by the Jurisdiction. Each written change order for extra work shall be explicit in its instruction and shall be duly executed by the Jurisdiction. One copy of said change order shall be filed with the Contractor. Each change order shall stipulate the amount and method of payment.

### 1.08 SITE CONDITIONS

A. The Contractor is required by Section 1020, 1.04-Examination of the Contract Documents and Site of Work to make reasonable investigation and examination to determine latent and subsurface conditions at the site of the work prior to preparing its proposal. The Jurisdiction makes no guarantee of any conditions, latent or subsurface, at the site of the work. The Jurisdiction shall not be obligated to make any payments to the Contractor by reason of any latent or subsurface conditions.
B. Failure of the Contractor in determining adverse site conditions prior to filing its proposal, or in any phase of its performance of the work, shall be grounds for refusal by the Jurisdiction to agree to pay for additional work by the contractor necessitated by such site conditions.

### 1.09 CHANGED SITE CONDITIONS

A. Latent or Subsurface Conditions:

1. If the Contractor encounters latent or subsurface conditions differing materially from those indicated in the contract documents or from those ordinarily encountered in performing work of the character involved, and which the Contractor could not have discovered by a reasonable site investigation and examination of the type customarily undertaken by prudent and competent contractors, and if these unusual or changed conditions are considered by the Contractor as a basis for compensation in addition to the contract price, the Contractor shall promptly after discovery thereof notify the Engineer of its claim in writing. Before disturbing the site at which the latent or subsurface condition is alleged to exist, the Contractor shall give the Engineer the opportunity to inspect the same.

### 1.09 CHANGED SITE CONDITIONS (Continued)

2. After inspection by the Engineer, the Jurisdiction may, in its discretion, authorize the Contractor to proceed with or abandon the work. The Contractor shall resume construction operations pending a decision regarding its claim by the Jurisdiction. Failure of the Contractor to give prompt written notice and to give the Engineer full opportunity to inspect the condition before disturbing the site shall be deemed a waiver by the Contractor of all claims for extra compensation arising out of the alleged condition.

## B. Compensation:

1. If the Engineer determines the condition could not reasonably have been discovered, the Contractor is entitled to additional compensation by reason of increased expense caused by the condition, and said condition requires work not contemplated by the contract, a change order will be executed by the parties providing for additional compensation for such amount as the parties may agree upon.
2. If the Engineer determines the condition to be such as to justify an extension in contract time, such additional time will be granted according to Section 1040, 1.11-Delays Caused by the Jurisdiction and Section 1080, 1.09 - Extension of Time.

### 1.10 DISPUTED CLAIMS FOR EXTRA COMPENSATION

## A. Basis of Claim for Extra Compensation:

1. In any case where the Contractor believes extra compensation is due for work or material beyond the scope of the work under the contract and not ordered by the Engineer as extra work as defined herein, the Contractor shall notify the Engineer in writing of its intention to make claim for such extra compensation before beginning the work on which the claim is based. The Contractor shall not proceed with that work until the Contractor and the Jurisdiction have executed a change order with respect to extra compensation.
2. The Jurisdiction shall be responsible for damages attributable to the performance, nonperformance, or delay, of any other contractor, governmental agency, utility agency, firm, corporation, or individual authorized to do work on the project, only when such damages result from negligence on the part of the Jurisdiction, its Engineer, or any of its officers or employees.
3. In any case where the Contractor deems that extra compensation is due from the contracting authority as damages resulting from such performances, nonperformances, or delays, the Contractor shall notify the Engineer in writing at the time the delay occurs.
4. In either case, if such notification is not given, or if after such notification is given, the Engineer is not allowed facilities for keeping strict account of actual costs as defined for force-account construction, the Contractor thereby agrees to waive the claim for extra compensation for such work. Such notice by the Contractor, and the fact the Engineer has kept account of the cost as aforesaid, shall not be construed as establishing the validity of the claim.
5. The claim, when filed, shall be in writing and in sufficient detail to permit auditing and an evaluation by the Jurisdiction. The claim shall be supported by such documentary evidence as the claimant has available and shall be verified by affidavit of the claimant or other person having knowledge of the facts.

### 1.10 DISPUTED CLAIMS FOR EXTRA COMPENSATION (Continued)

B. Presentation and Consideration of Claim: If the claimant wishes an opportunity to present its claim in person, the claim shall be accompanied by a written request to do so. Where the claimant asks an opportunity to present its claim in person, the Jurisdiction, within 30 calendar days of the filing of the claim, shall fix a time and place for a meeting between the claimant and the Jurisdiction or its designated representatives or representative. The Jurisdiction shall, within a reasonable time after the filing of the claim or the meeting above referred to, whichever is later, rule upon the validity of the claim and notify the claimant, in writing, of its ruling together with the reasons therefore. In case the claim is found to be just, in whole or in part, it shall be allowed and paid to the extent so found.
C. Request for Arbitration: In the event a Contractor's claim as outlined in the above procedure has been disallowed, in whole or in part, the Contractor may, within 30 calendar days from the date the ruling of the Jurisdiction is mailed, make a written request to the Jurisdiction that its claim or claims be submitted to a board of arbitration. The Jurisdiction shall decide if the matter is subject to arbitration and shall, within 30 calendar days of the receipt of the request for arbitration, grant or deny the request for arbitration. The Jurisdiction's decision shall be final.

## D. Board of Arbitration:

1. The board of arbitration shall consist of three persons - one to be appointed by the Jurisdiction, one to be appointed by the Contractor, and the third to be appointed by the two arbitrators thus chosen.
2. The arbitrators selected shall be persons experienced and familiar with construction or engineering practices in the general type of work involved in the contract, but shall not have been a regular employee or an individual retained by either party at the time the claim arose, or at the time of arbitration.
E. Arbitration Proceedings: The board of arbitration shall make its own rules of procedure and shall have authority to examine records kept by the Jurisdiction and the Contractor. If the desired records are not produced within 10 calendar days after they are requested, the board of arbitration shall proceed without them as best it may. Notification of arbitration proceedings shall be made by the arbitration board to both the Jurisdiction and the Contractor, and each shall have the opportunity to attend all sessions of the arbitration board. In determining the findings or award or both, a majority vote of the board shall govern. Copies of the findings or award or both, signed by the arbitrators, shall be filed with the Jurisdiction and the Contractor. A unanimous report or majority report may be used. The board of arbitration shall fix the cost of the proceedings, including a reasonable compensation to the arbitrators, and shall determine how the total cost shall be borne by the parties.
F. Jurisdiction of Board of Arbitration: The board of arbitration shall have jurisdiction to pass upon questions involving compensation to the Contractor for work actually performed or materials furnished and upon claims for extra compensation that have not been allowed by the Jurisdiction. The board's jurisdiction shall not extend to a determination of quality of workmanship or materials furnished, or to an interpretation of the intent of the plans and specifications except as to matters of compensation. Jurisdiction of the board shall not extend to setting aside or modifying the terms or requirements of the contract.

### 1.10 DISPUTED CLAIMS FOR EXTRA COMPENSATION (Continued)

G. Determination of Board of Arbitration Final: The findings or award, or both, of the arbitration board, if acceptable to both parties to the contract, may become a basis for final payment. If the findings of the arbitration board are unacceptable to either party to the contract, said findings may become the basis for further negotiation between the parties. In the event a solution agreeable to both parties has not been reached through the filing of a claim, through arbitration, or if arbitration has been denied, either party may resort to whatever other methods for resolving the claim are available to it. The Contractor shall not initiate any suit against the Jurisdiction for the adjudication of any claim until said claim has been first presented to the Jurisdiction, pursuant to this article, and either submitted to arbitration or a request for arbitration is denied.

### 1.11 DELAYS CAUSED BY THE JURISDICTION

If the Jurisdiction or its agents should cause a delay in any part of the work or in the final completion of the job, this fact shall not make void the provisions of the contract as to liquidated damages; but the Contractor will promptly be given such extension of time for the final completion of the job as the Jurisdiction may deem proper to compensate the Contractor for such delay.

### 1.12 ORAL AGREEMENTS, CONVERSATIONS, AND INFORMAL COMMUNICATIONS

No oral agreement or conversation made or had with any officer, agent, or employee of the Jurisdiction, and no informal written communication from any officer, agent, or employee of the Jurisdiction, occurring either before or after execution of the contract, shall affect or modify any of the terms or obligations contained in any of the contract documents. Such oral contact and such informal writings shall be considered as unofficial information and in no way binding upon the Jurisdiction.

### 1.13 ERRORS OR OMISSIONS

The Contractor shall examine the plans before beginning construction work. If errors or omissions are discovered in the plans, the Contractor shall call them to the attention of the Engineer before proceeding with the work. In no case shall the Contractor make the corrections therefore without written permission from the Jurisdiction. In case revised plans of a supplementary or explanatory nature are necessary or desirable for clarification, or to correct any errors or omissions, they will be furnished by the Jurisdiction from time to time as the work progresses.

END OF SECTION

### 1.11 PROVIDING JOB SITE UTILITIES

A. The Contractor shall make all necessary arrangements for the provision to the job site of all required utilities for the project. The Contractor shall arrange its work so it will not be delayed because such regulations or requirements relating to the use of utilities. All costs for the provision of utilities to the job site shall be borne by the Contractor.
B. Fire hydrants shall not be used by the Contractor or its subcontractors unless authorization for such use has been obtained from the appropriate water utility agency.

### 1.12 SALVAGE

A. When the contract documents specify salvage of materials for the Jurisdiction as part of the work, the material to be salvaged shall be carefully salvaged and delivered to the designated location in the best condition and ready for storage. When the contract documents provide for salvage of such materials by the Contractor, the Contractor shall salvage such materials and promptly remove them from the site.
B. The Contractor shall not allow inspection or sale of salvage materials to third parties at the site without written approval of the Jurisdiction.

### 1.13 PROTECTION OF WATER QUALITY AND WETLANDS

A. The Contractor shall comply with the requirements of the Clean Water Act (33 U.S.C. 1344 and 33 CFR 323) and Executive Order 11990. When it becomes necessary for the Contractor to work in waters of the United States, the Contractor shall be aware that a Section 404 permit may be required.
B. When required, the Contracting Authority will obtain a Section 404 permit for essential work on the right-of-way prior to the award of the contract. The Contractor shall adhere to the requirements of the permit. Activities occurring in or across waters of the United States not specifically reviewed and approved in the permit are not authorized. If the Contractor desires to use construction methods that are not specifically approved by the permit, the Contractor shall be responsible for obtaining approval in the form of a new Section 404 permit from the U.S. Army Corps of Engineers and possibly lowa DNR. The Contractor shall not use construction methods that require additional mitigation by the Contracting Authority. The Contractor will not be granted additional compensation or contract time due to their request for a new permit. If, however, due to no fault of the Contractor, a Section 404 permit modification involving activities within the right-of-way is deemed necessary by the Engineer, additional contract time and/or compensation may be considered.

### 1.14 FINAL INSPECTION AND ACCEPTANCE

A. As soon as practicable after the completion of the work, it will be inspected thoroughly by the Engineer. The Contractor will be notified when the inspection is to be made so it or its representative may be present.
B. If the inspection reveals any defects in the work as contemplated by the specifications, such defects shall be repaired or unsatisfactory work shall be replaced, as the Engineer may direct, before final acceptance. The cost of all such repairs and replacement shall be borne by the Contractor, and no extension of the contract time shall be granted because of the time required to remedy such defects.
C. When the work is found to be satisfactory, it will be accepted as provided in Section 1090, 1.08 - Acceptance and Final Payment. Such final acceptance will not be reopened after having once been made, except on evidence of collusion, fraud, or obvious error.

### 1.15 ADDITIONAL CONTRACTOR RESPONSIBILITIES

If a form of automated machine guidance (AMG) is used for grading or paving operations, the following is required:
A. At least one week prior to the preconstruction meeting, submit to the Engineer for review a written AMG work plan which indicates the following:

- Equipment type
- Control software manufacturer and version
- Proposed location of GPS base station for broadcasting differential correction data to rover units
- Proposed locations where AMG will be utilized
B. Provide Engineer with up to 8 hours of formal training on Contractor's AMG systems.
C. For grading contracts, provide a rover for use by the Engineer.
D. Check and recalibrate, if necessary, the AMG system at the beginning of each work day.
E. Contractor will bear all costs associated with use of the AMG system, including but not limited to reconstruction of work that may be incurred due to errors in application of the AMG system. Correction of grade elevation errors and any associated quantity adjustments resulting from the Contractor's activities are to be done at no cost to the Contracting Authority.

END OF SECTION

### 2.15 FINISHING AND CLEANUP REQUIREMENTS

From time to time, as may be ordered by the Engineer, and immediately after completion of the improvement, the Contractor shall, at its expense, cleanup and remove all refuse and unused materials of any kind resulting from the work. Upon failure to do so within three working days after such request by the Engineer, the work may be done by the Jurisdiction and the cost thereof charged to the Contractor and deducted from its final payment. Upon completion of the work, the Contractor shall remove all its equipment and put the area of the work in a neat and clean condition and do all other cleaning necessary to complete the work in a workmanlike manner satisfactory to the Engineer.

## PART 3 - BONDS AND INSURANCE

### 3.01 PERFORMANCE, PAYMENT, AND MAINTENANCE BOND

A. The lowest responsive, responsible bidder shall be required to file, before the contract is awarded, a surety bond for performance, payment, and/or maintenance on a form provided by the Jurisdiction and in penal sum equal to the total bid amount. Said bond shall be executed by a corporation authorized to contract as a surety in the state of lowa. Said bond shall be filed in the specified number of copies as a part of the executed contract documents for the Jurisdiction's approval and award.
B. Said bond shall provide that the Contractor shall well and satisfactorily perform and execute the work in all respects, according to the contract documents therefore, and according to the time and conditions of the contract documents, and also that the Contractor shall pay all debts incurred by it in the prosecution of such work, including those for labor and materials furnished. Said bond may also provide for the maintenance of the improvement for the number of years stipulated in the contract documents, and shall remain in full force for the entire maintenance period. Said bond shall in all cases comply with the laws of the State of Iowa and shall be subject to the approval of the Jurisdiction.
C. Within the time period specified in the maintenance portion of the bond, the Contractor shall, as and when ordered by the Engineer, repair, replace, or rebuild such portions of the work found to be faulty because of materials or workmanship. After being notified of the need for repairs, the Contractor shall submit, within seven calendar days, a written report stating its intentions and schedule for completing the repairs for approval by the Engineer. If the Contractor fails to submit such written report or to make the repairs as approved by the Engineer, the Jurisdiction shall have the right to make such repairs and to collect from the Contractor or its surety all outlay and expense the Jurisdiction incurs in making the repair, and in attempting to enforce the terms of the contract and the bond against the Contractor and its surety.

### 3.02 INSURANCE REQUIREMENTS

A. The Contractor shall purchase and maintain insurance to protect the Contractor and the Jurisdiction against all hazards herein enumerated throughout the duration of the contract. Said insurance shall be provided by an insurance company or companies, "admitted" or "nonadmitted" to do business in the State of lowa, having an A.M. Best rating of no less than "B+."
B. "Insurance," "insurance policy," or "insurance contract" when used in these specifications shall have the same meaning as "insurance policy" and "insurance contract" under lowa Code Section 507B.2. All insurance required by this section shall provide coverage on an occurrence basis, not on a claims-made basis, and the person or other entity shall provide evidence of such coverage through an "insurance policy," "contract of insurance," or "certificate of insurance" that clearly discloses on its face coverage on an occurrence basis. Insurance coverage required for hazardous materials abatement including removal of lead, asbestos, PCB's, or the like may be provided on a claims-made basis when it is demonstrated to the satisfaction of the Jurisdiction that occurrence coverage is not reasonably available.
C. Except for workers compensation insurance, the Contractor shall purchase and maintain such insurance as will protect the Contractor and the Jurisdiction as set forth below, which may arise out of or result from the Contractor's operations under the contract, whether such operations be by the Contractor, its subcontractors or consultants, suppliers, third parties, or the agents, officers, or employees of any of them. In addition, the Contractor shall purchase and maintain workers compensation insurance to cover its employees.

### 3.05 PROPERTY INSURANCE (Continued)

H. Before an exposure to loss may occur, the Jurisdiction shall file with the Contractor a copy of each policy that includes insurance coverages required by this section. Each policy shall contain all generally applicable conditions, definitions, exclusions, and endorsements related to this project. Each policy shall contain a provision that the policy will not be cancelled or allowed to expire until at least 30 calendar days prior written notice has been given to the Contractor.
I. Waivers of Subrogation: The Jurisdiction and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other, and (2) the Jurisdiction's consultants, separate contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this section or other property insurance applicable to the work, except such rights as they have to proceeds of such insurance held by the Jurisdiction as fiduciary. The Jurisdiction or Contractor, as appropriate, shall require of the Jurisdiction's consultants, separate contractors, if any, and the subcontractors, sub-subcontractors, agents, and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.
J. A loss insured under the Jurisdiction's property insurance shall be adjusted by the Jurisdiction as fiduciary and made payable to the Jurisdiction as fiduciary for the insureds, as their interest may appear, subject to requirements of any applicable mortgagee clause and of Section 1070, 3.05, K. The Contractor shall pay subcontractors their shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require subcontractors to make payments to their subsubcontractors in a similar manner.
K. The Jurisdiction as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five calendar days after occurrence of loss to the Jurisdiction's exercise of this power; if such objection be made, arbitrators shall be chosen according to Section 1040, 1.10, D, provided one arbitrator shall be appointed by the Jurisdiction, one by the party in interest making objection, and the third to be appointed by the two arbitrators thus chosen. Arbitration shall thereafter proceed as provided in Section 1040, 1.10, E through G. The Jurisdiction as fiduciary shall, in that case, make settlement with insurers according to the direction of such arbitrators. If distribution of insurance proceeds by arbitration is required, the arbitrators will direct such distribution.
L. Partial occupancy or use of the work shall not commence until the insurance company or companies provided property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Jurisdiction and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance.
M. Installation Floater: Under contracts where the Jurisdiction does not provide Builders Risk Insurance, the Jurisdiction may by special provision require the Contractor to provide coverage under an "Installation Floater" covering all materials, fixtures, equipment, and supplies provided for the job. Such insurance shall be on an "all risk" form in an amount equal to the maximum value of such materials, equipment, or supplies covered on the job site, off-premises at any temporary storage location, or in transit. The Installation Floater covering the equipment shall have a maximum deductible no greater than $\$ 5,000$ for each occurrence, which will be the responsibility of the Contractor.

### 3.06 ENDORSEMENT NAMING JURISDICTION AS AN ADDITIONAL INSURED / CANCELLATION AND MATERIAL CHANGE / GOVERNMENTAL IMMUNITIES ENDORSEMENT

A. All liability insurance policies the Contractor is required to provide pursuant to this Section 1070, Part 3 - Bonds and Insurance shall be by endorsement name and designate the Jurisdiction as an additional insured.
B. The Additional Insured Endorsement shall include the following provisions:

The Jurisdiction, including all its elected and appointed officials, all its employees and volunteers, all its boards, commissions and/or authorities and their board members, employees, and volunteers, and all its officers, agents, and consultants, are named as Additional Insureds with respect to liability arising out of the Contractor's work and services performed for the Jurisdiction. This coverage shall be primary to the Additional Insureds, and not contributing with any other insurance or similar protection available to the Additional Insureds, whether other available coverage by primary, contributing, or excess.

The Additional Insured Endorsement shall be included on all Commercial General Liability, Automobile Liability, and Umbrella/Excess Insurance policies.
C. The Cancellation and Material Change Endorsement shall include the following provisions:

Thirty calendar days advance written Notice of Cancellation, Non-Renewal or Reduction in Insurance coverage and/or Limits, and 10 calendar days written Notice of Non-payment of Premium, shall be sent to the Jurisdiction at the office and attention of the Certificate Holder. This endorsement supersedes the standard cancellation statement on the Certificate of Insurance to which this endorsement is attached.

This Cancellation and Material Change Endorsement shall be included on insurance policies required by the SUDAS Standard Specifications.
D. All liability policies that include the Jurisdiction as an additional insured shall include a Governmental Immunities Endorsement, pursuant to lowa Code Section 670.4, which endorsement shall include the following provisions:

1. Nonwaiver of Government Immunity: The insurance carrier expressly agrees and states the purchase of this policy and including the Jurisdiction as an Additional Insured does not waive any of the defenses of governmental immunity available to the Jurisdiction under Iowa Code Section 670.4 as it now exists and as it may be amended from time to time.
2. Claims Coverage: The insurance carrier further agrees this policy of insurance shall cover only those claims not subject to the defense of governmental immunity under lowa Code Section 670.4 as it now exists and as it may be amended from time to time.
3. Assertion of Government Immunity: The Jurisdiction shall be responsible for asserting any defense of governmental immunity, and may do so at any time and shall do so upon the timely written request of the insurance carrier. Nothing contained in this endorsement shall prevent the carrier from asserting the defense of governmental immunity on behalf of the Jurisdiction.
4. Non-Denial of Coverage: The insurance carrier shall not deny coverage or deny any of the rights and benefits accruing to the Jurisdiction under this policy for reasons of governmental immunity unless and until a court of competent jurisdiction has ruled in favor of the defense(s) of governmental immunity asserted by the Jurisdiction.

### 1.02 CONTRACT TIME (Continued)

B. Intermediate contract periods may be designated for completion of a specific item or certain portions of the contract. The contract period and the liquidated damages, if any, for each portion will be listed in the contract documents.
1.03 WORK PROGRESS AND SCHEDULE
A. The progress of the work shall be at a rate sufficient to complete the contract within the time allowed. The Contractor's sequence of operations shall be such as to cause as little inconvenience to the general public as possible.
B. After being awarded the contract, and if requested by the Engineer, the Contractor shall immediately prepare and submit to the Engineer for approval a progress schedule that will ensure the completion of the project within the time specified. Adequate equipment and forces shall be made available by the Contractor to start work immediately upon Notice to Proceed by the Engineer and to prosecute the work to completion according to schedule and within the time specified.
C. If it appears the rate of progress is such that the contract will not be completed within the time allowed, or if the work is not being executed in a satisfactory and workmanlike manner, the Engineer may order the Contractor to take such steps as necessary to complete the contract within the period of time specified or to prosecute the work in a satisfactory manner. If the Contractor fails to comply with such order within two weeks after receipt of the order, the Jurisdiction will have the right to declare the contract in default.

### 1.04 PRECONSTRUCTION CONFERENCE

The Engineer may schedule and conduct a preconstruction conference. The Contractor and the intended subcontractors, if known, shall participate in this conference. The Engineer will invite representatives of railroads and utilities and others having responsibilities or interest in the work.

### 1.05 NOTICE TO PROCEED

A. The return of the signed and executed contract to the Contractor shall serve as notice the contract bond is acceptable, the contract is in force, and the Contractor may complete arrangements for materials and other work according to the contract documents.
B. The Contractor shall begin work as specified in the Notice to Proceed issued by the Engineer and shall prosecute the work vigorously and continuously to completion, except when it is physically impossible to do so due to weather conditions or other unavoidable handicaps. The necessity of discontinuing and resuming work on any portion of the contract shall be determined by the Engineer.
C. The Jurisdiction may, if provided for in the contract documents, give a limited Notice to Proceed as to any portion of the work under the contract.

### 1.06 WEEKLY RECORD OF WORKING DAYS

A. On contracts with completion provisions based upon working days, the Engineer will furnish the Contractor a weekly statement showing the number of working days charged to the Contractor for the preceding week, the number of working days specified for completion of the project, the number of working days remaining to complete the contract, and the revised date for completion.

### 1.06 WEEKLY RECORD OF WORKING DAYS (Continued)

B. Working days will be charged under the following circumstances:

1. Prior to Commencement of Work: Beginning on the date designated in the Notice to Proceed, or beginning on the specified starting date or as soon thereafter as provided in the specifications, a working day will be charged for every calendar day other than Saturday, Sunday, or a recognized legal holiday. Working days will be charged for Saturdays if a mandatory six-day work week is specified in the contract documents.
2. After Commencement of Work: One full working day will be charged for any weekday, exclusive of Saturdays, Sundays, or a recognized legal holiday, when weather or other conditions (not under control of the Contractor) will permit construction operations to proceed for not less than $3 / 4$ of a normal workday in the performance of a controlling item of work as determined by the Engineer. If such conditions allow operations to proceed for at least $1 / 2$ but less than $3 / 4$ of the normal working hours, one-half working day will be charged.

Working days will not be charged for Saturdays (unless a mandatory six-day work week is specified in the contract documents), Sundays, and recognized legal holidays the Contractor does not work. Working days will be charged for Sundays and recognized legal holidays the contractor does work.

As an incentive to the Contractor to expedite the work, working days will not be charged for Saturdays that the Contractor does work, unless a mandatory six-day work week is specified in the contract documents.

Upon written notice to the Contractor, the Engineer may suspend charging of working days on substantially completed contracts for up to 30 calendar days when only cleanup of the project site or minor work items remain. If the designated time has expired and the remaining work items and site cleanup remain uncompleted, the Engineer may restart charging of working days effective at the end of the designated period by providing written notice to the Contractor.
C. Any objection by the Contractor to such weekly determinations shall be deemed waived and shall not thereafter be made the basis of any claim, unless the Contractor shall, within seven calendar days after receipt of a weekly statement, file with the Engineer its written protest setting forth its objections and reasons. If the Contractor's objection to the working day count is made on the grounds it was unable to work due to causes beyond its control, the Contractor shall state its reasons in writing, furnish proof to establish its claim, and state the approximate number of calendar days it estimates it was delayed. The Engineer shall then determine the appropriate number of working days to be charged under the contract.

### 1.07 WORK ON SUNDAYS OR LEGAL HOLIDAYS

A. Except when an accelerated work schedule is required in the contract documents, no work requiring inspection will be allowed on Sundays or holidays observed by the Jurisdiction except with permission of the Engineer. The Contractor should request a determination of the holidays observed by the Jurisdiction.
B. Such work as may be required to properly maintain or protect completed or partially completed construction, or to maintain lights and barricades, will be permitted on Sundays or holidays without specific permission of the Engineer.

### 3.06 SUBGRADE PREPARATION (Continued)

3. Remove stones over 3 inches from subgrade.
4. Construct to elevation and cross-section such that, after rolling, surface will be above required subgrade elevation.

## B. Subgrade Stability:

1. Perform proof rolling with a truck loaded to the maximum single legal axle gross weight of 20,000 pounds or the maximum tandem axle gross weight of 34,000 pounds. Operate trucks at less than 10 mph . Make multiple passes for every lane. The subgrade will be considered to be unstable if, under the operation of the loaded truck, the surface shows yielding (soil wave in front of the loaded tires) or rutting of more than 2 inches, measured from the top to the bottom of the rut at the outside edges.
2. If soft or yielding areas are located, remove unstable materials and replace with suitable foundation materials as approved by the Engineer, meeting Section 2010, 2.04.
Compact subgrade materials in cut sections as required by the Engineer. If stabilization material is used, place and compact as required for subbase.
C. Final Subgrade: Complete final subgrade by excavation to grade by use of steel-shod template supported on side forms, support rollers, or by use of an automatically-controlled subgrade excavating machine.
D. Subgrade Check: Check subgrade elevation and grade by method approved by Engineer prior to paving.
E. Ruts: If ruts or other objectionable irregularities form in subgrade during construction, reshape and re-roll subgrade before placing pavement. Fill ruts or other depressions with material similar to other subgrade material, and compact.

### 3.07 SUBGRADE TREATMENT

A. Lime, Cement, Fly Ash, or Asphalt:

1. Incorporate the subgrade treatment material uniformly during subgrade preparation to the depth and rate specified in the contract documents.
2. Place subgrade treatment in the areas specified in the contract documents for the width of the pavement, plus 2 feet on each side.
B. Geogrid or Geotextiles:
3. Install according to manufacturer's recommendations, on top of the prepared subgrade.
4. Place in the areas specified in the contract documents for the width of the pavement, plus 2 feet on each side.

### 3.08 SUBBASE

A. Subgrade: Compact subgrade and shape smooth before subbase material is placed.
B. Construction: Construct the specified type of subbase to the specified depth, plus 2 feet outside the pavement area.

### 3.08 SUBBASE (Continued)

C. Moisture and Density: Compact subbase and provide testing according to Section 2010, 3.09 .

## D. Final Elevation:

1. Trim to the design elevation and shape to the final template with an automaticallycontrolled trimming machine. Excess material may be salvaged and spread for use on any other approved project location or operation.
2. Conform to the design profile and cross-section to the extent that no point is higher than the designated elevation, and no point is lower than 0.05 foot below the design elevation.
3. Ensure that the top 1 inch of the subbase is uniformly moist prior to paving.
4. Do not allow hauling equipment and other traffic on completed subbase.

### 3.09 FIELD QUALITY CONTROL

A. Compaction Testing: If it is specified in the contract documents that the Contractor will conduct compaction testing, use the services of an independent testing laboratory approved by the Engineer.

## B. Moisture Content and Density:

1. Ensure that moisture content falls within a range of optimum moisture to $4 \%$ above optimum moisture.
2. Compact cohesive soils to no less than $95 \%$ of maximum Standard Proctor Density; and cohesionless soils to no less than 70\% of Relative Density.

## C. Testing:

1. Lab Test: Determine laboratory density of material according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density) or ASTM D 4253 and ASTM D 4254 (Maximum and Minimum Index Density for Cohesionless Soils). Provide at least one analysis for each material type used unless provided by the Engineer.
2. Field Test:
a. Perform in-place field density and moisture testing according to ASTM D 2922 and ASTM D 3017 (nuclear) or ASTM D 1556 (sand cone) and ASTM D 2216 (moisture content).
b. Frequency:
1) Urban Section: Provide one test per lift per 150 feet. If section is less than 300 feet, perform at least two tests per lift.
2) Rural Section: Provide one test for each 500 cubic yards of material placed, with at least two tests per lift.
3. Test only locations selected by the Engineer.
4. The Engineer may require additional testing if noncompliance or change in conditions occur.
D. Test Failure: Rework, recompact, and retest as necessary until required compaction is achieved.

END OF SECTION

### 2.05 STABILIZATION (FOUNDATION) MATERIALS

A. Clean $21 / 2$ inch crushed stone with the following gradation:

Table 3010.06: Stabilization Materials

| Sieve | Percent Passing |
| :---: | :---: |
| $21 / 2^{\prime \prime}$ | 100 |
| $2^{\prime \prime}$ | 90 to 100 |
| $11 / 2^{\prime \prime}$ | 35 to 70 |
| $1^{\prime \prime}$ | 0 to 20 |
| $1 / 2^{\prime \prime}$ | 0 to 5 |

B. If specified, meet lowa DOT Section 4128 for Gradation No. 13 screened over a 1 inch screen or the Engineer may authorize a change in gradation depending on materials available locally at time of construction.
C. Crushed concrete may be used, if approved by the Engineer, if it is within $\pm 5 \%$ of the gradation for each size of material.

### 2.06 SPECIAL PIPE EMBEDMENT AND ENCASEMENT MATERIAL

A. Concrete Cradle, Arch, or Encasement: Use lowa DOT Class C concrete.
B. Flowable Mortar: Comply with lowa DOT Article 2506.02.
C. CLSM:

1. Approximate quantities per cubic yard:
a. Cement: 50 pounds
b. Fly ash: 250 pounds
c. Fine aggregate: 2,910 pounds
d. Water: 60 gallons
2. A compressive strength of at least 50 psi compressive strength at 28 calendar days can be expected.
3. Comply with material requirements of lowa DOT Article 2506.02.

## PART 3 - EXECUTION

### 3.01 TRENCH EXCAVATION

A. Notify the Engineer prior to the start of excavation activities.
B. Remove topsoil to a minimum depth of 12 inches and stockpile.
C. Excavate trench to required elevations and dimensions. Comply with Figure 3010.101.

1. Protect existing facilities, trees, and shrubs during trench excavation.
2. Place excavated material away from trench.
3. Grade spoil piles to drain. Do not allow spoil piles to obstruct drainage.
D. Unsuitable Backfill Material:
4. If unsuitable backfill material is encountered, notify the Engineer.
5. Remove rock, rubbish, boulders, debris, and other unsuitable backfill materials at least 6 inches below and on each side of the pipe.
6. Keep unsuitable backfill material separated from suitable backfill material and topsoil.
7. Restore trench to design dimensions using bedding or stabilization material.

### 3.02 ROCK OR UNSTABLE SOILS IN TRENCH BOTTOM

A. Notify the Engineer prior to over-excavation.
B. The Engineer will determine the need for over-excavation and trench foundation stabilization prior to installation of pipes and structures.
C. Comply with Figure 3010.101 for over-excavation of rock and wet or soft foundations.

### 3.03 TRENCH PROTECTION

A. Install adequate trench protection (sheeting, shoring, and bracing) to prevent ground movement or damage to adjacent structures, pipelines, and utilities.
B. Move trench boxes carefully to avoid disturbing pipe, bedding, or trench wall.
3.04 DEWATERING
A. Maintain water levels below the bottom of trench excavation.
B. Perform the dewatering operation according to the dewatering plan approved by the Engineer. The dewatering plan may be modified to meet actual field conditions, with approval of the Engineer.
C. Ensure operation of the dewatering system does not damage adjoining structures and facilities. Cease dewatering operations and notify the Engineer if damage is observed.
D. Discharged Water:

1. Do not discharge water into sanitary sewers.
2. Discharging water into storm sewers requires Engineer's approval.





## TRENCHLESS CONSTRUCTION (BORING, JACKING, AND TUNNELING)

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Trenchless Installation of Carrier Pipe with Casing Pipe
B. Trenchless Installation of Carrier Pipe without Casing Pipe
1.02 DESCRIPTION OF WORK
A. Excavate launching and receiving pits.
B. Install casing or carrier pipe by trenchless methods.
C. Install carrier pipe inside casing pipe (if required).
D. Place backfill material in excavations.
1.03 SUBMITTALS

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.
B. Carrier Pipe Installed without a Casing Pipe:
6. 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.
7. 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.
8. 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.
9. 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.

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

1. Comply with American Welding Society Code D1.1. Weld all joints with full penetrating weld. Welders must be qualified according to lowa 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.

## Section 4020-Storm Sewers (Continued)

3.09 Cleaning, Inspection, and Testing

Figures
Storm Sewer Pipe Connections

## Section 4030 - Pipe Culverts

## Part 1-General

1.01 Section Includes 1
1.02 Description of Work 1
1.03 Submittals 1
1.04 Substitutions 1
1.05 Delivery, Storage, and Handling 1
1.06 Scheduling and Conflicts 1
1.07 Special Requirements 1
1.08 Measurement and Payment 1

Part 2 - Products
2.01 Pipe Culverts 3
2.02 Pipe Aprons and Beveled Ends 4
2.03 Apron Footings 4
2.04 Apron Guard 4

Part 3 - Execution
3.01 Pipe Culvert Installation 5
3.02 Aprons 5
3.03 Cleaning, Inspection, and Testing 5

Figures
RCP Apron Section Footing
Circular Concrete Aprons
Arch and Elliptical Concrete Pipe Aprons 4030.223
Concrete Pipe Apron Guard
Metal Pipe Aprons and Apron Guards
4030.224

Figure No.
4030.221
4030.222
4030.225

## Section 4040 - Subdrains and Footing Drain Collectors

## Page No.

## Part 1-General

1.01 Section Includes 1
1.02 Description of Work 1
1.03 Submittals 1
1.04 Substitutions 1
1.05 Delivery, Storage, and Handling 1
1.06 Scheduling and Conflicts 1
1.07 Special Requirements 1
1.08 Measurement and Payment 1

Part 2 - Products
2.01 Footing Drain Collectors 3
2.02 Type 1 Subdrains (Longitudinal Subdrain) 3
2.03 Type 2 Subdrains (Combination Subdrain/Footing Drain Collector) 4
2.04 Porous Backfill Material 4
2.05 Subdrain Outlets 4
2.06 Subdrain or Footing Drain Cleanouts 5
2.07 Engineering Fabric 5
2.08 Storm Sewer Service Stubs 5

Part 3 - Execution
3.01 Subdrains 6
3.02 Footing Drain Collectors 6
3.03 Footing Drain Service Stubs 6

Figures
Subdrains
Subdrain Cleanouts 4040.232
Subdrain Outlets 4040.233

## SANITARY SEWERS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Sanitary Sewer Gravity Mains
B. Sanitary Sewer Force Mains
C. Sanitary Sewer Services
1.02 DESCRIPTION OF WORK
A. Construct sanitary sewer gravity and force mains.
B. Construct or relocate building sanitary sewer services, stubs, and connections.

### 1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.
1.07 SPECIAL REQUIREMENTS

None.
1.08 MEASUREMENT AND PAYMENT
A. Sanitary Sewer Gravity Main:

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

### 1.08 MEASUREMENT AND PAYMENT (Continued)

B. Sanitary Sewer Gravity Main with Casing Pipe:

1. Trenched:
a. Measurement: Each type and size of pipe installed with a casing pipe in a trench will be measured in linear feet along the centerline of the casing pipe, from end of casing to end of casing.
b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.
c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, furnishing and installing annular space fill material, casing spacers, pipe connections, testing, and inspection.
2. Trenchless:
a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe from end of casing to end of casing.
b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.
c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.
C. Sanitary Sewer Force Main:
3. Trenched:
a. Measurement: Each type and size of pipe installed in an open trench will be measured in linear feet along the centerline of the pipe from the outside wall of the pumping station to the center of manhole, or from the center of manhole to the center of manhole.
b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.
c. Includes: Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, wyes and other fittings, pipe joints, testing, and inspection.
4. Trenchless:
a. Measurement: Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.
b. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe.
c. Includes: Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; pipe connections; testing; and inspection.

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

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

### 1.08 MEASUREMENT AND PAYMENT (Continued)

2. Trenchless:
a. Measurement: Each type and size of pipe installed by trenchless methods with a casing pipe will be measured in linear feet along the centerline of the casing pipe.
b. Payment: Payment will be made at the unit price per linear foot for each type and size of carrier pipe.
c. Includes: Unit price includes, but is not limited to, furnishing and installing both carrier pipe and casing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; casing spacers; furnishing and installing annular space fill material; pipe connections; testing; and inspection.
E. Sanitary Sewer Service Stub: The portion of the sanitary sewer service from the main to a point 10 feet outside of the right-of-way line or as specified in the contract documents (comply with Figure 4010.201).
3. Measurement: Each type and size of pipe will be measured in linear feet along the centerline of the pipe from the end of the pipe to the centerline of the sewer main.
4. Payment: Payment will be made at the unit price per linear foot for each type and size of sanitary sewer service stub.
5. Includes: Unit price includes, but is not limited to, trench excavation, furnishing bedding material, placing bedding and backfill material, tap, fittings, testing, and inspection.
F. Sanitary Sewer Service Relocation: The portion of an existing sanitary sewer service in a zone of conflict.
6. Measurement: Each completed relocation will be counted.
7. Payment: Payment will be made at the unit price for each relocation.
8. Includes: Unit price includes, but is not limited to, removal of existing pipe, trench excavation, furnishing new pipe and bedding material, placing bedding and backfill material, connection back to existing service, compaction, testing, and inspection.
G. Sewage Air Release Valve and Pit:
9. Measurement: Each completed installation, including valve, accessories, and pit, will be counted.
10. Payment: Payment will be made at the unit price for each sewage air release valve and pit.
11. Includes: Unit price includes, but is not limited to, excavation, furnishing bedding material, placing bedding and backfill material, compaction, and testing.

## H. Removal of Sanitary Sewer:

1. Measurement: Each type and size of pipe removed will be measured in linear feet from end to end.
2. Payment: Payment will be at the unit price per linear foot for each type and size of pipe.
3. Includes: Unit price includes, but is not limited to, removal, disposal, and capping (if specified) of pipe.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

I. Sanitary Sewer Cleanout:

1. Measurement: Each sanitary sewer cleanout will be counted.
2. Payment: Payment will be made at the unit price for each cleanout.
3. Includes: Unit price includes, but is not limited to, plug at the end of the main, fittings, riser pipe, cap with screw plug, casting, and concrete casting encasement.
J. Connection to Existing Manhole: Comply with Section 6010, 1.08, G.

## K. Sanitary Sewer Abandonment:

1. Plug: Plugging sanitary sewers is incidental to other work and will not be paid for separately.
2. Fill and Plug:
a. Measurement: Each size of pipe filled and plugged will be measured in linear feet from end of pipe to end of pipe.
b. Payment: Payment will be at the unit price per linear foot of each size of pipe filled and plugged.

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(1) Place bedding and backfill material as required for sewer main.
(2) Service Line Slope:
4 inch: $2 \%$ to $5 \%$




## STORM SEWERS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Storm Sewers
B. Abandonment of Storm Sewers
1.02 DESCRIPTION OF WORK
A. Construct storm sewers.
B. Abandon storm sewers.
1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.
1.07 SPECIAL REQUIREMENTS

None.
1.08 MEASUREMENT AND PAYMENT
A. Storm Sewer:

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

### 1.08 MEASUREMENT AND PAYMENT (Continued)

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

## B. Storm Sewer with Casing Pipe:

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

## C. Removal of Storm Sewer:

1. Measurement: Each type and size of pipe removed will be measured in linear feet from end to end.
2. Payment: Payment will be made at the unit price per linear foot for each type and size of pipe removed.
3. Includes: Unit price includes, but is not limited to, removal, disposal, and capping (if specified) of pipe.
D. Connection to Existing Manhole or Intake: Comply with Section 6010, 1.08, G.

## E. Storm Sewer Abandonment:

1. Plug: Plugging storm sewers is incidental to other work and will not be paid for separately.
2. Fill and Plug:
a. Measurement: Each size of pipe filled and plugged will be measured in linear feet from end of pipe to end of pipe.
b. Payment: Payment will be at the unit price per linear foot for each size of pipe filled and plugged.

### 3.04 PIPE JOINTING

A. General:

1. Clean joint surfaces to remove soil or foreign material prior to jointing pipe.
2. Assemble joints according to pipe manufacturer's recommendations. Use equipment that does not apply damaging forces to pipe joints.
B. Reinforced Concrete Pipe (RCP), Reinforced Concrete Arch Pipe (RCAP), and Reinforced Concrete Elliptical Pipe (RCEP):
3. Comply with Figure 4020.211 for pipe joint wrapping. Secure engineering fabric in place to prevent displacement while placing backfill material.
4. If a rubber O-ring or profile gasket is specified for RCP, coat the rubber gasket and joint with soap-based lubricant immediately prior to closing the joint.
5. Place pipe such that joint openings on the outside or inside of the pipe do not exceed $1 / 8$ inch at the bottom and $5 / 8$ inch at the top.
C. Reinforced Concrete Low Head Pressure Pipe (RCPP); Polyvinyl Chloride Pipe (PVC) and Corrugated PVC Pipe; Polypropylene Pipe; and High Density Polyethylene Pipe (HDPE): Coat gasket and joint with soap-based lubricant immediately prior to closing the joint.
D. Corrugated Metal Pipe (CMP) and Corrugated Metal Arch Pipe (CMAP): Lap coupling bands to form a tightly closed joint upon installation.
E. Connections between Dissimilar Pipes:
6. Use manufactured adapters or couplings approved by the Engineer.
7. Where adapters or couplings are not available, the Engineer may authorize use of a concrete collar as shown in Figure 4020.211.

### 3.05 TOLERANCES

The following tolerances apply to utilities installed by open trench construction. For trenchless construction, comply with Section 3020.
A. Do not allow horizontal and vertical alignment to vary from design line and grade at any structure by more than $1 \%$ of the inside diameter of the pipe or $1 / 4$ inch, whichever is larger.
B. Do not allow the horizontal alignment of the pipe to vary from design line at any point along the pipe by more than $1 \%$ of the inside diameter of the pipe.
C. Low spots holding water exceeding the following depths for each pipe size will be considered unacceptable and must be removed and reinstalled to proper grade.

| Pipe Diameter | Maximum Low Spot Depth |
| :---: | :---: |
| $8 "$ | $1 / 2 "$ |
| $10 "$ | $1 / 2 "$ |
| $12 "$ | $3 / 4 "$ |
| $15^{\prime \prime}$ | $3 / 4 "$ |
| $18 "$ and Larger | $5 \%$ of Pipe Diameter* |

[^0]
### 3.06 CONFLICTS

## A. Horizontal Separation of Gravity Sewers from Water Mains:

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

- The top of a sewer main is at least 18 inches below the bottom of the water main, and
- The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

2. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Section 5010, 2.01. However, provide a linear separation of at least 2 feet.
B. Separation of Sewer Force Mains from Water Mains: Separate storm sewer force mains and water mains by a horizontal distance of at least 10 feet unless:
3. 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
4. The sewer force main is laid at least 4 linear feet from the water main.
C. Separation of Sewer and Water Main Crossovers:
5. Vertical separation of storm sewers crossing under any water main should be at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, the sewer may be placed not closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases. The sewer and water pipes must be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.
6. Where the storm sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material or reinforced concrete pipe (RCP) with flexible gasket joints meeting ASTM C 443 so both joints are as far as possible from the water main.

### 3.07 STORM SEWER ABANDONMENT

A. Plug:

1. Prior to placing the sewer plug, the Engineer will verify the sewer line is not in use.
2. Construct sewer plug by completely filling the end of the pipe with concrete. Force concrete into the end of the pipe for a distance of 16 inches, or one-half the pipe diameter, whichever is greater.
B. Fill:
3. Prior to filling the sewer, the Engineer will verify the sewer line is not in use.
4. If specified in the contract documents, fill the line to be abandoned with flowable mortar or CLSM (comply with Section 3010) by gravity flow or pumping.


### 3.05 DEFLECTION TESTING

A. Perform deflection tests on all flexible sanitary sewer mains, excluding ductile iron pipe. Also perform deflection tests on all HDPE storm sewer or culvert pipe 12 inches in diameter or greater.
B. Perform deflection tests after backfill has been in place at least 30 calendar days and before paving activity takes place, or as per appropriate sections of these specifications.
C. Pull 9 arm deflection mandrel, complying with applicable ASTM Standards, through sewer by hand.
D. Ensure pipe deflection does not exceed $5 \%$ of average inside diameter as established by ASTM Standards.
E. Remove and replace pipe exceeding deflection limits.
F. Handle and divert existing flows during deflection testing.

### 3.06 FORCE MAIN TESTING

A. Provide test pumps, test plugs, pipe, and gages. Make necessary piping connections.
B. Fill the force main with potable water and flush before testing to remove entrapped air. Other water sources may be used if approved by the Engineer.
C. Insert taps as required to remove air. Plug taps after the completion of tests.
D. Use a test pressure of 1.5 times the working pressure at the lowest point along the test section, but not less than 50 psi.
E. Pressurize the test section and allow it to stabilize prior to beginning the leakage test.
F. Maintain pressure to within 5 psi of the test pressure by pumping in potable water as required.
G. Leakage is the quantity of water that must be supplied into the test section to maintain pressure within 5 psi of the specified test pressure during a 2 hour test period.
H. The maximum allowable leakage is determined by the following formula:
$L=\frac{(S)(D)(P))^{0.5}}{148,000}$

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

### 3.06 FORCE MAIN TESTING (Continued)

The following table assumes an average test pressure (P) of 50 psi and length of pipe (S) of 1,000 feet.

Table 4060.04: Maximum Allowable Leakage Rate

| Pipe Diameter <br> (inches) | Allowable Leakage Rate <br> (gallons/hour/1,000 feet of pipe) |
| :---: | :---: |
| 4 | 0.19 |
| 6 | 0.29 |
| 8 | 0.38 |
| 10 | 0.48 |
| 12 | 0.57 |
| 14 | 0.67 |
| 16 | 0.76 |

I. Examine exposed pipe and fittings during testing. Repair all visible leaks.
J. If the test indicates leakage greater than allowed, locate, repair, or replace damaged or defective pipe, and repeat tests until the requirements are met.

END OF SECTION

### 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 bedding material, installation of tracer wire system for non-metallic service pipe, and placing bedding and backfill material.

## 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 bedding material, installation of tracer wire system for non-metallic service pipe, and placing bedding and backfill material.
2. Water Service Corporation:
a. Measurement: Each type and size of water service corporation will be counted.
b. Payment: Payment will be made at the unit price for each type and size of water service corporation.
3. Water Service Curb Stop and Box:
a. Measurement: Each type and size of water service curb stop and box will be counted.
b. Payment: Payment will be made at the unit price for each type and size of water service curb stop and box.

## PART 2 - PRODUCTS

### 2.01 WATER MAIN

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

1. Minimum Wall Thickness:
a. $\mathbf{4}$ inch through $\mathbf{2 4}$ inch sizes: DR 18.
b. Sizes over 24 inch: As specified in the contract documents.
2. Joint Type: Use push-on joint type, except as otherwise specified in the contract documents or as authorized by the Engineer.
a. Push-on: According to AWWA C900.
b. Integral Restrained Joint: AWWA C900 pipe with restraining system manufactured integrally into pipe end.
c. Mechanical Restrained Joint: Ductile iron mechanical device designed for joint restraint of AWWA C900 pipe complying with the requirements of ASTM F 1674.

## 3. Markings on Pipe:

a. Name of manufacturer.
b. Size and class.
c. Spigot insertion depth gauge.
d. National Sanitation Foundation (NSF) seal.
B. Ductile Iron Pipe (DIP):

1. Minimum Thickness Class:
a. 4 inch through 24 inch sizes: Special thickness Class 52 according to AWWA C151.
b. Sizes over 24 inches: As specified in the contract documents.
2. Cement-mortar Lined: According to AWWA C104 with asphalt seal coat.
3. External Coating: Asphalt according to AWWA C151.
4. Joint Type: Use push-on type, unless otherwise specified in the contract documents or as authorized by the Engineer.
a. Push-on: According to AWWA C111.
b. Mechanical: According to AWWA C111.
c. Restrained, Buried: Pipe manufacturer's standard field removable system.
d. Restrained, in Structures: Restraining gland, flanged or grooved.
e. Flanged: According to AWWA C111.
f. Grooved: According to AWWA C606.
g. Gaskets: According to AWWA C111.
5. Markings on Pipe:
a. Name of manufacturer.
b. Size and class.
c. Spigot insertion depth gauge.

### 3.03 ADDITIONAL REQUIREMENTS FOR PVC PIPE INSTALLATION

A. Cut the pipe perpendicular to the pipe barrel. Deburr and bevel cut spigot end of the pipe barrel to match factory bevel. Re-mark the insertion line.
B. When connecting to shallow-depth bells, such as on some cast iron fittings or valves, cut the spigot end square to remove factory bevel. Deburr the end and form a partial bevel on the end.

### 3.04 ADDITIONAL REQUIREMENTS FOR PRESTRESSED CONCRETE CYLINDER PIPE INSTALLATION

A. Install according to AWWA M9.
B. Relieve gasket tension by inserting a small rod between the gasket and the gasket groove and running the tool around the pipe twice.
C. Check gasket position using a metal feeler gauge after the joint has been assembled.
D. Complete joint exterior grouting after pipe has been properly positioned using non-shrink grout.

### 3.05 POLYETHYLENE ENCASEMENT INSTALLATION

A. Apply polyethylene encasement to buried ductile iron pipe and to buried fittings, fire hydrants, and appurtenances. The polyethylene encasement is used to prevent contact between the pipe and the bedding material, but need not be airtight or watertight.
B. Install polyethylene encasement according to AWWA C105, using tubes or flat sheets, and pipe manufacturer's recommendations.
C. Do not expose the polyethylene encasement to sunlight for long periods before installation.
D. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before encasing the pipe. Take care to prevent soil or bedding material from becoming trapped between the pipe and polyethylene.
E. Lift polyethylene-encased pipe with a fabric-type sling or padded cable.
F. Secure and repair encasement material using polyethylene tape, or replace as necessary.

### 3.06 TRACER SYSTEM INSTALLATION

A. Install with all buried water main piping. Comply with Figure 5010.102 for tracer wire installation.
B. Begin and terminate the system at all connections to existing mains.
C. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 2 inch wide, 10 mil thickness polyethylene pressure sensitive tape.
D. Install splices only as authorized by the Engineer. Allow the Engineer to inspect all belowgrade splices of tracer wire prior to placing the backfill material.
E. Install ground rods adjacent to connections to existing piping and at locations specified in the contract documents or as directed by the Engineer.

### 3.06 TRACER SYSTEM INSTALLATION (Continued)

F. Bring two wires to the surface at each fire hydrant location and terminate with a tracer wire station (comply with Figure 5010.102).
G. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair discontinuities.

### 3.07 CONFLICTS

## A. Horizontal Separation of Gravity Sewers from Water Mains:

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

- The top of a sewer main is at least 18 inches below the bottom of the water main, and
- The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.

2. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Section 5010, 2.01. However, provide a linear separation of at least 2 feet.
B. Separation of Sewer Force Mains from Water Mains: Separate sewer force mains and water mains by a horizontal distance of at least 10 feet unless:
3. 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
4. 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.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

## H. 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.

## I. 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.

## J. 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.

## K. 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:
4. Standards: Comply with AWWA C509 (gray iron or ductile iron) or AWWA C515 (ductile iron) and NSF 61.
5. Stem Seals: Double O-rings permanently lubricated between seals. Lubricant certified for use in potable water.
6. External Bolts and Hex Nuts: Stainless steel according to ASTM A 240, Type 304.
C. Butterfly Valves:
7. Standards: Comply with AWWA C504 class 150B (gray iron or ductile iron) and NSF 61.
8. Stem: Stainless steel according to ASTM A 240, Type 304, turned, ground, and polished.
9. 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.
10. 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.
11. 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.
Table of Contents
Section 6010 - Structures for Sanitary and Storm Sewers Page No.
Part 1 - General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1
1.05 Delivery, Storage, and Handling ..... 2
1.06 Scheduling and Conflicts ..... 2
1.07 Special Requirements ..... 2
1.08 Measurement and Payment ..... 2
Part 2 - Products
2.01 Manhole and Intake Types ..... 4
2.02 Precast ..... 4
2.03 Cast-in-Place ..... 4
2.04 Non-shrink Grout ..... 5
2.05 Precast Riser Joints ..... 5
2.06 Manhole or Intake Top ..... 5
2.07 Base ..... 5
2.08 Pipe Connections ..... 6
2.09 Manhole or Intake Adjustment Rings (Grade Rings) ..... 6
2.10 Castings (Ring, Cover, Grate, and Extensions) ..... 6
2.11 Additional Materials for Sanitary Sewer Manholes ..... 7
2.12 Concrete Fillet ..... 8
2.13 Steps ..... 9
2.14 Precast Concrete Tee ..... 9
2.15 Anchor Bolts and Washers ..... 9
2.16 Excavation and Backfill Material ..... 9

## Section 6010 - Structures for Sanitary and Storm Sewers (Continued) <br> Part 3 - Execution

3.01 General Requirements for Installation of Manholes and Intakes 10
3.02 Additional Requirements for Cast-in-place Concrete Structures 12
3.03 Additional Requirements for Precast Concrete Structures 13
3.04 Adjustment of Existing Manhole or Intake 14
3.05 Connection to Existing Manhole or Intake 15
3.06 Removal of Manhole or Intake 16
3.07 Cleaning, Inspection, and Testing 16

Figures
Circular Sanitary Sewer Manhole
Figure No.

Rectangular Sanitary Sewer Manhole 6010.302
Sanitary Sewer Manhole Over Existing Sewer 6010.303
Rectangular Base/Circular Top Sanitary Sewer Manhole 6010.304
Tee-section Sanitary Sewer Manhole 6010.305
Chimney Seals for Sanitary Sewer Manholes 6010.306
Drop Connection for Sanitary Sewer Manhole 6010.307
Circular Storm Sewer Manhole 6010.401
Rectangular Storm Sewer Manhole 6010.402
Deep Well Rectangular Storm Sewer Manhole 6010.403
Rectangular Base/Circular Top Storm Sewer Manhole 6010.404
Tee-section Storm Sewer Manhole 6010.405
Shallow Rectangular Storm Sewer Manhole 6010.406
Single Grate Intake 6010.501
Circular Single Grate Intake 6010.502
Single Grate Intake with Manhole 6010.503
Single Grate Intake with Flush-top Manhole 6010.504
Double Grate Intake 6010.505
Double Grate Intake with Manhole

## STRUCTURES FOR SANITARY AND STORM SEWERS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Manholes and Intakes for Storm Sewers
B. Manholes for Sanitary Sewers
C. Adjustment of Existing Manholes and Intakes
D. Connection to Existing Manholes and Intakes
E. Removal of Manholes and Intakes
F. Special Structures for Storm Sewers
G. Excavation and Backfill of Structures

### 1.02 DESCRIPTION OF WORK

A. Construct sanitary and storm sewer manholes to provide access to sewer systems for maintenance and cleaning purposes.
B. Construct storm sewer intakes for collection of surface water and conveyance to the storm sewer system.
C. Modify existing manholes and intakes as necessitated by other improvements adjacent to the manholes or intakes.

### 1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Shop drawings of steel reinforcement, showing sizes, lengths, bends, and counts, if required.
B. Concrete mix design, if required by Engineer.
C. Shop drawing schedule of new manholes and/or intakes showing total depth, relative elevations of all connecting sanitary or storm sewer lines, all drops, and orientation of connecting lines.
D. Results of required testing.
E. Catalog cuts of iron castings and sewer line connection gaskets.
F. Gradation and soil classification reports for structure bedding and backfill materials.
G. Dewatering plan.

### 1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Store reinforcing steel only on pallets or lagging.
B. Follow the aggregate storage and concrete transport requirements in lowa DOT Article 2301.02, C.

### 1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.
1.07 SPECIAL REQUIREMENTS
A. Do not place concrete when stormy or inclement weather will prevent good quality work.
B. Cold weather placement is restricted per lowa DOT Article 2403.03, F.
1.08 MEASUREMENT AND PAYMENT
A. Manhole:

1. Measurement: Each type and size of manhole will be counted.
2. Payment: Payment will be at the unit price for each type and size of manhole.
3. Includes: Unit price includes, but is not limited to, excavation, furnishing bedding material, placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), concrete fillets, pipe connections, infiltration barriers (sanitary sewer manholes only), castings, and adjustment rings.
B. Intake:
4. Measurement: Each type and size of intake will be counted.
5. Payment: Payment will be at the unit price for each type and size of intake.
6. Includes: Unit price includes, but is not limited to, excavation, furnishing bedding material, placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), concrete fillets, pipe connections, castings, and adjustment rings.
C. Drop Connection:
7. Measurement: Each drop connection will be counted.
8. Payment: Payment will be at the unit price for each drop connection.
9. Includes: Unit price includes, but is not limited to, the connection to the manhole and all pipe, fittings, concrete encasement, and bedding and backfill material.
D. Casting Extension Rings:
10. Measurement: Each casting extension ring will be counted.
11. Payment: Payment will be at the unit price for each casting extension ring.

### 1.08

## MEASUREMENT AND PAYMENT (Continued)

## E. Manhole or Intake Adjustment, Minor:

1. Measurement: Each existing manhole or intake adjusted to finished grade by addition or removal of adjustment rings or adjustment of adjustable casting will be counted.
2. Payment: Payment will be made at the unit price for each minor manhole or intake adjustment.
3. Includes: Unit price includes, but is not limited to, removing existing casting and existing adjustment rings, furnishing and installing adjustment rings, furnishing and installing new casting, and installing new infiltration barrier (sanitary sewer manholes only).

## F. Manhole or Intake Adjustment, Major:

1. Measurement: Each existing manhole or intake adjusted to grade by addition or removal of riser, cone or flat top sections, or the exchange of existing riser sections with sections having different vertical dimensions will be counted.
2. Payment: Payment will be at the unit price for each major adjustment.
3. Includes: Unit price includes, but is not limited to, removal of existing casting, adjustment rings, top sections, and risers; excavation; concrete and reinforcing steel or precast sections; furnishing and installing new casting; installing new infiltration barrier (sanitary sewer manholes only); placing backfill material; and compaction.

## G. Connection to Existing Manhole or Intake:

1. Measurement: Each connection made to an existing manhole or intake will be counted.
2. Payment: Payment will be made at the unit price for each sewer connection.
3. Includes: Unit price includes, but is not limited to, coring or cutting into the existing manhole or intake, pipe connections, grout, and waterstop (when required).

## H. Remove Manhole or Intake:

1. Measurement: Each manhole or intake removed will be counted.
2. Payment: Payment will be made at the unit price for each manhole or intake.
3. Includes: Unit price includes, but is not limited to, removal of casting, concrete, and reinforcement; plugging pipes; filling remaining structure with flowable mortar; and placing compacted fill over structure to finished grade.

## PART 2 - PRODUCTS

### 2.01 MANHOLE AND INTAKE TYPES

Table 6010.01: Manhole and Intake Types

|  | Figure No. | Type | Description |
| :---: | :---: | :---: | :---: |
|  | 6010.301 | SW-301 | Circular Sanitary Sewer Manhole |
|  | 6010.302 | SW-302 | Rectangular Sanitary Sewer Manhole |
|  | 6010.303 | SW-303 | Sanitary Sewer Manhole Over Existing Sewer |
|  | 6010.304 | SW-304 | Rectangular Base/Circular Top Sanitary Sewer Manhole |
|  | 6010.305 | SW-305 | Tee-section Sanitary Sewer Manhole |
|  |  |  |  |
|  | 6010.401 | SW-401 | Circular Storm Sewer Manhole |
|  | 6010.402 | SW-402 | Rectangular Storm Sewer Manhole |
|  | 6010.403 | SW-403 | Deep Well Rectangular Storm Sewer Manhole |
|  | 6010.404 | SW-404 | Rectangular Base/Circular Top Storm Sewer Manhole |
|  | 6010.405 | SW-405 | Tee-section Storm Sewer Manhole |
|  | 6010.406 | SW-406 | Shallow Rectangular Storm Sewer Manhole |
|  |  |  |  |
|  | 6010.501 | SW-501 | Single Grate Intake |
|  | 6010.502 | SW-502 | Circular Single Grate Intake |
|  | 6010.503 | SW-503 | Single Grate Intake with Manhole |
|  | 6010.504 | SW-504 | Single Grate Intake with Flush-top Manhole |
|  | 6010.505 | SW-505 | Double Grate Intake |
|  | 6010.506 | SW-506 | Double Grate Intake with Manhole |
|  | 6010.507 | SW-507 | Single Open-throat Intake, Small Box |
|  | 6010.508 | SW-508 | Single Open-throat Intake, Large Box |
|  | 6010.509 | SW-509 | Double Open-throat Intake, Small Box |
|  | 6010.510 | SW-510 | Double Open-throat Intake, Large Box |
|  | 6010.511 | SW-511 | Rectangular Area Intake |
|  | 6010.512 | SW-512 | Circular Area Intake |
|  | 6010.513 | SW-513 | Open-sided Area Intake |

PRECAST
Comply with ASTM C 478.

### 2.03 CAST-IN-PLACE

A. Concrete: Use Class C concrete. Comply with the following lowa DOT Specifications and Materials I.M.s.

1. Iowa DOT Specifications Sections:
a. 2403 - Structural Concrete
b. 4101 - Portland Cement
c. 4102 - Water for Concrete and Mortar
d. 4103 - Liquid Admixtures for Portland Cement Concrete
e. 4104 - Burlap for Curing Concrete
f. 4106 - Plastic Film and Insulating Covers for Curing Concrete
g. 4108 - Supplementary Cementitious Materials
h. 4109 - Aggregate Gradations
i. 4110 - Fine Aggregate for Portland Cement Concrete
j. 4115 - Coarse Aggregate for Portland Cement Concrete

## 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 lowa DOT Section 4151 for epoxy coated reinforcement.

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:
3. 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.
4. 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 lowa 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:
5. Circular Manhole: Integral base and lower riser section according to ASTM C 478.
6. 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 $30 \mathrm{~g} / 10 \mathrm{~min}$. |
| Density | ASTM D 792 | 0.94 to $0.98 \mathrm{~g} / \mathrm{cm}^{3}$ |
| Tensile Strength | ASTM D 638 | 2,000 to $5,000 \mathrm{lb} / \mathrm{in}^{2}$ |

b. Do not use polyethylene grade adjustment rings when they are exposed to HMA pavement or heat shrink infiltration barriers.
c. When used in a single configuration, provide tapered adjustment ring with thickness that varies from $1 / 2$ inch to 3 inches.
d. Install adjustment rings on clean, flat surfaces according to the manufacturer's recommendations with the proper butyl rubber sealant/adhesive.
3. Expanded Polypropylene Adjustment Rings: Comply with ASTM D 4819 for expanded polypropylene when tested according to ASTM D 2375.
a. Use adhesive meeting ASTM C 920, Type S, Grade N5, Class 25.
b. Provide finish rings with grooves on the lower surface and flat upper surface.
c. Do not use when heat shrinkable infiltration barrier is used.
B. Ensure the inside diameter of the adjustment ring is not less than the inside diameter of the manhole frame or not less than the inside dimension of the intake grate opening.

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

A. Gray Cast Iron: AASHTO M 306.
B. Ductile Iron: ASTM A 536, Grade 80-55-06 or 70-50-05.
C. Load Capacity: Standard duty unless otherwise shown on the casting figures.

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

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

## C. Casting Types:

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

Table 6010.03: Manhole Casting Types

|  | Figure No. | Casting Type | Number of Pieces | Ring/ Cover | Bolted Frame | Bolted Cover (Floodable) | Gasket |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 6010.601 | SW-601, A | 2 | Fixed ${ }^{2}$ | Yes | No | Yes ${ }^{1}$ |
|  | 6010.601 | SW-601, B | 3 | Adjustable ${ }^{3}$ | No | No | Yes ${ }^{1}$ |
|  | 6010.601 | SW-601, C | 2 | Fixed ${ }^{2}$ | Yes | Yes | Yes ${ }^{1}$ |
|  | 6010.601 | SW-601, D | 3 | Adjustable ${ }^{3}$ | No | Yes | Yes ${ }^{1}$ |
|  | 6010.602 | SW-602, E ${ }^{4}$ | 2 | Fixed ${ }^{2}$ | Yes | No | No |
|  | 6010.602 | SW-602, $\mathrm{F}^{4}$ | 3 | Adjustable ${ }^{3}$ | No | No | No |
|  | 6010.602 | SW-602, G ${ }^{4}$ | 2 | Fixed | No | No | No |

${ }^{1}$ Machine bearing surfaces required.
${ }^{2}$ Typically used with non-paved or flexible surfaces, including HMA, seal coat, gravel, and brick.
${ }^{3}$ Typically used with PCC surfaces, including castings in concrete boxouts.
${ }^{4}$ Storm sewer casting may include environmental symbols and/or messages such as "DUMP NO WASTE, DRAINS TO RIVER."
2. Intakes:
a. Comply with Figures $6010.602,6010.603,6010.604$, and the contract documents.
b. Castings may include environmental symbols and/or messages such as "DUMP NO WASTE, DRAINS TO RIVER."
3. Manhole Casting Extension Ring:
a. Match the dimensions of the existing ring and cover with an allowable diameter tolerance of $-1 / 4$ inch for the frame ridge and $+1 / 4$ inch for the cover recess.
b. Provide extension ring with height as required to raise the top of the casting to make it level or no more than $1 / 4$ inch below the finished pavement surface. Maximum ring height is 3 inches.

### 2.11 ADDITIONAL MATERIALS FOR SANITARY SEWER MANHOLES

A. Infiltration Barrier:

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

### 2.11 ADDITIONAL MATERIALS FOR SANITARY SEWER MANHOLES (Continued)

2. Internal Chimney Seal:
a. Rubber Sleeve and Extension:
1) Double pleated, minimum thickness $1 / 8$ inch thick, according to ASTM C 923.
2) Minimum allowable vertical expansion of at least 2 inches.
3) Integrally formed expansion band recess top and bottom with multiple sealing fins.
b. Expansion Bands:
4) One-piece band assembly to compress sleeve or extension against manhole and casting surfaces to make a watertight seal.
5) 16 gauge ASTM C 923, Type 304 stainless steel, minimum 1 inch width, minimum adjustment range of 2 inches more than the manhole inside diameter.
6) Positive stainless steel locking mechanism permanently securing the band in its expanded position after tightening.
3. Molded Shield:
a. Barrier Shield:
1) Medium density polyethylene, according to ASTM D 1248.
2) Certified for 40,000 pound proof-load according to AASHTO M 306.
3) Diameter to match cone section and internal dimension of casting.
b. Sealant: Butyl material meeting ASTM C 990.
4. Heat Shrink Sleeve: Heat-shrinkable wrap around sleeve designed for protection of buried and exposed sanitary sewer manholes. Do not use with polypropylene or polyethylene adjustment rings.
a. Primer: Compatible with concrete, ductile and cast iron, and sleeve material.
b. Sleeve and Backing:

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

c. Adhesive: Softening point of $212^{\circ} \mathrm{F}$ maximum meeting ASTM E 28 .

## B. Riser Section Coating:

1. Exterior: When exterior waterproof coating is specified, provide bituminous or coal tar coating.
2. Interior: When interior manhole lining is specified, provide lining according to Section 4010, 2.01 (lined, reinforced concrete pipe).

### 2.12 CONCRETE FILLET

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

1. For sanitary sewers, provide a precast concrete fillet, unless otherwise allowed by the Engineer. Comply with Section 6010, 3.01.
2. For storm sewers, provide a cast-in-place concrete fillet with concrete complying with the requirements of Section 6010, 2.03.

### 2.13 STEPS

A. Provide steps in all circular, precast manholes unless otherwise specified in the contract documents.
B. Comply with ASTM C 478.
C. Manufacture using polypropylene encased steel.
D. Uniformly space steps at 12 to 16 inches.
E. Align with vertical side of eccentric top section.
F. Place first step no more than 36 inches from top of casting.

### 2.14 PRECAST CONCRETE TEE

A. Tee and Eccentric Reducers: ASTM C 478.
B. Composite Tee: Comply with Figure 6010.305. May be substituted for pipe diameters less than 48 inches.

### 2.15 ANCHOR BOLTS AND WASHERS

A. Material: Stainless steel or hot-dipped galvanized.
B. Diameter: Provide bolts and washers $1 / 8$ inch smaller than hole or slot in the casting frame, but no less than $1 / 2$ inch diameter.
C. Bolt Length: As required to pass through adjustment rings and into manhole or intake structure to embedment depth recommended by anchor manufacturer.

### 2.16 EXCAVATION AND BACKFILL MATERIAL

Comply with Section 3010 for bedding and backfill materials.

## PART 3 - EXECUTION

### 3.01 GENERAL REQUIREMENTS FOR INSTALLATION OF MANHOLES AND INTAKES

A. Excavation: Excavate according to Section 3010.
B. Subgrade Preparation:

1. Cut Sections (Undisturbed Soil): Prepare subgrade to accurate elevation required to place structure base or subbase.
2. Fill Sections: Compact to $95 \%$ of maximum Standard Proctor Density and hand grade to accurate elevation required to place structure base or subbase, or install stabilization material as directed by the Engineer.
3. Unstable Soil: Install stabilization material as directed by the Engineer.
C. Subbase:
4. Cast-in-place Structures: No subbase material is required.
5. Precast Structures: If precast structure is provided, install 8 inch thick pad of Class I bedding material a minimum of 12 inches outside footprint of the structure.
D. Installation of Manhole or Intake Structure: When necessary, adjust wall height and depth of base to provide a minimum of 48 inches between form grade elevation and top of base.
6. Cast-in-place: Comply with Section 6010, 3.02.
7. Precast: Comply with Section 6010, 3.03.
E. Pipes: Install and bed pipes and connect to manhole or intake. Install pipe flush with inside wall of structure. Place bedding and pipe embedment material according to Section 3010.
8. Cast-in-place Structures:
a. Storm: Form structure walls around pipe.
b. Sanitary: Form or core circular opening and install flexible, watertight gasket according to Section 6010, 2.08. Keep void between pipe and manhole section free of debris and concrete.
9. Precast Storm Sewer Manholes or Intakes: If annular space between pipe and structure is less than 2 inches, fill with non-shrink grout. If annular space is 2 inches or greater, construct a concrete collar around the pipe according to Section 6010, 3.05.
10. Precast Sanitary Sewer Manholes: Connect to structure with flexible, watertight gasket according to Section 6010, 2.08. Keep void between pipe and manhole section free of debris and concrete.
11. Sanitary Sewer Manholes on Existing Pipe: Install waterstop according to Section 6010, 2.08.
F. Joint Sealant:
12. Sanitary Sewer Manholes:
a. Install rubber O-ring or profile gasket (precast structures).
b. Apply bituminous jointing material or butyl sealant wrap to exterior of all sanitary sewer manhole joints.

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

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

## G. Fillet:

1. Construct manhole or intake fillet up to one-half of pipe diameter to produce a smooth half-pipe shape between pipe inverts.
2. Slope fillet top toward pipe $1 / 2$ inch per foot perpendicular to flow line.
3. For sanitary sewer, keep void between pipe and structure wall free of debris and concrete.
4. For precast fillets, remove any projections and repair any voids to provide a hydraulically smooth channel between ends of pipes.
H. Top Sections: Install manhole eccentric cone or flat top section or install intake top.

## I. Adjustment Ring(s):

1. Bed each concrete ring with bituminous jointing material in trowelable or rope form.
2. Bed each polyethylene or expanded polypropylene ring with manufacturer's approved product and according to manufacturer's recommended installation procedure.
3. Construct manholes and intakes with the following adjustment ring stack heights:
a. Minimum: 4 inches for new manholes and intakes. No minimum for rehabilitation projects.
b. Maximum: 12 inches for new manholes and intakes; 16 inches for existing manholes and intakes.
4. For greater adjustment, modify lower riser section(s).
J. Casting: Install the type of casting specified in the contract documents and adjust to proper grade. Where a manhole or intake is to be in a paved area, adjust the casting to match the slope of the finished surface. When specified in the contract documents, attach a casting frame to the structure with four anchor bolts.
K. Infiltration Barrier: Install on sanitary sewer manholes.
5. Internal or External Chimney Seal:
a. Do not use external chimney seal if seal will be permanently exposed to sunlight.
b. Extend seal 3 inches below the lowest adjustment ring.
c. Extend seal to 2 inches above the flange of the casting for a standard two-piece casting, or 2 inches above the top of the base section of the casting for an adjustable three-piece casting.
d. Use multiple seals, if necessary.
e. Install compression bands (external chimney seal) or expansion bands (internal chimney seal) to lock the rubber sleeve or extension into place and to provide a positive watertight seal. Once tightened, lock the bands into place. Use only manufacturer recommended installation tools and sealants.

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

2. Molded Shield:
a. Clean surface of structure cone section.
b. Apply sealant to the top surface of the cone section. Use sufficient sealant to accommodate flaws in the surface of the cone section.
c. Cut molded shield to height by adding the dimensions of the adjustment rings and casting height. Be sure not to interfere with seating of the lid into the casting frame.
d. Seat the molded shield against the sealant on the cone section.
e. Add adjustment rings and casting to meet final grade.
3. Heat Shrink Sleeve:
a. Ensure all surfaces are clean, dry, and free of foreign objects and sharp edges.
b. Warm the surface to drive off any moisture.
c. Cut sleeve to required length per manufacturer's requirements.
d. Apply primer to manhole and casting surface.
e. Place sleeve according to manufacturer's requirements.
f. Apply heat to the sleeve, smooth out wrinkles, and remove trapped air.
g. Cut the sleeve at the casting gussets. Reheat to place the sleeve onto the casting.
h. Trim off any excess material.

## L. Backfill and Compaction:

1. Place suitable backfill material after concrete in structure has reached at least $3,000 \mathrm{psi}$ compressive strength or 550 psi flexural strength. If concrete strength is not determined, place backfill at least 14 calendar days after initial concrete placement.
2. Place backfill material simultaneously on all sides of walls and structures so the fill is kept at approximately the same elevation at all times.
3. Compact the 3 feet closest to all walls using pneumatic or hand tampers only. Ensure proper and uniform compaction of backfill around structure.

## ADDITIONAL REQUIREMENTS FOR CAST-IN-PLACE CONCRETE STRUCTURES

A. Forms:

1. Comply with lowa DOT Article 2403.03, B.
2. Form all cast-in-place manholes and intakes on both the inside and the outside face above the base. Do not form against excavated earthen surface.

## B. Reinforcing Steel:

1. Comply with Iowa DOT Section 2404.
2. Lap bars a minimum of 36 diameters, unless otherwise specified in the contract documents.
3. Provide a minimum of 3 inches of clearance for structure bases and 2 inches of clearance for walls and tops.

## C. Concrete Mixing:

1. Comply with lowa DOT Article 2403.02, D.
2. When using ready-mixed concrete, comply with ASTM C 94.

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

## D. Concrete Placing:

1. Comply with lowa DOT Article 2403.03, C.
2. Do not place concrete when the air temperature is less than $40^{\circ} \mathrm{F}$ without the approval of the Engineer. When placement of concrete below $40^{\circ} \mathrm{F}$ is allowed, comply with lowa DOT Article 2403.03, F.
3. Place concrete continuously in each section until complete. Do not allow more than 30 minutes to elapse between depositing adjacent layers of concrete within each section.
4. Comply with lowa DOT Article 2403.03, D for concrete vibration.
5. Form $11 / 2$ inch by 3 inch keyed construction joints at locations shown in the contract documents.
6. Provide a broom finish on portions of structure that are to become part of exposed pavement.

## E. Stripping and Cleaning:

1. Remove forms for manhole and intake walls and tops according to lowa DOT Article 2403.03, M. References to culverts include all sanitary and storm structures. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used in determining concrete strength of structure tops.
2. Finish surfaces according to lowa DOT Article 2403.03, P. Give exposed surfaces a Class 2 finish.
F. Curing:
3. Comply with lowa DOT Article 2403.03, E.
4. For surfaces visible to the public, use only curing compounds complying with ASTM C 309, Type 1-D or Type 2.
G. Exterior Loading:
5. Restrict exterior loads on concrete according to lowa DOT Article 2403.03, N.
6. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used.
H. Repairs: After visual inspection of the completed manhole or intake, repair honeycomb areas, visible leaks, tie holes, or other damaged areas. Remove concrete webs or protrusions.
I. Concrete Testing: The Engineer will conduct testing.

### 3.03 ADDITIONAL REQUIREMENTS FOR PRECAST CONCRETE STRUCTURES

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

ADDITIONAL REQUIREMENTS FOR PRECAST CONCRETE STRUCTURES (Continued)
B. Cast-in-place Base:

1. Comply with Section 6010, 3.02 for placement of concrete.
2. Ensure proper vertical and horizontal alignment of base riser section.
C. Precast Base or Base with Integral Riser Section: Place base or base with integral riser section and ensure proper vertical and horizontal alignment.
D. Additional Riser Sections: Install additional riser sections as required.
E. Lift Holes: Install rubber plug in lift holes. Cover plug and hole with non-shrink grout.
3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE

## A. Casting Extension Rings:

1. Install casting extension rings only when specified in the contract documents, and only in conjunction with pavement overlays.
2. Install according to the manufacturer's recommendation and adjust for proper alignment.
B. Minor Adjustment (Adding or Removing Adjustment Rings):
3. Remove casting.
4. Modify adjustment ring stack height by one of the following methods:
a. Add adjustment rings as necessary to adjust existing manhole or intake to finished pavement grade or finished topsoil grade, to a maximum ring stack height of 16 inches. Bed each concrete ring with bituminous jointing material. Bed each polyethylene ring with manufacturer's approved product.
b. Remove one or more adjustment rings, as appropriate, to reduce casting elevation.
5. Install new casting on modified adjustment ring stack. Existing casting may be reinstalled when specified in the contract documents.
6. Replace infiltration barrier for sanitary sewer manhole using only new materials.
C. Major Adjustment (Adding, Removing, or Modifying Riser or Cone Section): When adjustment is greater than can be accomplished through adding or removing adjustment rings, a major adjustment will be required.
7. Remove casting.
8. Remove top.
9. Remove and replace or modify existing riser section and/or top section according to the method approved by the Engineer.
10. Install new frame and cover or grate. Existing casting may be reinstalled when specified in the contract documents.
11. Replace infiltration barrier for sanitary sewer manhole using only new materials.

### 3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE

A. General:

1. Remove existing fillet as necessary to install pipe at required elevation and develop hydraulic channel.
2. Insert pipe into structure and trim end flush with inside wall of structure.
3. Place backfill material according to Section 3010.
B. Concrete Collar:
4. For new pipes 12 inches or smaller, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to a minimum thickness and width of 6 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.
5. For new pipes larger than 12 inches, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to minimum thickness and width of 9 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.

## C. Sanitary Sewer:

1. General:
a. Core new openings in existing manholes unless otherwise specified in the contract documents.
b. Divert flow as necessary. Obtain approval of the diversion plan from the Engineer. Maintain sanitary sewer service at all times unless otherwise specified in the contract documents.
2. Cored Opening:
a. Insert flexible watertight connector into new opening.
b. Install and tighten internal expansion sleeve to hold flexible connector in place.
c. Insert pipe through flexible connector and tighten external compression ring.
d. Do not install grout or concrete collar for cored opening with flexible connector.
3. Cut and Chipped Opening (Knock-out): Use only when specified or allowed.
a. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
b. Remove concrete and expand opening to a diameter at least 6 inches larger than the outside diameter of the new pipe.
c. Cut off all reinforcing steel protruding from the structure wall.
d. Install waterstop around new pipe centered within structure wall.
e. Fill opening between structure and pipe with non-shrink grout.
f. Construct concrete collar around pipe and exterior manhole opening.
g. Provide pipe joint, non-shear coupling, or other approved flexible coupling within 2 feet of structure wall to allow for differential settlement between the new sewer and the structure.

### 3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE (Continued)

## D. Storm Sewer:

1. Cut and Chipped Opening:
a. Use for pipe sizes 12 inches in diameter or larger.
b. Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
c. Remove concrete and expand opening to a diameter at no more than 4 inches larger than the outside diameter of the new pipe.
d. Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.
e. Cut off all reinforcing steel protruding from the structure wall.
2. Cored Opening:
b. Core new openings in existing manholes or intakes for all pipes less than 12 inches in diameter.
c. Opening to be no greater than 2 inches larger than the outside diameter of the pipe.
c. Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.
3. Fill Opening: Fill opening between manhole or intake wall and outside of pipe with nonshrink grout or construct a concrete collar around the pipe according to Section 6010, 3.05, B.

### 3.06 REMOVAL OF MANHOLE OR INTAKE

A. Unless otherwise specified, remove the entire structure to a minimum of 10 feet below top of subgrade in paved areas or 10 feet below finished grade in other areas.
B. Pipes:

1. Contact the Engineer to verify the sewer line is not in use.
2. Construct sewer plug by completely filling the end of the pipe with concrete. Force concrete into the end of the pipe for a distance of 16 inches, or one-half the pipe diameter, whichever is greater.
3. If specified in the contract documents, fill the line to be abandoned with flowable mortar or CLSM (comply with Section 3010) by gravity flow or pumping.
C. Fill remaining structure using flowable mortar.
D. Place compacted backfill over remaining structure as required for embankment or compacted backfill.

CLEANING, INSPECTION, AND TESTING
Clean, inspect, and test structures according to Section 6030.
END OF SECTION








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Construct drop and overflow from ductile iron pipe of same diameter pipe and fittings．


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(1)Cast-in-place base shown. If base is
precast integral with bottom riser, the
footprint of the base is not required to
extend beyond the outer edge of the riser.
(2) For additional configurations, maintain a
minimum of 12 inches of concrete
between vertical edges of pipe openings.
(3) 12 inch minimum riser height above all
pipe openings.


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|  |  | 104-1 |
| FIGURE 6010.40 | Standard road plan | SW-401 |
|  |  | SHEET 1 of 1 |
|  |  |  |

 C


AR STORM SEWER
MANHOLE


TYPICAL SECTION


$$
\begin{aligned}
& \text { Adjacent walls may have different widths } \\
& \text { based upon pipe configuration, but structure } \\
& \text { must be rectangular. } \\
& \text { (1) Cast-in-place base shown. If base is } \\
& \text { precast integral with walls, the footprint of } \\
& \text { the base is not required to extend beyond } \\
& \text { the outer edge of the walls. } \\
& \text { (2) Wall widths vary with pipe diameter and } \\
& \text { range from } 40 \text { inches minimum to } 77 \\
& \text { inches maximum. Provide } 6 \text { inches of } \\
& \text { wall width (minimum) each side of pipe } \\
& \text { opening. } \\
& \text { (3)Provide two \#4 hoop bars at top opening } \\
& \text { and at all pipe openings. } \\
& \text { (4) } 12 \text { inch minimum wall height above all } \\
& \text { pipes. }
\end{aligned}
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|  |  | 04-1 |
|  |  | SW-402 |
| FIGURE 6010.402 | STANDARD ROAD PLAN | SHEET 1 of 2 |
| REVISIONS: Changed 'Invert' callout to 'Concrete Filler'. Updated line work and Dot andSudas Logo. |  |  |
| Phe D, Wrigand EBrian \& mith |  |  |
| STO | RECTANGULAR |  |


Adjacent walls may have different widths based upon pipe
configuration, but structure must be rectangular.
(1) Provide two \#4 hoop bars at top opening and at all pipe
openings.
(2) Cast-in-place base shown. If base is precast integral
with walls, the footprint of the base is not required to
extend beyond the outer edge of the walls.
(3) Wall widths vary with pipe diameter and range from 4
feet minimum to 9 feet maximum. Provide 12 inches of
wall width (minimum) each side of pipe opening.
(4) 12 inch minimum wall height above all pipes.


(1) Provide two \#4 hoop bars at top opening and at all pipe
Provide two \#4 hoop bars at top opening and at all pipe
openings.
 with walls, the footprint of the base is not required to
extend beyond the outer edge of walls. extend beyond the outer edge of walls.
 wall width (minimum) each side of pipe opening. $\square \longrightarrow$

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| REINFORCING BAR LIST |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Mark | Size | Location | Shape | Length | Spacing |
| 4 t 1 | 4 | Top | - | $36^{\prime \prime}$ | $12^{\prime \prime}$ |
| 4 t 2 | 4 | Top | - | Long Wall plus 12" | $6^{\prime \prime}$ |
| 4 t 3 | 4 | Top | - | Short Wall plus 12" | $6^{\prime \prime}$ |
| 4 b 1 | 4 | Base | $\llcorner$ | $36^{\prime \prime}$ | $12^{\prime \prime}$ |
| 4 b 2 | 4 | Base | - | Long Wall plus 18" | $12^{\prime \prime}$ |
| 4 b 3 | 4 | Base | - | Short Wall plus 18" | $12^{\prime \prime}$ |
| 4 w 1 | 4 | Walls | $\square$ | Short Wall plus 48" | $12^{\prime \prime}$ |
| 4 w 2 | 4 | Walls | - | Wall Height minus 4" | $12^{\prime \prime}$ |
| 4 w 3 | 4 | Walls | - | Long Wall plus 12" | $12^{\prime \prime}$ |





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



(3) Provide two \#4 hoop bars at top opening and at all pipe openings. 7 inch minimum wall height above all pipes.
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|  |  | 04-1 |
| FIGURE 6010.406 | STANDARD ROAD PLAN | SW-406 |
|  |  | SHEE |
|  |  |  |
|  |  |  |
| SHALLOW RECTANGULAR STORM SEWER MANHOLE |  |  |




Refer to SW-514 for boxout details.
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specified in the contract documents.
Kew əseg umous əseq əכe|d-u!-1sej(2)
with walls, the footprint of the base is not required to exte
edge of the walls.

a minimum of 12 inches of concrete
openings.
(4) 12 inch minimum riser height above all
pipes.




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|  |  | 2 | 04-17-18 |
|  |  | SW-502 |  |
| FIGURE 6010.502 | STANDARD ROAD PLAN |  |  | |  |  |
| :--- | :--- |
|  | REVISIONS: Changed 'Invert' callout to 'Concretel Filler.' Updated linework and lowa DOT |
| and SUODAS Sogo. |  |







PLAN

| REINFORCING BAR LIST |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Mark | Size | Location | Shape | Count | Length | Spacing |
| 4 t 1 | 4 | Top | - | 12 | $3^{\prime}-8^{\prime \prime}$ | $12^{\prime \prime}$ |
| 4 t 2 | 4 | Top | - | 8 | $4^{\prime}-2 "$ | $12^{\prime \prime}$ |
| 4 b 1 | 4 | Base | - | 7 | $4^{\prime}-2 "$ | $13^{\prime \prime}$ |
| 4 b 2 | 4 | Base | - | 5 | $7^{\prime \prime}-2^{\prime \prime}$ | $10^{\prime \prime}$ |
| 4 w 1 | 4 | Short Walls | - | Varies | $3^{\prime}-8^{\prime \prime}$ | $12^{\prime \prime}$ |
| 4 w 2 | 4 | Long Walls | - | Varies | $6^{\prime}-8^{\prime \prime}$ | $12^{\prime \prime}$ |
| 4 w 3 | 4 | Walls | - | 18 | Wall Height minus 4" | $13^{\prime \prime}$ |

Refer to SW-514 for boxout details.
(1) Install four \#4 diagonal bars at manhole opening and at all pipe
openings.
(2) Cast-in-place base shown. If base is precast integral with walls, the
footprint of the base is not required to extend beyond the outer
edge of the walls.
(3) 12 inch minimum wall height above all pipes.
(4) Slope of $1.5 \%$ or as specified in the contract documents.













 Adjust adjacent joint spacing as required to accommodate boxouts.
For retrofit intakes, match existing pavement
joints. Stop any transverse pavement joints joints. Stop any transverse pavement jo conform to the minimum spacing requirements at the edge of the insert area.

$\square$















## CLEANING, INSPECTION, AND TESTING OF STRUCTURES

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

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

### 1.02 DESCRIPTION OF WORK

A. Clean, inspect, and test sanitary sewer manholes.
B. Clean and inspect storm sewer manholes, intakes, and other utility structures.
1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

### 1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Notify the Engineer at least 24 hours prior to performing testing.
B. The Engineer must be present to review testing procedures and record results.
1.07 SPECIAL REQUIREMENTS

None.
1.08 MEASUREMENT AND PAYMENT

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

## PART 2 - PRODUCTS

None.

## PART 3 - EXECUTION

### 3.01 CLEANING

A. Clean all manholes, intakes, and structures by removing sheeting, bracing, shoring, forms, soil sediment, concrete waste, and other debris.
B. Do not discharge soil sediment or debris to drainage channels or existing storm sewer or sanitary sewer system.

### 3.02 VISUAL INSPECTION

A. Examine structure for:

1. Damage.
2. Slipped forms.
3. Indication of displacement of reinforcement.
4. Porous areas or voids.
5. Proper placement of seals, gaskets, and embedments.
B. Verify that the structure is set to true line, grade, and plumb.
C. Verify structure dimensions and thicknesses.

### 3.03 REPAIR

Comply with Section 6010 for repairs.

### 3.04 SANITARY SEWER MANHOLE TESTING

A. General:

1. Use vacuum testing for sanitary sewer manholes, unless exfiltration testing is specified in the contract documents.
2. Conduct the final test after manhole construction is complete, all repairs and connections have been made, and the invert has been installed.
B. Vacuum Test:
3. Applicable only for new manholes isolated from connecting sewer lines.
4. Use manufactured vacuum test equipment meeting the Engineer's approval. Follow the equipment manufacturer's recommended procedures throughout, unless directed otherwise by the Engineer or these specifications.
5. Use extreme care and follow safety precautions during testing operations. Keep personnel clear of manholes during testing.
6. Seal all openings except manhole top access using pneumatic plugs rated for test pressures. Install plugs according to the test equipment manufacturer's recommendations.
7. Brace pipe inverts if backfill material has not been placed around connecting pipes.

### 3.04 SANITARY SEWER MANHOLE TESTING (Continued)

6. Install the vacuum tester head assembly on the manhole top access, and inflate the seal.
7. Evacuate the manhole to 5 psi or 10 inches mercury ( Hg ). Close the isolation valve and start the test. Record the starting time.
8. Maintain a vacuum in the manhole for the time indicated in the following table for the diameter and depth of manhole being tested.
9. Test failure is indicated by vacuum loss greater than 0.5 psi or 1 inch mercury $(\mathrm{Hg})$ within the minimum test time indicated in the table below for the depth and diameter of the manhole being tested.

Table 6030.01: Minimum Vacuum Test Times for Various Manhole Diameters

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

C. Exfiltration Test:

1. Testing may be performed in conjunction with sanitary sewer line testing. Comply with Section 4060.
2. Do not test by this method if water may potentially freeze during the test.
3. Plug the manhole inlet and outlet.
4. Fill the manhole with water to 2 feet above the outside top of the connecting pipe. If ground water is present, fill the manhole to no less than 2 feet nor more than 5 feet above the ground water level. Do not fill above the top of the standard barrel sections.
5. Mark the water level.
6. Allow water to stand in the manhole for 1 hour, then refill to the original water level and begin the test.
7. Determine the allowable drop in water level by using the equation given in Section 4060, 3.04. After 1 hour, measure the drop in water level.
8. Test failure is indicated by water loss greater than the maximum allowable calculated exfiltration.

### 3.05 TEST FAILURE

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

END OF SECTION

Table of Contents

## Section 7010 - Portland Cement Concrete Pavement

Page No.
Part 1 - General
1.01 Section Includes 1
1.02 Description of Work 1
1.03 Submittals 1
1.04 Substitutions 1
1.05 Delivery, Storage, Handling, and Salvaging 1
1.06 Scheduling and Conflicts 1
1.07 Special Requirements 1
1.08 Measurement and Payment 2

Part 2 - Products
2.01 Materials 4
2.02 Concrete Mixes 5

Part 3 - Execution
3.01 Equipment 7
3.02 Pavement Construction 10
3.03 Curb and Gutter Construction 17
3.04 Pavement Protection 18
3.05 Use of Pavement 21
3.06 Transportation Restrictions 21
3.07 Quality Control 22

Figures
Joints
7010.101
$\begin{array}{ll}\text { PCC Curb Details } & 7010.102\end{array}$
$\begin{array}{ll}\text { Manhole Boxouts in PCC Pavement } & 7010.103\end{array}$
$\begin{array}{ll}\text { Ramped Median Nose } & 7010.104\end{array}$
Jointing PCC Pavement Widening 7010.121
Section 7010 - Portland Cement Concrete Pavement (Continued) Figure No.
PCC Pavement Jointing ..... 7010.901
PCC Pavement Widening ..... 7010.902
PCC Railroad Crossing Approach ..... 7010.903
Typical Jointing Layout ..... 7010.904
PCC Cul-de-sac Joint Locations ..... 7010.905
Medians ..... 7010.906
Section 7011 - Portland Cement Concrete Overlays
Page No.
Part 1-General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1
1.05 Delivery, Storage, Handling, and Salvaging ..... 1
1.06 Scheduling and Conflicts ..... 1
1.07 Special Requirements ..... 1
1.08 Measurement and Payment ..... 1
Part 2 - Products
2.01 Materials ..... 3
2.02 Concrete Mixes ..... 5
Part 3 - Execution
3.01 Equipment ..... 6
3.02 Construction ..... 6
3.03 Curb and Gutter Construction ..... 9
3.04 Pavement Protection ..... 9
3.05 Use of Pavement ..... 9
3.06 Transportation Restrictions ..... 9
3.07 Quality Control ..... 9

## Section 7020-Hot Mix Asphalt Pavement

## Page No.

Part 1 - General
1.01 Section Includes 1
1.02 Description of Work 1
1.03 Submittals 1
1.04 Substitutions 2
1.05 Delivery, Storage, Handling, and Salvaging 2
1.06 Scheduling and Conflicts 2
1.07 Special Requirements 2
1.08 Measurement and Payment 3

Part 2 - Products
2.01 HMA Materials 5
2.02 Warm Mix Asphalt Materials 5
2.03 Recycled Asphalt Materials 5
2.04 Subgrade and Subbase 5

Part 3 - Execution
3.01 HMA Pavement 6
3.02 Base Widening 6
3.03 Protection from Traffic 8
3.04 Defects or Deficiencies 8
3.05 Pavement Smoothness 9
3.06 Quality Control 10
3.07 Removal of Pavement 14

Figures
Manhole Boxouts in HMA Pavement and HMA Overlays
Figure No.

HMA Pavement
HMA Railroad Crossing Approach 7020.902
Details for Asphalt Resurfacing
7020.903

## Section 7021 - Hot Mix Asphalt Overlays

## Page No.

Part 1 - General
1.01 Section Includes 1
1.02 Description of Work 1
1.03 Submittals 1
1.04 Substitutions 1
1.05 Delivery, Storage, Handling, and Salvaging 1
1.06 Scheduling and Conflicts 1
1.07 Special Requirements 1
1.08 Measurement and Payment 1

Part 2 - Products
2.01 HMA Overlay Materials 2
2.02 Warm Mix Asphalt Materials 2
2.03 Recycled Asphalt Materials 2
2.04 Binder Grades 2
2.05 High Performance Thin Lift 3
2.06 Nominal Aggregate Size for Asphalt Overlays 3

Part 3 - Execution
3.01 HMA Overlay 4
3.02 Protection from Traffic 4
3.03 Defects or Deficiencies 4
3.04 Pavement Smoothness 4
3.05 Quality Control 4
3.06 Removal of Pavement 4

## Section 7030 - Sidewalks, Shared Use Paths, and Driveways <br> Part 1-General

1.01 Section Includes 1
1.02 Description of Work 1
1.03 Submittals 1
1.04 Substitutions 1
1.05 Delivery, Storage, and Handling 1
1.06 Scheduling and Conflicts 1
1.07 Special Requirements 2
1.08 Measurement and Payment 2

Part 2 - Products
2.01 Portland Cement Concrete 5
2.02 Hot Mix Asphalt 5
2.03 Brick Pavers 5
2.04 HMA Setting Bed for Brick 5
2.05 Neoprene Modified Asphalt Adhesive for Brick 6
2.06 Brick Joint Filler 6
2.07 Detectable Warnings 6
2.08 Granular Driveway Surfacing 6
2.09 Isolation and Expansion Joint Sealant 6

Part 3 - Execution
3.01 Removals 7
3.02 Subgrade Preparation 7
3.03 Adjustment of Fixtures 7
3.04 PCC Sidewalks, Shared Use Paths, and Driveways 8
3.05 HMA Shared Use Paths and Driveways 9
3.06 Brick Sidewalks 10
3.07 Detectable Warning Installation 11
3.08 Testing 11
Section 7030 - Sidewalks, Shared Use Paths, and Driveways (Continued) Page No.
3.09 Granular Driveway Surfacing ..... 11
3.10 Cleaning ..... 11
3.11 Testing ..... 12
3.12 Sidewalk and Curb Ramp Compliance ..... 12
Figures
Concrete Driveway, Type A ..... 7030.101
Concrete Driveway, Type B ..... 7030.102
Driveway Grading ..... 7030.103
Right-of-way Grading ..... 7030.104
Classes of Sidewalks ..... 7030.201
Curb Details for Class A Sidewalk ..... 7030.202
Brick Sidewalk ..... 7030.203
General Features of an Accessible Sidewalk ..... 7030.204
General Sidewalk and Curb Ramp Details ..... 7030.205
Curb Ramps Outside of Intersection Radius ..... 7030.206
Curb Ramp for Class B or C Sidewalk ..... 7030.207
Alternative Curb Ramp for Class B or C Sidewalk ..... 7030.208
Curb Ramps for Class A Sidewalk ..... 7030.209
Detectable Warning Placement ..... 7030.210
Section 7040 - Pavement Rehabilitation Page No.
Part 1 - General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1
1.05 Delivery, Storage, Handling, and Salvaging ..... 1
1.06 Scheduling and Conflicts ..... 2
1.07 Special Requirements ..... 2
1.08 Measurement and Payment ..... 2
Section 7040 - Pavement Rehabilitation (Continued)
Page No.
Part 2 - Products
2.01 Materials
Part 3 - Execution
3.01 General ..... 7
3.02 Full Depth Patching ..... 7
3.03 Partial Depth Patching ..... 9
3.04 Diamond Grinding ..... 10
3.05 Milling ..... 12
3.06 Crack and Joint Cleaning and Filling, Hot Pour ..... 12
3.07 Crack Cleaning and Filling, Emulsion ..... 13
3.08 Pavement Removal ..... 14
3.09 Curb and Gutter Removal ..... 14
3.10 Dowel Bar Retrofit ..... 15
Figures
Full Depth PCC Patches Less Than or Equal to 15' Long ..... 7040.101
Full Depth PCC Patches Greater Than 15' Long ..... 7040.102
Full Depth HMA Patches ..... 7040.103
Partial Depth Patches ..... 7040.104
Flowable Mortar Cutoffwall ..... 7040.105
Dowel Bar Retrofit ..... 7040.106Section 7050 - Asphalt StabilizationPage No.
Part 1-General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1
1.05 Delivery, Storage, and Handling ..... 1
1.06 Scheduling and Conflicts ..... 1
1.07 Special Requirements ..... 1
Section 7050 - Asphalt Stabilization (Continued)
Page No.
1.08 Measurement and Payment ..... 1
Part 2 - Products
2.01 Materials ..... 2
Part 3 - Execution
3.01 Equipment ..... 3
3.02 Re-shaping Ditches ..... 3
3.03 Prepare / Place Base Material ..... 3
3.04 Surface Fixture Adjustment ..... 3
3.05 Application and Mixing of Asphalt Emulsion ..... 3
3.06 Grade and Compact Material ..... 4
3.07 Surface Treatment ..... 4
Section 7060 - Bituminous Seal Coat
Part 1-General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1
1.05 Delivery, Storage, and Handling ..... 1
1.06 Scheduling and Conflicts ..... 1
1.07 Special Requirements ..... 1
1.08 Measurement and Payment ..... 1
Part 2 - Products
2.01 Materials ..... 3
Part 3 - Execution
3.01 Equipment ..... 4
3.02 Surface Preparation ..... 5
3.03 Heating Bituminous Material ..... 5
3.04 Spreading Bituminous Material ..... 5
3.05 Rolling ..... 6
Section 7060 - Bituminous Seal Coat (Continued) Page No.
3.06 Two Course Seal Coats ..... 7
3.07 Clean Up ..... 7
Section 7070 - Emulsified Asphalt Slurry Seal
Part 1 - General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1
1.05 Delivery, Storage, and Handling ..... 1
1.06 Scheduling and Conflicts ..... 1
1.07 Special Requirements ..... 1
1.08 Measurement and Payment ..... 1
Part 2 - Products
2.01 Materials ..... 3
2.02 Composition of the Slurry Mix ..... 3
2.03 Mix Design
Part 3 - Execution
3.01 Equipment ..... 6
3.02 Surface Preparation ..... 7
3.03 Applying Slurry Material ..... 8
3.04 Slurry Leveling ..... 9
3.05 Limitations ..... 9
3.06 Curing and Opening to Traffic ..... 10
Section 7080 - Permeable Interlocking Pavers Page No.
Part 1 - General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
Section 7080 - Permeable Interlocking Pavers (Continued) Page No.
1.04 Substitutions ..... 1
1.05 Delivery, Storage, and Handling ..... 1
1.06 Scheduling and Conflicts ..... 1
1.07 Special Requirements ..... 2
1.08 Measurement and Payment ..... 2
Part 2 - Products
2.01 Engineering Fabric ..... 4
2.02 Underdrain ..... 4
2.03 Aggregate ..... 4
2.04 Permeable Interlocking Pavers ..... 4
2.05 PCC Edge Restraint ..... 4
Part 3 - Execution
3.01 Pre-Installation Protection ..... 5
3.02 Subgrade Preparation for Permeable Interlocking Pavers ..... 5
3.03 Engineering Fabric ..... 5
3.04 Underdrain ..... 5
3.05 Storage Aggregate ..... 6
3.06 Filter Aggregate ..... 6
3.07 Bedding Aggregate ..... 6
3.08 Installing PCC Edge Restraint ..... 7
3.09 Installing Interlocking Permeable Paver System ..... 7
3.10 Quality Control ..... 7
3.11 Protection of Pavement ..... 7
Figures
Figure No.
Permeable Interlocking Pavers ..... 7080.101
Typical Alley with Permeable Pavers ..... 7080.102

## PORTLAND CEMENT CONCRETE PAVEMENT

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Pavement
B. Curb and Gutter

### 1.02 DESCRIPTION OF WORK

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

### 1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Two weeks prior to commencing any PCC pavement placement, submit a paving mix design for each different source of aggregate to be used for review and approval by the Engineer. Submit mixes or mix designs approved by the lowa Department of Transportation or an independent testing laboratory.
B. Maturity curves for paving mixes and maturity reading results.
C. Submit all testing and certifications according to Section 7010, 3.07

### 1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Aggregate Storage: Comply with lowa DOT Article 2301.02, C.
B. Cement and Fly Ash: Comply with lowa DOT Article 2301.02, C.
C. Admixtures: Store in suitable weather tight enclosures which will preserve quality.
D. Reinforcing Steel: Store off ground on timbers or other supports.
1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
Complete elements of the work that can affect line and grade in advance of other open cut construction unless noted on plans.
1.07 SPECIAL REQUIREMENTS

None

### 1.08 MEASUREMENT AND PAYMENT

## A. PCC Pavement:

1. Measurement: Measurement will be in square yards for each different thickness of PCC pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. Payment: Payment will be at the unit price per square yard for each thickness of PCC pavement.
3. Includes: Unit price includes, but is not limited to, final trimming of subgrade or subbase, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, pavement smoothness testing, and quality control for stringless paving.

## B. Air Content Deficiency:

1. Measurement: Measurement will be in square yards for each different thickness of PCC pavement subject to a unit price reduction for air content deficiency according to Section 7010, 3.07.
2. Payment: Payment will be at the reduced unit price according to Table 7010.03 for each thickness of PCC pavement. If there is an air content deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.
C. Pavement Smoothness Deficiency:
3. Measurement: Measurement will be in square yards for each different thickness of PCC pavement subject to a unit price reduction for pavement smoothness according to Section 7010, 3.07.
4. Payment: Payment will be at the reduced unit price according to Table 7010.04 for each thickness of PCC pavement. If there is a pavement smoothness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

## D. PCC Pavement Thickness Deficiency:

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

## E. Curb and Gutter:

1. Measurement: Measurement will be in linear feet measured along the face of the curb for each different width and thickness of curb and gutter.
2. Payment: Payment will be at the unit price per linear feet of curb and gutter.
3. Includes: Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

## F. Beam Curb:

1. Measurement: Measurement will be in linear feet measured along the face of the curb.
2. Payment: Payment will be at the unit price per linear feet of beam curb.
3. Includes: Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.
G. Concrete Median:
4. Measurement: Measurement will be in square yards of concrete median. When the curb is integral with the pavement, the width will be measured from back of curb to back of curb.
5. Payment: Payment will be at the unit price per square yard of concrete median.
6. Includes: Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection, and boxouts for fixtures.
H. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.
I. PCC Pavement Samples and Testing:
7. Measurement: Lump sum item; no measurement will be made.
8. Payment: Payment will be at the lump sum price for PCC pavement samples and testing.
9. Includes: Lump sum price includes, but is not limited to, certified plant inspection, pavement thickness cores, profilograph pavement smoothness measurement (when required by the contract documents), and maturity testing.
J. Granular Surfacing: Comply with Section 7030 for granular surfacing material placed at intersecting roads, driveways, and turnouts.

## K. PCC Pavement Widening:

1. Measurement: Measurement will be in square yards for each different thickness of PCC pavement widening. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement widening area.
2. Payment: Payment will be at the unit price per square yard for each thickness of PCC pavement widening.
3. Includes: Unit price includes, but is not limited to, final subgrade/subbase preparation, integral curb, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness.
L. Pavement Removal: Comply with Section 7040.

## PART 2 - PRODUCTS

### 2.01 <br> MATERIALS

A. Cement: Meet the requirements of lowa DOT Section 4101 and Materials I.M. 401, including Type I and Type II cements and blended hydraulic cements Type 1P, Type 1S, and Type 1L.
B. Supplementary Cementitious Materials (SCM):

1. Fly Ash: Comply with Iowa DOT Section 4108.
2. Ground Granulated Blast Furnace Slag (GGBFS): Comply with lowa DOT Section 4108.
3. Limestone: Comply with Iowa DOT Materials I.M. 401.

## C. Fine Aggregate for Concrete:

1. Meet the requirements of lowa DOT Section 4110 and Materials I.M. 409, Source Approvals for Aggregates.
2. Comply with the following gradation:

| Sieve Size | Percent Passing |
| :---: | :---: |
| $3 / 8^{\prime \prime}$ | 100 |
| No. 4 | 90 to 100 |
| No. 8 | 70 to 100 |
| No. 30 | 10 to 60 |
| No. 200 | 0 to 1.5 |
| lowa DOT Article 4109.02, Gradation No. 1 in the Aggregate Gradation Table. |  |

3. The Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.
D. Coarse Aggregate for Concrete:
4. Crushed stone particles with Class 2 durability complying with lowa DOT Section 4115 and Materials I.M. 409, Source Approvals for Aggregates.
5. Comply with one of the following gradations:

| Sieve Size | Gradation No. 3 <br> Percent Passing | Gradation No. 4 <br> Percent Passing | Gradation No. 5 <br> Percent Passing |
| :---: | :---: | :---: | :---: |
| $11 / 2^{\prime \prime}$ | 100 | 100 | ----- |
| $1^{\prime \prime}$ | 95 to 100 | 50 to 100 | 100 |
| $3 / 4^{\prime \prime}$ | ---- | 30 to 100 | 90 to 100 |
| $1 / 2^{\prime \prime}$ | 25 to 60 | 20 to 75 | ----- |
| $3 / 8^{\prime \prime}$ | ---- | 5 to 55 | 20 to 55 |
| No. 4 | 0 to 10 | 0 to 10 | 0 to 10 |
| No. 8 | 0 to 5 | 0 to 5 | 0 to 5 |
| No. 200 | 0 to 1.5 | 0 to 1.5 | 0 to 1.5 |
| Iowa DOT Article 4109.02, Gradation No. 3, 4, and 5 in the Aggregate Gradation Table. |  |  |  |

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

### 2.01 MATERIALS (Continued)

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

1. Meet the requirements of lowa 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 |
| :---: | :---: |
| $1 / 2^{\prime \prime}$ | 95 to 100 |
| $3 / 8^{\prime \prime}$ | ----- |
| 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 lowa 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.
5. Air Entrainment Admixture: Comply with lowa DOT Section 4103.
6. Retarding and Water Reducing Admixtures: Comply with lowa DOT Section 4103.
7. Accelerating admixtures (calcium chloride): Comply with lowa DOT Article 2529.02.
H. Bars: Comply with lowa DOT Section 4151 for tie bars and dowel bars. Meet the tie bar requirements for bar mats. All bars must be epoxy coated.
I. Expansion Tubes: Comply with lowa DOT Section 4191.
J. Metal Keyways: Comply with lowa DOT Section 4191.
K. Supports for Bars: Comply with lowa DOT Materials I.M. 451.01.
L. Joint Fillers and Sealers:
8. Joint Sealers: Comply with Iowa DOT Article 4136.02.
9. Preformed Expansion Joint Fillers and Sealers: Use the following types of preformed materials for filling expansion joints that comply with lowa 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

3. Backer Rod: Comply with lowa DOT Section 4136.

### 2.01 MATERIALS (Continued)

M. Liquid Curing Compound: Comply with lowa DOT Section 4105.
N. Covering:

1. Burlap: Comply with Iowa DOT Section 4104.
2. Plastic Film: Comply with lowa DOT Section 4106.
3. Insulating Cover: Comply with Iowa DOT Section 4106.
O. Grout Systems: Use polymer grouts that comply with lowa DOT Materials I.M. 491.11.

### 2.02 <br> CONCRETE MIXES

A. Mix Design:

1. Comply with lowa 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 lowa 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 lowa 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 lowa 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 lowa 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 lowa DOT Article 2001.20.
b. Mixing Equipment: Comply with lowa 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 lowa 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 nonuniform, 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:
3) Ensure the concrete is uniform in composition and consistency. If non-uniform, concrete producers must take corrective action.
4) 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.
5) 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.
6) 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 an approximate slope of 15 degrees below horizontal.
i. Use vibrators that meet or exceed the following specifications at the manufacturer's design frequency of $10,000 \mathrm{vpm}$ :

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.
3) Bracing, support, and staking must prevent deflection or movement of forms.
4) Ensure that forms used to shape back of curbs at returns have height at least equal to design thickness of pavement and curb height.
5) 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 <br> 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 <br> 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.
4. Ensure forms have sufficient strength to support paving operations being used.
5. 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.
6. 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.
7. 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.
8. 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 <br> 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 $T / 2 \pm 1 / 2$ 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 $81 / 2$ 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 <br> 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.
10. Pave, edge, protect, saw, and cure curb in same manner as pavement.
11. Finish curb as rapidly as finishing operations on pavement permit. Maximum distance behind paving machine is 100 feet.
12. Complete final finish on curbs by hand methods, including the use of a 6 foot straightedge.
13. Check surfaces of curb and gutter with 10 foot straightedge; correct variations greater than $1 / 8$ inch.
14. For drop curb at driveways and where sidewalks intersect streets, use forms to shape the backs of such curbs.
15. 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.

### 3.02 <br> PAVEMENT CONSTRUCTION (Continued)

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

## H. Finishing:

1. Grade and Crown: Promptly after concrete has been placed and vibrated, strike off the surface to the true section by the screed. Finish the surface true to crown and grade.
2. Watering the Surface: The practice of lubricating the pavement surface by sprinkling water by spray, brush, or other methods to afford greater ease in finishing operation is not allowed.
3. Floats: Finish surface with wood or magnesium floats; finish from both sides simultaneously if pavement is placed to full width with one pass of paving machine.

## 4. Straightedging:

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

## 5. Surface Treatment:

a. Drag Surface Treatment: Unless otherwise specified, texture the finished surface with an artificial turf or burlap drag treatment.

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

### 3.02 <br> PAVEMENT CONSTRUCTION (Continued)

## 2) Transverse:

a) If transverse surface tining is required or allowed, use a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines $1 / 8$ inch (+/- $1 / 64$ inch) in width and randomly spaced from $3 / 8$ inch to $15 / 8$ inch with no more than $50 \%$ of the spacing exceeding 1 inch. The depth of the grooves must be a minimum of $1 / 8$ inch to a maximum of approximately $3 / 16$ inch in the plastic concrete.
b) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.
c) Where abutting pavement is to be placed, the tining should extend as close to the edge as possible without damaging the edge.
d) If abutting pavement is not to be placed, do not tine the 6 inch area nearest the edge or 1 foot from the face of the curb.
6. Edge Finish: Before the concrete has taken its initial set, finish all edges of the pavement with an $1 / 8$ inch radius edging tool.

## I. Surface Curing:

1. Apply liquid curing compound in a fine spray to form a continuous, uniform film on the horizontal surface and vertical edges of pavement, curbs, and back of curbs immediately after surface moisture has disappeared, but no later than 30 minutes after finishing. With approval of the Engineer, the timing of cure application may be adjusted due to varying weather conditions and concrete mix properties to ensure acceptable macrotexture is achieved.
a. Use a white pigment liquid curing compound for concrete not receiving an asphalt overlay. When specified in the contract documents, use a linseed oil solution.
b. Use a dark-colored curing compound for concrete receiving an asphalt overlay.
2. Apply compound with power sprayer; rate of application not less than 15 square yards per gallon ( 0.067 gallon per square yard); do not dilute compound. For concrete receiving an asphalt overlay, use a minimum rate for dark-colored cure of 12.5 square yards per gallon ( 0.08 gallon per square yards).
3. Ensure liquid curing materials are well agitated in the supply drum or tank immediately before transfer to the sprayer. Keep curing materials well agitated during application.
4. Hand operated sprayers may be used for small and irregular areas.
5. If forms are used, apply to pavement edges and back of curbs within 30 minutes after forms are removed.
6. If, due to other operations, the coating is damaged within 72 hours after being applied, immediately re-coat the affected areas. Coating of the sawed surface with curing compound will not be allowed on joints that are to be sealed. When pavement is opened to traffic prior to 72 hours after application of the curing coating, a re-coating will not be required.

## J. Construction of Joints:

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

### 3.02 <br> PAVEMENT CONSTRUCTION (Continued)

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

## 2. Saw Joints:

a. Mark joint locations with a string line before sawing.
b. Begin transverse joint sawing as soon as the concrete has hardened sufficiently to allow sawing without raveling or moving of aggregate. Saw joints before uncontrolled cracking takes place.
c. Saw all joints in a single cutting operation for a specific joint. Make saw cuts true to line and to the dimensions specified in the contract documents.
d. Discontinue sawing a joint if a crack develops ahead of the saw.
e. Saw longitudinal joints within 24 hours of the concrete being placed.
f. If necessary, continue the sawing operations both day and night.
g. The concrete must be capable of supporting the sawing operations to allow the use of an early green concrete saw.
h. Repair or replace pavement with uncontrolled or random cracking at no additional cost to the Contracting Authority. Use repair methods approved by the Engineer. Repair or replace at the direction of the Engineer.
i. Use wet sawing for dust control when specified in the contract documents.
j. Where boxouts occur in pavement, construct joints as shown on Figures 7010.103 and 7010.904.
3. Construction Joints:
a. Place longitudinal and transverse construction joints where specified in the contract documents, at boxouts, and at headers.
b. Locate and place forms for boxouts on grade prior to paving as shown on Figures 7010.103 and 7010.904.
c. Construct a Days Work (DW) or a Rigid Tie (RT) transverse construction joint no closer than 5 feet of an existing or planned transverse contraction joint. Construct the DW or RT transverse construction joint if concrete placement is delayed for more than 30 minutes, at planned pavement gaps, or at the end of each day.
d. Finish the edges of the pavement at construction joints with a $1 / 8$ inch radius edging tool.

## 4. Expansion Joints:

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

### 3.02 PAVEMENT CONSTRUCTION (Continued)

## K. Joint Sealing:

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

## 2. Cleaning:

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

## 3. Sealing:

a. Prepare and install joint sealer in the joint and to the proper level specified in the contract documents and as recommended by the manufacturer.
b. Heat hot-poured sealers in a thermostatically controlled heating kettle; heat the material to the temperature required for use, but not above that recommended by the manufacturer. After sealing, remove excess sealer from the pavement surface.
c. Seal joints the same day they are cleaned. Apply sealant only when the joint surfaces appear dry by visual examination.
d. Place joint sealer only when the pavement and ambient air temperatures are $40^{\circ} \mathrm{F}$ or above. When near this minimum, additional air blasting or drying time, or both, may be necessary to ensure a satisfactory bond to the joint faces. When this sealer cannot be properly placed due to late fall work, submit a joint construction plan and sealing details to the Engineer for approval before commencing paving. Delay the cleaning, sealing, and, if required, resawing of joints until the following spring. This delay requires the Engineer's approval.
e. When surface correction is required, repair seals damaged from the corrective work. Joint preparation, cleaning, and sealing may be delayed until after corrective work, provided the pavement is not opened to traffic before corrective work is performed.
L. Pavement Backfill: Following slipform paving operations, place backfill material along the pavement within 48 hours of pavement attaining opening strength or as directed by the Engineer to prevent flow of water and any subsequent damage caused by undermining of the pavement. Prior to placement of full backfill material, construct check dams or other protection as appropriate to ensure no damage to the subgrade and/or subbase occurs.

## M. Form Removal:

## 1. Timing:

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

## 2. Honeycomb Repair:

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

### 3.02 PAVEMENT CONSTRUCTION (Continued)

b. If the honeycombing is to the degree and nature that it is considered by the Engineer as defective work, remove and replace at no additional cost to the Contracting Authority.
3. Paving Protection: In the area adjacent to the curbs and pavement edge, immediately place backfill after the forms are removed. Construct dams or other protection to ensure that no saturation or erosion of the subgrade under or near the pavement occurs. This may include check dams, pumping, etc.
3.03 CURB AND GUTTER CONSTRUCTION (See Figure 7010.102)
A. Complete the construction of curb and gutter separate from pavement in the same manner as for pavement in Section 7010, 3.02.
B. Use a paving machine for curb and gutter. For curb and gutter sections less than 250 feet, hand finish methods may be used.

### 3.04 PAVEMENT PROTECTION

A. Weather Conditions: Do not place concrete when stormy or inclement weather or temperature prevents good workmanship. Temperature restrictions and protection requirements may be modified by the Engineer under unusual conditions.

1. Cold Weather:
a. Paving: Do not place aggregates containing frozen lumps, and do not place concrete on a frozen subgrade or subbase. Take all necessary actions to prevent the pavement from freezing.
1) Concrete mixing and placement may be started, if weather conditions are favorable, when the air temperature is at least $34{ }^{\circ} \mathrm{F}$ and rising. At the time of placement, concrete must have a temperature of at least $40^{\circ} \mathrm{F}$.
2) Stop mixing and placing when the air temperature is $38^{\circ} \mathrm{F}$ or less and falling or if the temperature stops rising and does not reach $38^{\circ} \mathrm{F}$.
b. Protection: Prior to applying protection, cure all concrete pavement and curb/gutters, including exposed edges of the pavement and curb. In addition, protect concrete less than 36 hours old as follows:

| Night Temperature Forecast | Type of Protection ${ }^{1}$ |
| :---: | :---: |
| $35^{\circ} \mathrm{F}$ to $32^{\circ} \mathrm{F}$ | One layer of burlap for concrete. |
| $31^{\circ} \mathrm{F}$ to $25^{\circ} \mathrm{F}$ | Two layers of burlap or one layer of plastic on one <br> layer of burlap. |
| Below $25^{\circ} \mathrm{F}$ | Four layers of burlap between layers of 4 mil plastic <br> or equivalent commercial insulating material <br> approved by the Engineer. |

${ }^{1}$ Keep protection in place until one of the following conditions is met:
a. The pavement is 5 calendar days old.
b. Opening strength is attained.
c. Forecasted low temperatures exceed $35^{\circ} \mathrm{F}$ for the next 48 hours.
d. Forecasted high temperatures exceed $55^{\circ} \mathrm{F}$ for the next 24 hours and subgrade temperatures are above $40^{\circ} \mathrm{F}$.

1) Shut down paving operations in time to comply with protection requirements outlined above. During cold weather, allow more time for finishing and protection. Perform all finishing and covering operations prior to darkness. Temperature restrictions and protection requirements may be modified by the Engineer.

### 3.04 PAVEMENT PROTECTION (Continued)

2) Equivalent commercial insulating material approved by the Engineer may be used. This material must be waterproof and have a minimum $R$ value of 1.0. If initial set has not yet occurred, place a layer of burlap on top of concrete prior to placing insulating blankets.
3) Use a method of protection and materials that will maintain the concrete temperature above $40^{\circ} \mathrm{F}$.
2. Hot Weather: Hot weather condition is defined as any combination of the following conditions that tend to impair the quality of plastic concrete by accelerating the rate of moisture loss and rate of cement hydration causing thermal shrinkage and resulting in plastic shrinkage cracking:

- High Ambient Temperature
- High Concrete Temperature
- Low Relative Humidity
- High Wind Velocity
- Solar Radiation
a. General:

1) During hot weather conditions, the Engineer may restrict concrete placement to early morning or evening hours.
2) During hot weather conditions, advise the Engineer of the results of the theoretical evaporation rate throughout paving operations.
b. Determine the Theoretical Rate of Evaporation: Use the following chart and the National Weather Service's predicted maximum air temperature, relative humidity, and maximum steady wind velocity without gusts, for the date and the location of the paving pour.

## Theoretical Rate of Evaporation Chart

## To Use this Chart:

1. Enter with air temperature, move up to relative humidity.
2. Move right to concrete temperature.
3. Move down to wind velocity.
4. Move left , read approximate rate of evaporation


### 3.04 PAVEMENT PROTECTION (Continued)

c. If the evaporation rate exceeds 0.1 pounds per square foot per hour but is less than 0.3 pounds per square foot per hour, provide the following concrete evaporation protection.

1) Immediately apply an approved evaporation retarder to the concrete pavement and curbs or increase the surface cure application to 1.5 times the standard specified rate.
2) Take special precautions to ensure that the forms and subgrade are sufficiently moist or protected to avoid lowering the water content at the pavement/subgrade interface. In hot weather conditions, moisten the subgrade the evening before operations.
3) Ensure that the time between placing and curing is minimized and eliminate delays.
4) Moisten concrete aggregates that are dry and absorptive.
5) Use a fog spray to raise the relative humidity of the ambient air if there is a delay in immediately applying the curing compound.
6) Minimize solar heat by shading, wetting, or covering concrete chutes or other equipment that comes in contact with plastic concrete.
d. If the evaporation rate is 0.3 pounds per square foot per hour or greater, discontinue placement of concrete.

## 3. Rain Protection:

a. Have materials available, near the work site, for proper protection of the edges and surface of concrete. Protective material may consist of sheets of burlap or plastic film. Also have planks or other material with suitable stakes that can be used as temporary forms available.
b. If initial set has not occurred, take every precaution necessary to protect the surface texture of the concrete.
c. If so determined by the Engineer, failure to properly protect concrete will constitute cause for removal and replacement of defective pavement.
B. Night Conditions: Perform all finishing and covering operations prior to darkness (half an hour after sunset). Do not commence construction until half an hour before sunrise. Do not place or finish concrete under artificial light, unless approved by the Engineer.

## C. Protection from Traffic:

1. General:
a. Protect the new pavement and its appurtenances from traffic, both public and that caused by the Contractor's own employees and agents, at no additional cost to the Contracting Authority. This includes the erection and maintenance of warning signs, lights, barricades, watchmen to direct traffic, and pavement bridges or crossovers.
b. Do not operate equipment with metal tracks, metal bucket blades, or metal motor patrol blades directly on new paving. Do not unload soil or granular materials, including base rock for storage and future reloading directly onto new paving.

## 2. End of Day's Run:

a. At the end of each day's run and at all side streets, erect and maintain safety barriers and fencing as necessary to protect the pavement from damage.
b. Install safety fences within 1 hour of the completion of finishing and curing operations. Leave fences in place and maintained until the concrete has attained the minimum strength or age.
c. Intermediate safety fences may be required for the purpose of opening the pavement for access to a side road, side street, or entrance.

### 3.04 PAVEMENT PROTECTION (Continued)

3. Repair of Damages: At the discretion of the Engineer, and at no additional cost to the Contracting Authority, repair or replace any part of the pavement damaged by traffic or other causes occurring prior to final acceptance of the pavement.

### 3.05 USE OF PAVEMENT

Time for opening pavement for use is determined by maturity method complying with lowa DOT Materials I.M. 383 or age and test results. The minimum age and test results needed for opening are shown in Table 7010.01.

Table 7010.01: Minimum Age and Tested Strength of Pavement Before Opening

| Class of <br> Mix | Type of <br> Cement | Minimum Age <br> For Opening |  |  |
| :---: | :---: | :---: | :---: | :---: |
| C | Type I | 7 Days $^{2}$ | Minimum <br> Compressive <br> Strength (psi) | Minimum Flexural <br> Strength Center <br> Point (psi) |
| M | Type I | 48 Hours | 3,000 | 500 |

${ }^{1}$ Opening without testing only allowed upon approval of Engineer
${ }^{2}$ Five calendar days for concrete 9 inches thick or more.

### 3.06 TRANSPORTATION RESTRICTIONS

A. Do not use concrete transported with continuous agitation when the cement has been in contact with the aggregate more than 90 minutes before it is placed. With the approval of the Engineer, an approved retarding admixture may be used at the rates required in lowa DOT Materials I.M. 403.
B. Do not use concrete transported without continuous agitation if the period elapsed between the time the concrete is mixed and the time it is placed is greater than 30 minutes. With the approval of the Engineer, an approved retarding admixture may be used at the rates required in lowa DOT Materials I.M. 403 and the mixed-to-placed time may be extended.
C. Ensure the methods of delivering and handling the concrete are such that objectionable segregation or damage to the concrete will not occur, and concrete placing will occur with a minimum of rehandling.
D. Thoroughly clean the truck compartment in which concrete is transported and flush with water to ensure that hardened concrete will not accumulate. Discharge the flushing water from the truck compartment to the designated discharge point before it is charged with the next batch.

### 3.07 QUALITY CONTROL

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

Table 7010.02: Material Certifications and Testing

| Material or Construction Item | Tests | Applicable <br> Standard ${ }^{1}$ | Methods of Acceptance of Sampling and Testing | Field Sampling and Testing |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Frequency (minimum) | Responsible Party |
| Fine <br> Aggregates | Gradation | $\begin{gathered} \hline \text { I.M. } 302,306, \\ 336 \end{gathered}$ | Cert. Plant Insp. ${ }^{2}$ | 1/250 CY or min 1/day | Supplier/ Contractor |
|  | Moisture | I.M. 308, 527 | Cert. Plant Insp. ${ }^{2}$ | 1 per 1/2 day |  |
|  | Specific Gravity | I.M. 307 | Cert. Plant Insp. ${ }^{2}$ | 1/250 CY or min 1/day |  |
|  | Quality | I.M. 209 | Approved Source | Prior to use |  |
| Coarse Aggregates | Gradation | $\begin{gathered} \hline \text { I.M. } 302,306, \\ 336 \end{gathered}$ | Cert. Plant Insp. ${ }^{2}$ | 1/250 CY or min 1/day |  |
|  | Moisture | I.M. 308, 527 | Cert. Plant Insp. ${ }^{2}$ | 1 per 1/2 day |  |
|  | Specific Gravity | I.M. 307 | Cert. Plant Insp. ${ }^{2}$ | 1/250 CY or min 1/day |  |
|  | Quality | I.M. 209 | Approved Source | Prior to use |  |
| Portland Cement | Quality | I.M. 401 | Approved Source | Prior to use |  |
| Fly Ash | Quality | I.M. 491.17 | Approved Source | Prior to use |  |
| GGBFS | Quality | I.M. 491.14 | Approved Source | Prior to use |  |
| Curing Compound | Quality | Iowa DOT <br> Section 4105 | Approved Source | Prior to use |  |
| Joint Sealer | Quality | I.M. 436.01 | Approved Source | Prior to use |  |
| Epoxy Dowel Bars and Assemblies | Quality | I.M. 451.03B | Approved Source | Prior to use |  |
| Tie Bars | Quality | I.M. 451 | Approved Source | Prior to use |  |
| Plastic Concrete | Air Content | I.M 318, 327 | Field Test | 1/200 CY or min. 1/day | Engineer |
|  | Slump | I.M. 317 | Field Test | 1/200 CY or min. 1/day |  |
|  | Cylinders 6" | I.M. 315 | Field Test | Set of 3/500 CY or two sets/day |  |
|  | Beams | $\begin{gathered} \text { I.M. } 316,327, \\ 328 \\ \hline \end{gathered}$ | Field Test | Set of $3 / 500 \mathrm{CY}$ or two sets/day |  |
|  | Thickness | --------- | Field Test | 1/200 CY |  |
| Hardened Concrete | Smoothness | $\begin{gathered} \hline \text { SUDAS 7010, } \\ 3.08 \\ \hline \end{gathered}$ | Field Test Straightedge | Project length |  |
|  | Smoothness | $\begin{gathered} \hline \text { SUDAS 7010, } \\ 3.08 \\ \hline \end{gathered}$ | Field Test Profilograph | Project length | Contractor |
|  | Thickness | $\begin{gathered} \hline \text { SUDAS 7010, } \\ 3.08 \\ \hline \end{gathered}$ | Field Test | 1 core/1000 SY or 3 cores/project |  |
|  | Strength | I.M. 383 | Maturity Tests ${ }^{3}$ | Prior to placement |  |

[^1]
### 3.07 <br> QUALITY CONTROL (Continued)

## B. Air Content:

1. Air content of the concrete will be evaluated according to lowa DOT Materials I.M. 318 and 327.
2. When a test result is outside the tolerance for the target air content, the contractor will be notified immediately. An air test will then be immediately run behind the paver to aid in identifying the limits of the non-complying air. A test result between $5 \%$ and $8 \%$ behind the paver will be considered complying. This test will represent all concrete from the back of the paver back to the last documented complying test. Make immediate adjustments to the mix production and placement process to bring the air content back within tolerance. Do not use succeeding loads below the lower target air content tolerance by more than $0.5 \%$. Each subsequent load will be tested until air content is within tolerance for two consecutive loads. For all incorporated, non-complying concrete that is out of tolerance, the Engineer will determine if removal and replacement is required or if a price adjustment, according to Table 7010.03, will be applied.

Table 7010.03: Concrete Air Content Price Adjustments

*Air content deviation below the acceptable limits
** Air content deviation above the acceptable limits
C. Pavement Smoothness: Evaluate pavement smoothness for all PCC pavement and overlay surfaces.

1. Straightedge: The Engineer will check PCC pavement surfaces with a 10 foot straightedge placed parallel to the centerline. Areas showing high spots of more than $1 / 4$ of an inch in 10 feet will be marked. Complete surface corrections according to the procedures in lowa DOT Section 2316 to an elevation where the area or spot will not show surface deviations in excess of $1 / 8$ inch when tested with a 10 foot straightedge. Surface corrections will be completed at the direction of the Engineer with no additional cost to the Contracting Authority.
2. Profilograph:
a. If specified in the contract documents, comply with lowa DOT Section 2316 to measure pavement smoothness with a profilograph.
b. Evaluate according to the smoothness requirements of Table 7010.04 and make surface corrections and price reductions. Surface corrections will be completed with no additional cost to the Contracting Authority. No incentive for pavement smoothness will be made.

### 3.07 <br> QUALITY CONTROL (Continued)

Table 7010.04: Pay Factor if Profilograph Used

| Segment Index (inch/mile) | Pay Factor |
| :---: | :---: |
| $0-22.0$ | $100 \%$ |
| $22.1-30.0$ | $97 \%$ |
| 30.1 and over | Grind as directed by Engineer |

c. Smoothness measurements will be suspended for structures and through intersections.

## D. Pavement Thickness:

1. At locations determined by the Engineer, cut samples from the pavement by drilling with a core bit that will provide samples with a 4 inch outside diameter. Restore the surface by tamping low slump concrete into the hole, finishing, and texturing. The Engineer will witness the core drilling, identify, and take possession of the cores. The Engineer will determine the core locations, measure the cores, and determine the thickness index according to lowa DOT Materials I.M. 346 and 347, except as modified as follows:
a. For regular or irregular shaped areas, use a lot size of 1,000 square yards. Include remnants less than 500 square yards in the last lot and remnants greater than 500 square yards in a separate lot. Take a minimum of three cores per project.
b. For any core with a deficiency greater than 0.15 inch, take two additional cores in that pavement lot and use the average of the three cores.
2. Coring of pavement or other work for thickness determination may be waived by mutual agreement for sections of the same design thickness less than 2,500 square yards.
3. Based on the thickness index determined by the Engineer, the pavement payment will be as shown in Tables 7010.05 and 7010.06.
4. If the thickness index deficiency is greater than 0.51 for pavements thinner than 9 inches or 0.91 for pavements 9 inches or thicker, the Engineer will study the extent and severity of the deficiency of the pavement areas. The Engineer will require one of the following based on a review on the level of deficiency, the amount of the payment penalty, and the estimated reduction in the design life of the deficient pavement:
a. Removal and replacement of the deficient areas with pavement complying with the contract documents at no additional cost to the Contracting Authority.
b. Completion of an agreement that provides a combination of an extended guarantee period and payment penalty and allows the deficient pavement to be left in place.

Table 7010.05: Pay Factor for PCC Pavement for Design Thickness less than 9 "

| Thickness Index Range | Percent Payment |
| :---: | :---: |
| More than 0 to -0.15 | 100 |
| -0.16 to -0.25 | 95 |
| -0.26 to -0.50 | 85 |
| -0.51 or less | As determined by the Engineer |

### 3.07 <br> QUALITY CONTROL (Continued)

Table 7010.06: Pay Factor for PCC Pavement for Design Thickness 9" or Greater

| Thickness Index Range | Percent Payment |
| :---: | :---: |
| More than 0.00 to -0.15 | 100 |
| -0.16 to -0.20 | 99 |
| -0.21 to -0.25 | 98 |
| -0.26 to -0.30 | 97 |
| -0.31 to -0.35 | 96 |
| -0.36 to -0.40 | 95 |
| -0.41 to -0.45 | 94 |
| -0.46 to -0.50 | 93 |
| -0.51 to -0.55 | 92 |
| -0.56 to -0.60 | 91 |
| -0.61 to -0.65 | 90 |
| -0.66 to -0.70 | 89 |
| -0.71 to -0.75 | 88 |
| -0.76 to -0.80 | 87 |
| -0.81 to -0.85 | 86 |
| -0.86 to -0.90 | 85 |
| -0.91 or less | As determined by the Engineer |

E. Defects or Deficiencies: Remove and replace or repair pavement containing excessive cracks, fractures, spalls, or other defects at no additional cost to the Contracting Authority. The method of replacement or repair will be determined by the Engineer.

END OF SECTION

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## PORTLAND CEMENT CONCRETE OVERLAYS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Bonded Concrete Overlays Over Concrete
B. Bonded Concrete Overlays Over Asphalt
C. Unbonded Concrete Overlays Over Concrete (with separation layer)
D. Unbonded Concrete Overlays Over Asphalt
1.02 DESCRIPTION OF WORK

Includes the requirements for the construction of PCC overlays.
1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants and Section 7010, 1.03.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants and Section 7010, 1.05.
1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants and Section 7010, 1.06.
1.07 SPECIAL REQUIREMENTS

None.
1.08 MEASUREMENT AND PAYMENT
A. PCC Overlays:

## 1. PCC Overlay, Furnish Only:

a. Measurement: Measurement will be in cubic yards of PCC furnished and incorporated into the PCC overlay, including widening sections, partial depth patches (as part of pre-overlay repairs), and irregular sections.
b. Payment: Payment will be at the unit price per cubic yard of PCC furnished and incorporated into the PCC overlay.
c. Includes: Unit price includes, but is not limited to, furnishing the concrete mixture and delivery to the project site.
2. PCC Overlay, Place Only:
a. Measurement: Measurement will be in square yards of PCC overlay placed, including widening sections, partial depth patches, and irregular sections. The area of manholes, intakes, or other fixtures in the overlay will not be deducted from the measured overlay area. Area is based on the longitudinal surface and nominal width of existing pavement.
b. Payment: Payment will be at the unit price per square yard of PCC overlay placed.
c. Includes: Unit price includes, but is not limited to, integral curb, bars and reinforcement, joints and sealing, finishing and texturing, surface curing and pavement protection, safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness testing.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

3. Surface Preparation for Bonded PCC Overlay:
a. Measurement: Measurement will be in square yards of pavement surface prepared for bonded PCC overlay based on the area shown in the contract documents. Area is based on the longitudinal surface and nominal width of existing pavement.
b. Payment: Payment will be at the unit price per square yard of pavement surface prepared for bonded PCC overlay.
c. Includes: Unit price includes, but is not limited to, sandblasting, shot blasting, scarification, and surface cleaning.
4. Surface Preparation for Unbonded PCC Overlay:
a. Measurement: Measurement will be in square yards of pavement scarified for unbonded PCC overlay based on the area shown in the contract documents. Area is based on the longitudinal surface and nominal width of existing pavement.
b. Payment: Payment will be at the unit price per square yard of pavement scarified for unbonded PCC overlay.
c. Includes: Unit price includes, but is not limited to, surface preparation required by the contract documents, including scarification and surface cleaning.
5. HMA Separation Layer for Unbonded PCC Overlay:
a. Measurement: Measurement will be in square yards of HMA separation layer for unbonded PCC overlay. Area is based on the longitudinal surface and nominal width of existing pavement.
b. Payment: Payment will be at the unit price per square yard of HMA separation layer for unbonded PCC overlay.
c. Includes: Unit price includes, but is not limited to, cleaning surface and furnishing and placing HMA mix, including asphalt binder.
6. Geotextile Fabric Separation Layer for Unbonded PCC Overlay:
a. Measurement: Measurement will be in square yards of geotextile fabric separation layer for unbonded PCC overlay. Area is based on the longitudinal surface and nominal width of existing pavement.
b. Payment: Payment will be at the unit price per square yard of geotextile fabric separation layer for unbonded PCC overlay.
c. Includes: Unit price includes, but is not limited to, cleaning surface and furnishing, placing, and securing the geotextile fabric separation layer.
B. Pavement Removal: Comply with Section 7040, 1.08, H.
C. Air Content Deficiency: Comply with Section 7010, 1.08, B.
D. Pavement Smoothness Deficiency: Comply with Section 7010, 1.08, C.
E. PCC Pavement Thickness Deficiency: Comply with Section 7010, 1.08, D.
F. Curb and Gutter: Comply with Section 7010, 1.08, E.
G. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.
H. PCC Pavement Samples and Testing: Comply with Section 7010

## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. Cement: Comply with Section 7010, 2.01, A.
B. Supplementary Cementitious Materials (SCM): Comply with Section 7010, 2.01, B.
C. Fine Aggregate for Concrete: Comply with Section 7010, 2.01, C.
D. Coarse Aggregate for Concrete:

1. Crushed stone particles with Class 2 durability complying with lowa DOT Section 4115 and Materials I.M. 409.
2. Comply with Iowa DOT Section 4115 and Article 4109.02, Gradation No. 3 and 5 in the Aggregate Gradation Table.
3. Bonded PCC Overlays:
a. Use the maximum nominal coarse aggregate size that is no greater than one-third of the overlay thickness.
b. Provide aggregates that will produce a concrete mixture having a coefficient of thermal expansion (CTE) equal to or less than the CTE of the existing concrete pavement.
4. The Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

## E. Fiber Reinforcement:

1. Provide macro-synthetic fibers complying with ASTM C 1116, Type III Section 4.1.3
2. Incorporate at a dosage rate according to the manufacturer's recommendations (typically 3 pounds per cubic yard to 7.5 pounds per cubic yard).
F. Water Requirements: Comply with Section 7010, 2.01, E.
G. Admixtures: Comply with Section 7010, 2.01, F.
H. Tie Bars, Dowel Bars, and Expansion Tubes: Comply with Section 7010, 2.01, G and H.
I. Joint Fillers and Sealers: Comply with Section 7010, 2.01, K.

## J. Liquid Curing Compound:

1. White Pigmented Compounds. Comply with lowa DOT Section 4105.
2. Poly Alpha-methylstyrene: Comply with ASTM C 309, Type 2, Class B with $100 \%$ of the resin consisting of poly alpha-methylstyrene (PAMS) meeting the requirements of Table 7011.01.

Table 7011.01: PAMS Curing Compound

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

### 2.01 MATERIALS (Continued)

## K. HMA Separation Layer for Unbonded Overlay over Concrete:

1. Asphalt Binder: PG $58-28 \mathrm{~S}$.
2. Mixture: Standard Traffic (ST) $3 / 8$ inch HMA mix.
a. Target air voids is $3 \%$.
b. No maximum film thickness restriction.
c. No minimum filler/bitumen ratio restriction.
3. Aggregate:
a. Type B.
b. No percent crushed particle requirement.
c. Gradation cannot fall below the restricted zone.

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

1. Material Properties: Based on the contract document's specified mass per unit area, provide a geotextile fabric meeting the requirements of Table 7011.02.
2. Fabric Weight and Thickness:
a. For unbonded overlays less than or equal to 4 inches thick, provide a geotextile separation layer with a weight of $13.3 \mathrm{oz} / \mathrm{yd}^{2}$ and a thickness of 130 mils.
b. For unbonded overlays greater than or equal to 4.5 inches thick, provide a geotextile separation layer with a weight of $14.7 \mathrm{oz} / \mathrm{yd}^{2}$ and a thickness of 170 mils.

| Table 7011.02: Geotextile Separation Layer |  |  |
| :---: | :---: | :---: |
| Property | Requirements | Test Procedures |
| Geotextile Type | Nonwoven, needle-punched, no thermal treatment to include calendaring ${ }^{\star}$ | EN 13249, Annex F (Certification) |
| Color | Uniform/nominally same color fibers | (Visual Inspection) |
| Weight (mass per unit area) ${ }^{13}$ | $\begin{aligned} & \geq 13.3 \mathrm{oz} / \mathrm{yd}^{2} \\ & \geq 14.7 \mathrm{oz} / \mathrm{yd}^{2} \\ & \leq 16.2 \mathrm{oz} / \mathrm{yd}^{2} \\ & \hline \end{aligned}$ | ISO 9864 (ASTM D 5261) |
| Thickness under load (pressure) | [a] $0.29 \mathrm{psi}: \geq 0.12 \mathrm{in}$. [b] $2.9 \mathrm{psi}: \geq 0.10 \mathrm{in}$. [c] $29 \mathrm{psi}: \geq 0.04 \mathrm{in}$. | ISO 9863-1 (ASTM D 5199) |
| Wide-width tensile strength | $\geq 685 \mathrm{lb} / \mathrm{ft}$. | ISO 10319 (ASTM D 4595) |
| Wide-width maximum elongation | $\leq 130$ percent | ISO 10319 (ASTM D 4595) |
| Water permeability in normal direction under load (pressure) | $\geq 3.3 \times 10^{-4} \mathrm{ft} / \mathrm{s}$ at 2.9 psi | DIN 60500-4 (modified ASTM D5493) |
| In-lane water permeability (transmissivity) under load (pressure) | $[\mathrm{a}] \geq 1.6 \times 10^{-3} \mathrm{ft} / \mathrm{s}$ at 2.9 psi $[\mathrm{b}] \geq 6.6 \times 10^{-3} \mathrm{ft} / \mathrm{s}$ at 2.9 psi | ISO 12958 (ASTM D 6574) or ISO 12958 (modified ASTM D 4716) |
| Weather resistance | Retained strength $\geq 60$ percent ( $70 \%$ average) | EN 12224 (ASTM D 4355 @ 500 hr exposure for grey, white, or black material only) |
| Alkali resistance | $\geq 96$ percent polypropylene/polyethylene | EN 13249, Annex B (Certification) |

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


### 2.01 MATERIALS (Continued)

M. Covering:

1. Burlap: Comply with lowa DOT Section 4104.
2. Plastic Film: Comply with lowa DOT Section 4106.
3. Insulating Cover: Comply with lowa DOT Section 4106.

### 2.02 CONCRETE MIXES

A. Mix Design: Comply with Section 7010, 2.01 and 2.02, except as modified below:

1. Provide $\mathrm{C}-3 \mathrm{WR}$ or $\mathrm{C}-4 \mathrm{WR}$ for bonded overlays.
2. Comply with lowa DOT Class C mix meeting the requirements of lowa DOT Materials I.M. 529.
3. 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: Comply with Section 7010, 2.02, B.
C. Fly Ash and Ground Granulated Blast Furnace Slag (GGBFS) as Supplementary Cementitious Materials: Comply with Section 7010, 2.02, C.

## PART 3 - EXECUTION

### 3.01 EQUIPMENT

Comply with Section 7010, 3.01.

### 3.02 CONSTRUCTION

Construct overlays in the same manner as PCC pavement (Section 7010, 3.02), except as modified herein.
A. Pre and Post Construction: Comply with the contract documents.
B. Overlay Transition Areas: Refer to the contract documents for details of overlay transitions at project limits, bridges, intersections, and other locations.

## C. Temperature Limitations:

1. Air Temperature: Do not place overlay concrete when air or existing pavement surface is below $40^{\circ} \mathrm{F}$.
2. Surface Temperature: Do not place overlay on pavement when the surface temperature exceeds $120^{\circ} \mathrm{F}$. If the surface is above $110^{\circ} \mathrm{F}$ :
a. Apply water to the pavement surface ahead of the paving operation. Ensure no standing water remains on the pavement at the time the overlay is placed.
b. If a fabric separation layer is used, wet the fabric but do not saturate.
c. Do not apply water to the surface if the temperature is below $100^{\circ} \mathrm{F}$.

## D. Bonded Overlay Surface Preparation:

1. Over PCC:
a. Remove all dirt, oil, and other foreign materials, as well as any laitance or loose material from the surface against which new concrete is to be placed, including all pavement markings and raised pavement markings.
b. If the existing pavement is milled, shotblast or waterblast the milled surface.
c. Complete patching with concrete patches after milling, as shown in the contract documents.
d. Sweep the prepared surface and blow clean with dry, oil free compressed air directly ahead of the paving operation to remove loose dirt or debris. Keep air blasting operations as close to overlay operations as possible to prevent any resettlement of debris onto the previously cleaned area. If material is subsequently tracked onto the surface, the surface must be re-cleaned.
2. Over HMA:
a. If required, mill the existing surface to the depth and cross-slope shown in the contract documents. If stripped or loose asphalt is encountered, remove to provide sound structural layer for bonding. Minimum thickness of sound asphalt required for bonding is 3 inches.
b. Complete patching with concrete patching after milling, as shown in the contract documents. Adjust panel location as necessary so no single overlay panel is located over both asphalt pavement and a concrete patch.
c. Sweep the prepared surface and blow clean with dry, oil free compressed air directly ahead of the paving operation to remove loose dirt or debris. Keep air blasting operations as close to overlay operations as possible to prevent any resettlement of debris onto the previously cleaned area. If material is subsequently tracked onto the surface, the surface must be re-cleaned.

### 3.02 <br> 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 lowa 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 $\pm 2$ 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 <br> 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.
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.

### 3.02 CONSTRUCTION (Continued)

4. Unbonded Overlays Over Concrete, Composite, or Asphalt Pavement:
a. Transverse Joints: 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.

### 3.03 CURB AND GUTTER CONSTRUCTION

Comply with Section 7010, 3.03.

### 3.04 PAVEMENT PROTECTION

Comply with Section 7010, 3.04.
3.05 USE OF PAVEMENT

Comply with Section 7010, 3.05.
3.06 TRANSPORTATION RESTRICTIONS

Comply with Section 7010, 3.06.

### 3.07 QUALITY CONTROL

Comply with Section 7010, 3.07.
END OF SECTION

### 1.08 <br> MEASUREMENT AND PAYMENT

## A. HMA Pavement by Ton:

1. Measurement: Measurement will be in tons of HMA pavement.
2. Payment: Payment will be at the unit price per ton of HMA pavement.
3. Includes: Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.
B. HMA Pavement by Square Yards:
4. Measurement: Measurement will be in square yards for each different thickness of HMA pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
5. Payment: Payment will be at the unit price per square yard for each thickness of HMA pavement.
6. Includes: Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.

## C. HMA Base Widening by Ton:

1. Measurement: Measurement will be in tons of HMA base widening.
2. Payment: Payment will be at the unit price per ton of HMA base widening.
3. Includes: Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat between layers, construction zone protection, and quality control.

## D. HMA Base Widening by Square Yard:

1. Measurement: Measurement will be in square yards for each different thickness of HMA base widening. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured base widening area.
2. Payment: Payment will be at the unit price per square yard for each thickness of HMA base widening.
3. Includes: Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat between layers, construction zone protection, and quality control.

## E. Density Deficiency:

1. Measurement: Measurement will be in square yards for each different density of HMA pavement subject to a unit price reduction for density deficiency according to Section 7020, 3.04.
2. Payment: Payment will be at the reduced unit price according to Table 7020.02 for each density of HMA pavement. If there is a density deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

## F. HMA Pavement Thickness Deficiency:

1. Measurement: Measurement will be in square yards for each different thickness of HMA pavement that has deficient pavement thickness as determined in Section 7020, 3.04.
2. Payment: Payment will be at the percentage of the unit price indicated in Table 7020.03 for each different thickness of HMA pavement. If there is a pavement thickness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

## G. HMA Pavement Smoothness Deficiency:

1. Measurement: Measurement will be in square yards for each different segment of HMA pavement subject to a unit price reduction for pavement smoothness according to Section 7020, 3.05.
2. Payment: Payment will be at the reduced unit price according to Table 7020.04 for each segment of HMA pavement. If there is a pavement smoothness deficiency on a privately contracted roadway project, the Jurisdiction ultimately accepting ownership of the roadway will receive the penalty payment prior to acceptance of the work.

## H. HMA Pavement Samples and Testing:

1. Measurement: Lump sum item; no measurement will be made.
2. Payment: Payment will be at the lump sum price for HMA pavement samples and testing.
3. Includes: Lump sum price includes, but is not limited to, certified plant inspection, pavement thickness cores, density analysis, profilograph pavement smoothness measurement (when required by the contract documents), and air void testing.
I. Fixture Adjustment: Comply with Section 6010 for adjustment of manholes and intakes and Section 5020 for adjustment of water valves and fire hydrants.
J. Pavement Removal: Comply with Section 7040.
K. Subgrade and Subbase: For excavation and construction of subgrade and subbase, comply with Section 2010.

## PART 2 - PRODUCTS

### 2.01 HMA MATERIALS

Comply with lowa DOT Section 2303, with the following exception:
Follow the procedure outlined in lowa DOT Materials I.M. 510 for HMA mixture designs, except replace Table 1 in Appendix A, HMA Mixture Design Criteria with the SUDAS HMA Mixture Design Criteria (Table 7020.01) (Tables 2 through 4 in Appendix A still apply).

### 2.02 WARM MIX ASPHALT MATERIALS

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

### 2.03 RECYCLED ASPHALT MATERIALS

A. Recycled Asphalt Pavement: If use of recycled asphalt pavement (RAP) is approved by the Jurisdiction, comply with lowa DOT Section 2303.
B. Recycled Asphalt Shingles: If use of recycled asphalt shingles (RAS) is approved by the Jurisdiction, comply with lowa DOT Section 2303.
2.04 SUBGRADE AND SUBBASE

Comply with Section 2010.

## PART 3 - EXECUTION

### 3.01 HMA PAVEMENT

Construct according to lowa DOT Section 2303 and the following:
A. Preparation of Pavement Foundation: Construct subgrade and subbase according to Section 2010.
B. Compaction: Compact to a minimum of $94 \%$ of laboratory density. Do not exceed $8 \%$ average air void level for roadway density specimens.
C. Tack Coats: Apply tack coats according to lowa DOT Section 2303. In addition, if the emulsion is diluted, the dilution must be done by the manufacturer and certified. Provide the Engineer with the new application rate required to achieve the specified undiluted application rate.
D. Fillets and Runouts: Rake out coarse aggregate prior to shaping and compaction of fillets and runouts.

## E. Fixtures in the Pavement Surface:

1. Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with Section 6010, 3.04 for manhole adjustments and Section 5020, 3.04 for water fixture adjustments.
2. Clean outside of fixture to depth of pavement before asphalt placement.
3. Construct boxouts where allowed for later adjustment of fixtures. See Figure 7020.201 for the size and shape of the boxout.
F. Samples and Testing: Take samples from the compacted material and test according to Section 7020, 3.04. Randomly locate samples in the pavement area Notify the Jurisdiction the day prior to coring and testing to give the Jurisdiction the opportunity to witness coring and testing.

### 3.02 BASE WIDENING

A. Equipment: Use equipment complying with lowa DOT Section 2213.
B. Conditions:

1. Resurfacing over Concrete Base Widening: When the existing pavement is HMA material over concrete pavement, saw or mill the old asphalt to the full depth of the proposed resurfacing or to depth of sound material producing a reasonable vertical line at the edge of the underlying concrete.
2. HMA Base Widening: Apply a tack coat to the vertical edge of the old pavement at a rate of 0.10 to 0.15 gallon per square yard according to Section 7020, 3.01. No waiting period will be required before placing the widening.

### 3.02 <br> BASE WIDENING (Continued)

## C. Preparation of Subgrade:

1. Cut the width of the trench for the widening at least 6 inches greater than the base width of the widening according to the contract documents. If widening roadways with open ditches, provide ditches or drains from the widening trench at frequent intervals to allow subgrade drainage to side ditches.
2. Construct subgrade and subbase according to Section 2010.
3. Bring the subgrade to an elevation and cross-section such that, after being compacted to a minimum of $95 \%$ of maximum Standard Proctor Density, the surface will be at the required elevation.
4. Remove material, other than sand, that will not readily compact. Replace with material that will readily compact and roll that portion of the subgrade again. Use an appropriate roller complying with lowa DOT Article 2001.05.
5. While constructing the subgrade, maintain the soil in a condition sufficiently moist to facilitate compaction.
6. Check the finished subgrade with a template supported on the surface of the adjacent pavement. Clean the edge of the old pavement.

## D. Construction:

1. Place the HMA mixture in the number of lifts required to produce the required thickness. Do not allow the compacted thickness of the top lift to exceed $21 / 2$ inches.
2. The maximum compacted thickness of lower lifts may exceed 3 inches if the thicker lifts demonstrate satisfactory compaction. Maximum lift thickness shall be $41 / 2$ inches.
3. Do not place HMA on the surface of the existing pavement, and immediately remove any spilled base material.
4. Ensure that, after compaction, the constructed width conforms to the required width.
5. Promptly and thoroughly compact each lift. Comply with Section 7020, 3.01.
6. Place succeeding lifts of HMA material as soon as the previous lift has been compacted.
7. Obtain the lab density for that day's HMA paving from an lowa DOT-approved testing lab and based on the job mix formula design criteria.
8. Take density samples from the compacted material and test according to Section 7020, 3.04. Randomly locate samples in the area 6 inches from the base being widened to 6 inches from the outside edge of a given pass of the placing equipment. Notify the Jurisdiction the day prior to coring and testing to give the Jurisdiction the opportunity to witness coring and testing.
9. When the contract for base widening does not include resurfacing, construct the final surface of widening flush with, or no more than $1 / 8$ inch below, the surface of the old pavement.
10. Do not open the widening to traffic until it has cooled sufficiently to support the traffic without displacement or movement.

### 3.03 PROTECTION FROM TRAFFIC

## A. General:

1. Protect the new pavement and its appurtenances damages caused by traffic, both public and that of the Contractor's own employees and agents, at no additional cost to the Contracting Authority. This includes the erection and maintenance of warning signs, lights, fence, and barricades; flaggers to direct traffic; and pavement bridges or crossovers as appropriate.
2. Do not operate equipment with metal tracks, metal bucket blades, or metal motor patrol blades directly on new paving. Do not unload soil or granular materials, including base rock for storage and future reloading directly onto new paving.
B. End of Day's Run:
3. At the end of each day's run and at all side streets, erect and maintain safety barriers and fencing as necessary to protect the pavement from damage.
4. Install construction zone protection upon completion of paving operations. Leave protection in place and maintained until the pavement has cooled sufficiently to withstand traffic without damage.
5. Intermediate construction zone protection may be required for the purpose of opening the pavement for access to a side road, side street, or entrances.
C. Repair of Damages: At the discretion of the Engineer, and at no additional cost to the Contracting Authority, repair or replace any part of the pavement damaged by traffic or other causes occurring prior to final acceptance of the pavement.

### 3.04 DEFECTS OR DEFICIENCIES

## A. Repairs Required:

1. Remove and replace or repair pavement containing excessive cracks, deformities, deficiencies, or other defects at no additional cost to the Contracting Authority. The method of replacement or repair will be determined by the Engineer. Extended warranty may be approved by the Engineer.
2. Areas to be replaced will be determined by the Engineer. Complete all repairs according to Section 7040.

## B. Density Deficiencies:

1. The Engineer will obtain and test 7 samples for each lot according to lowa DOT Materials I.M. 204 Appendix F. The quality index for density of each lot will be determined by the following formula:

Density (Q.I.) =
(Average $\mathrm{G}_{\mathrm{mb}}$ )Field Lot - ((\% Density) specified X (Average Gmb) Lab Lot)
(Standard Deviation $\mathrm{Gmb}_{\mathrm{mb}}$ ) Field Lot
where $\mathrm{G}_{\mathrm{mb}}=$ bulk Specific Gravity of the mixture

### 3.04 DEFECTS OR DEFICIENCIES (Continued)

2. Payment will be adjusted according to the density requirements of Table 7020.02 for the quality index for density determined for the lot:

Table 7020.02: Pay Factor for HMA Pavement Density

| Density Index 7 Samples $^{\mathbf{1}}$ | Percent Payment |
| :---: | :---: |
| greater than 0.72 | 100 |
| 0.40 to 0.72 | 95 |
| 0.00 to 0.39 | 85 |
| less than 0.00 | 75 Maximum |

${ }^{1}$ Or 6 samples and 1 outlier. Only one outlier will be allowed.
No incentive payment for pavement density will be made.

## C. Thickness Deficiencies:

1. The Engineer will measure the cores according to lowa DOT Materials I.M. 337. All areas of uniform and similar thickness and width for the project will be divided into lots.
2. The thickness of the completed course will be measured to the nearest $1 / 8$ inch, exclusive of seal coat. All areas of uniform and similar thickness and width for the project will be divided into lots. The frequency specified for taking density samples from the surface lift will be used when measuring for completed thickness. However, samples that may not be tested for density because they are less than $70 \%$ of the intended thickness will be used for thickness, and in these particular instances, the additional samples of sufficient thickness that are used for density tests will not be measured for thickness. Thickness samples will be taken full depth of the completed course and after measurement; remove the density samples for the top layer from the core. If any of the measurements for a lot is less than the designated thickness, the quality index for thickness of that lot will be determined by the following formula:

Thickness (Q.I.) $=\frac{\text { Avg. Thickness }-(\text { Design Thickness }-0.50)}{\text { Max Thickness }- \text { Minimum Thickness }}$
3. Payment will be further adjusted by the appropriate percentage according to the quality index for thickness determined for that lot and the following table:

Table 7020.03: Pay Factor for HMA Pavement Thickness

| Thickness Index 7 Samples | Percent Payment <br> (Previously Adjusted for Density) |
| :---: | :---: |
| greater than 0.34 | 100 |
| 0.14 to 0.34 | 95 |
| 0.00 to 0.13 | 85 |
| less than 0.00 | 75 Maximum |

No incentive payment for pavement thickness will be made.

### 3.05 PAVEMENT SMOOTHNESS

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

### 3.05 PAVEMENT SMOOTHNESS (Continued)

## B. Profilograph:

1. If specified in the contract documents, comply with lowa DOT Section 2316 to measure pavement smoothness with a profilograph. Ensure the evaluation is certified according to lowa DOT Materials I.M. 341. Position the center wheel of the profilometer 6 feet from the centerline or the lane line.
2. Evaluate according to the smoothness requirements of Table 7020.04 and make surface corrections and/or price reductions. Surface corrections will be completed with no additional cost to the Contracting Authority. No incentive for pavement smoothness will be made.

Table 7020.04: Price Reduction for Pavement Smoothness

| Initial Profile Index <br> (inch/mile/segment) | New Pavements <br> (\$/segment) | Resurfaced Pavements <br> (\$/segment) |
| :---: | :---: | :---: |
| $12.1-22.0$ | Unit price | Unit price |
| $22.1-30.0$ | $\$ 500$ | $\$ 250$ |
| 30.1 and over ${ }^{1}$ | Grind only | Grind only |

${ }^{1}$ For segments with an initial index of 30.1 and over, grind the surface to a finish index of 22.0 or better. In lieu of accepting a price reduction and grinding the surface to a final index of 22.0 or better, the Contractor may elect to replace part or the entire segment.

### 3.06 QUALITY CONTROL

A. Provide Quality Management - Asphalt (QM-A) for bid items with HMA quantities exceeding 1,000 tons. On locally let projects, all testing normally conducted by the lowa DOT may be performed by the Jurisdiction or an independent testing laboratory hired by the Jurisdiction.

1. General: Follow the procedures and meet the criteria established in lowa DOT Article 2303.03, B; Section 2521; and Materials I.M. 510 and 511. Percent within Limits (PWL) stipulations in these documents is not required.
2. Mix Design - Job Mix Formula (JMF):
a. The Contractor is responsible for the JMF for each mixture.
b. Submit a completed JMF for approval to the materials lab designated by the Contracting Authority. Submit supporting documentation demonstrating the design process was followed and how the recommended JMF was determined. Include an economic evaluation when required according to lowa DOT Section 2303. Include trial and final proposed aggregate proportions and corresponding gyratory data. In addition, submit sufficient loose mixture and individual material samples for approval of the design if requested by the Engineer.
c. The person preparing the JMF must be lowa DOT certified in bituminous mix design.
d. If the JMF is not satisfactory, submit another JMF for review. An approved JMF will be required prior to beginning plant production.
3. Plant Production:
a. General:
1) Perform sampling and testing to provide the quality control of the mixture during plant production. Certified Plant Inspection according to lowa DOT Section 2521 is required.
2) Ensure personnel performing production quality control testing is lowa DOT certified for the duties performed.
3) Provide easy and safe access to the location in the plant where samples are taken.

## HOT MIX ASPHALT OVERLAYS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

HMA Overlays

### 1.02 DESCRIPTION OF WORK

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

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

Comply with Division 1 - General Provisions and Covenants.

### 1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

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

### 1.06 SCHEDULING AND CONFLICTS

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

None.

### 1.08 MEASUREMENT AND PAYMENT

Comply with Section 7020, 1.08, except as modified herein:
A. HMA Overlay by Ton:

1. Measurement: Measurement will be in tons of HMA overlay.
2. Payment: Payment will be at the unit price per ton of HMA overlay.
3. Includes: Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coats between layers, construction zone protection, and quality control.
B. HMA Overlay by Square Yards:
4. Measurement: Measurement will be in square yards for each different thickness of HMA overlay. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
5. Payment: Payment will be at the unit price per square yard for each thickness of HMA overlay.
6. Includes: Unit price includes, but is not limited to, asphalt mix with asphalt binder, tack coat, construction zone protection, and quality control.

## PART 2 - PRODUCTS

### 2.01 HMA OVERLAY MATERIALS

Comply with Iowa DOT Section 2303, with the following exception:
Follow the procedure outlined in lowa DOT Materials I.M. 510 for HMA mixture designs, except replace Table 1 in Appendix A, HMA Mixture Design Criteria with the SUDAS HMA Mixture Design Criteria (Table 7020.01) (Tables 2 through 4 in Appendix A still apply).

### 2.02 WARM MIX ASPHALT MATERIALS

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

### 2.03 RECYCLED ASPHALT MATERIALS

When recycled asphalt materials (RAM) are used and they exceed 20\% replacement of the total binder, the binder grades may need to be modified. Comply with lowa DOT Materials I.M. 510 .
A. Recycled Asphalt Pavement: If use of recycled asphalt pavement (RAP) is approved by the Jurisdiction, comply with lowa DOT Section 2303.
B. Recycled Asphalt Shingles: If use of recycled asphalt shingles (RAS) is approved by the jurisdiction, comply with lowa DOT Section 2303.

### 2.04 BINDER GRADES

A. Conventional Overlays: Use the specified binder grade meeting the following requirements.

Table 7021.01: Asphalt Binder for Local Agencies

| Asphalt Mixture |  | PG Binder |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Design Traffic ( $1 \times 10^{6}$ ESALs) | Mix <br> Designation | $\begin{array}{r} \text { Design } \\ \text { Traffic } \\ \left(1 \times 10^{6} \mathrm{ES}\right. \end{array}$ |  | Design Speed (MPH) |  |  |
| $\leq 0.3 \mathrm{M}$ | LT | $\leq 0.3 \mathrm{M}$ | and | $\leq 45$ | 58-28S | 58-28S |
| 0.3 M to 1 M | ST | 0.3 M to 1 M |  | > 45 | 58-28S | $\begin{gathered} \hline 58-28 \mathrm{~S} \text { or } \\ 58-34 \mathrm{~S}^{1} \end{gathered}$ |
| 0.3 M to 1 M | ST | 0.3 M to 1 M | and | 15 to 45 | 58-28S ${ }^{2}$ | $\begin{gathered} 58-28 \mathrm{~S}^{2} \text { or } \\ 58-34 \mathrm{~S}^{1,3} \\ \hline \end{gathered}$ |
| 1 to 10 M | HT | 1 to 10 M | and | 15 to 45 | 58-28H | 58-34H |
| Overlays | LT/ST/HT | $\leq 10 \mathrm{M}$ | and | 15 to 45 | $\begin{gathered} \hline 64-22 \mathrm{~S}^{4} \text { or } \\ 58-28 \mathrm{~S} \text { or } \mathrm{H} \end{gathered}$ | 58-28S or H |

[^2]
### 2.04 BINDER GRADES (Continued)

B. HMA Interlayer: Use PG 58-34E meeting AASHTO T 321 with minimum 100,000 cycles to failure. Comply with lowa DOT Materials I.M. 510A. Do not use RAP.
C. High Performance Thin Lift: Use PG 58-34E meeting AASHTO T-324 with minimum 90\% elastic recovery. Comply with lowa DOT I.M. 510A. Do not use RAS.

### 2.05 <br> HIGH PERFORMANCE THIN LIFT

A. Mix Design:

| Design Gyrations | 50 |
| :--- | :--- |
| Design Target (\%Gmm) | 3.0 |
| Film Thickness | 8.0 to 13.0 |
| Aggregate Quality | A |
| Minimum crushed content | $50 \%$ |
| FAA minimum | 40 |
| Minimum sand equivalency | 50 |
| VMA | $16 \%$ |
| Friction Aggregate | Minimum 50\% Type 4 or better |

B. Replacement: Do not use more than $15 \%$ binder replacement. Do not use RAS.
C. Hamburg Testing: Compact to $3.5 \%$ air voids. No more than 8 mm rutting in first 8,000 passes.
D. Gradation:

| Sieve Size | Minimum <br> Percent Passing | Maximum <br> Percent Passing |
| :---: | :---: | :---: |
| $11 / 2^{\prime \prime}$ |  |  |
| $1^{\prime \prime}$ |  |  |
| $3 / 8^{\prime \prime}$ | 91 | 100 |
| No. 4 |  | 90 |
| No. 8 | 27 | 63 |
| No. 16 |  |  |
| No. 30 |  |  |
| No. 50 |  |  |
| No. 100 |  | 10 |
| No. 200 | 2 |  |

### 2.06 NOMINAL AGGREGATE SIZE FOR ASPHALT OVERLAYS

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

## PART 3 - EXECUTION

### 3.01 HMA OVERLAY

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

## A. Preparation of Existing Pavement:

1. Remove pavement by milling as required by the contract documents. Mill to the depth, cross-section, or profile specified.
2. Sweep existing pavement with approved broom. Provide dust control during brooming.
3. If milling is not required, correct irregularities in existing pavement cross slope with partial patching, full-depth patching, and leveling base coat prior to placing the overlay. Use base or intermediate course mixes to correct irregularities. Surface course thickness per plan.

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

1. Apply tack coat prior to placement of thin lift overlay and HMA interlayer. Comply with Section 7020.
2. Compact with static steel wheel roller.

### 3.02 PROTECTION FROM TRAFFIC

Comply with Section 7020, 3.03.

### 3.03 DEFECTS OR DEFICIENCIES

Comply with Section 7020, 3.04.

### 3.04 PAVEMENT SMOOTHNESS

Comply with Section 7020, 3.05.

### 3.05 QUALITY CONTROL

A. General: Comply with Section 7020, 3.06.
B. Special Requirements for Thin Lift Overlays and HMA Interlayer:

1. Complete field voids for Class II compaction as defined in Iowa DOT Section 2303.
2. Sample and test at least one hot box per day of production unless otherwise approved by the Engineer. Apply lowa DOT Article 2303.05, A, 3 for AAD acceptance. Air void target is based on approved JMF.
3. Take at least one cold feed each day for gradation control.

### 3.06

REMOVAL OF PAVEMENT
Comply with Section 7040.

## PART 3 - EXECUTION

### 3.01 REMOVALS

A. Remove sidewalks, shared use paths, driveways, bricks, and curbs to the removal limits specified in the contract documents.
B. Saw pavement full depth in straight lines to the specified removal limits.
C. Remove to the specified removal limits without damage to adjacent property, trees, utilities, or pavement that are to remain in place.
D. Salvage and stockpile all bricks removed.
E. Grind or saw existing curbs at locations specified in the contract documents to install sidewalks, shared use paths, and driveways.
F. Dispose of rubble and debris resulting from removal operations.

### 3.02 SUBGRADE PREPARATION

## A. Shared Use Paths:

1. Subgrade Preparation: Comply with Iowa DOT Section 2109.
2. Special Subgrade Preparation:
a. Construct subgrade to final elevation.
b. Scarify and mix the top 6 inches of subgrade material to a width equal to that of the proposed pavement, plus 2 feet on each side.
c. Compact loose subgrade material with Type A compaction complying with Section 2010.
d. Proof roll compacted subgrade according to Section 2010.

## B. Sidewalks and Driveways:

1. Remove all vegetation and roots from ground surface.
2. Construct grade to final subgrade elevation.
a. Cut area: Remove all material that will be displaced by the sidewalk.
b. Fill area: Scarify the surface to be covered with embankment to a depth of at least 6 inches and compact. Construct embankment in lifts of 6 inches or less and compact each lift. Tamp surface with a mechanical tamper until firm and unyielding.
3. Remove all soft, spongy, or yielding spots and fill the void with suitable backfill material.

### 3.03 ADJUSTMENT OF FIXTURES

A. Adjust fixtures to conform to the finished pavement surface. Cooperate and coordinate with the utility agency to ensure proper fixture adjustment.
B. Comply with Sections 5020,6010 , or 8010 as appropriate.

### 3.04 PCC SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS

A. Form Setting: Comply with Section 7010 with the following additional requirements and exceptions.

1. Slip form paving equipment may be allowed in lieu of setting forms, if approved by the Engineer.
2. Wood forms are allowed.
3. Use of an automated subgrade trimmer is not required.
4. Set forms true to line and grade and hold them rigidly in place by stakes placed outside the forms and flush with or below the top edge of the forms.
5. Measure or stake as required to construct project elements. If either of the following is met and construction survey is not a bid item, the Contracting Authority will verify that form work complies with the design requirements:
a. The tolerance between the design running slope and the maximum allowable running slope is less than $1.0 \%$.
b. The tolerance between the design cross slope of the sidewalk, turning space, or shared use path and the maximum allowable cross slope is less than $0.5 \%$.

If adequate tolerances are contained in the design, the Contracting Authority will not verify the form work for the construction of sidewalks or shared use paths. If field adjustments cause changes that will bring the facility into the range of tolerances shown above, notify the Engineer prior to construction.

## B. Concrete Pavement Placement:

1. Shared Use Paths: Comply with Section 7010.
2. Sidewalk:
a. Maintain moist subgrade in front of paving operation
b. Deposit concrete on the subgrade as required to minimize rehandling to prevent segregation.
c. Hand spread with shovels, not rakes.
d. Place concrete as required to slightly overfill the space between the forms.
e. For thicknesses less than 5 inches, consolidate by knifing with hand tools. When thickness is 5 inches or greater, consolidate with hand or mechanical vibrators meeting 7010, 3.01, C, 3. Smooth by use of a straightedge.
f. Do not contaminate freshly mixed concrete with earth or other foreign materials.
3. Driveways: Comply with Figures 7030.101 and 7030.102 and Section 7010. The use of a paving machine is not required.

## C. Finishing:

1. Shared Use Paths and Driveways:
a. Comply with Section 7010.
b. Provide a burlap drag or broom finish.

## 2. Sidewalks:

a. Use a wood float to depress the large aggregate and create a dense surface.
b. Allow concrete to set until all shine has disappeared from the surface.
c. Smooth with a metal trowel until surface is free from defects and blemishes.
d. Construct joints by sawing or by using a jointer or groover tool.
e. Finish edges of sidewalk or driveway with an edging tool having a radius of approximately $1 / 2$ inch. Ensure tool marks do not appear on the finished surface.
f. Brush with a soft broom at right angles to the side forms to provide a non-skid surface.

### 3.04 PCC SIDEWALKS, SHARED USE PATHS, AND DRIVEWAYS (Continued)

D. Curing: When curing is specified in the contract documents, comply with Section 7010.
E. Form Removal: Comply with Section 7010.
F. Jointing:

1. Construction Joints:
a. Locate construction joints to provide uniform joint spacing.
b. Place a construction joint at the close of each day's work or when depositing of concrete is stopped for 45 minutes or more.
c. Form construction joint by using a header board. Set perpendicular to the surface and at right angles to the centerline.
2. Transverse Contraction Joints:
a. Shared Use Paths:
1) Space transverse joints equal to the width of the shared use path, or as specified in the contract documents.
2) Saw contraction joints according to Section 7010.
b. Sidewalks and Driveways:
3) Space sidewalk contraction joints equal to the width of the sidewalk.
4) Space driveway contraction joints so panel length does not exceed 12 feet.
5) Form transverse contraction joints to a depth of $11 / 4$ inches with a pointed trowel or jointing tool. In lieu of forming, joints may be sawed within 12 hours of placement with a $1 / 8$ inch blade saw to a depth of $1 / 3$ the pavement thickness. Use a straightedge if joints are sawed with a hand-held saw.
3. Longitudinal Contraction Joints:
a. Shared Use Paths and Sidewalks: Saw joint to $1 / 8$ inch wide and to a depth of $1 / 3$ the pavement thickness.
b. Driveways:
1) Space longitudinal contraction joints so panel width does not exceed 12 feet.
2) Form longitudinal contraction joints to a depth of $11 / 4$ inches with a pointed trowel or jointing tool. In lieu of forming, joints may be sawed with a $1 / 8$ inch blade saw to a depth of $1 / 3$ the pavement thickness. Use a straightedge if joints are sawed with a hand-held saw.

## 4. Isolation Joints:

a. Install isolation joints where sidewalks, shared use paths, or driveways abut roadway pavement, parking lots, buildings, and structures.
b. For a sidewalk constructed with a driveway, install an isolation joint on the property side of the sidewalk and a ' $C$ ' or ' $E$ ' joint on the street side of the sidewalk.
c. Install a $1 / 2$ inch or $3 / 4$ inch thick strip of preformed resilient joint material, according to Section 7010, to the full depth of concrete. Trim any isolation joint material protruding above the finished work to the level of the abutting concrete.
d. If the isolation joint is to be sealed, place the preformed material $1 / 2$ inch below the level of the abutting concrete.
5. Joint Sealing:
a. Do not seal construction or contraction joints in sidewalks, shared use paths, or driveways.
b. If sealing of expansion or isolation joints is specified in the contract documents, trim preformed joint material to a depth of $1 / 2$ inch below the concrete surface. Ensure the joint is clean and dry. Install joint sealant per manufacturer's recommendations.

HMA SHARED USE PATHS AND DRIVEWAYS
Comply with Section 7020.

### 3.06 BRICK SIDEWALKS

A. Brick Sidewalk with a Sand Base:

1. Comply with Figure 7030.203.
2. Use a cross-section and patterns as specified in the contract documents or approved by the Engineer.
3. Do not use broken bricks or materials with stained faces in the paving areas.
4. Set edge restraints true to line and grade along both edges of brick sidewalk.
5. Place bricks on smooth, compacted bedding sand and tightly set in place without gaps.
6. Compact bricks using a 3 to 5 ton roller or machine with a vibratory plate weighing a minimum of 100 pounds.
7. Tightly compact joints with brick sand/cement.

## B. Brick Sidewalks with a Concrete Base:

1. General:
a. Comply with Figure 7030.203.
b. Use a cross-section and patterns as specified in the contract documents or approved by the Engineer.
c. Do not use broken bricks or materials with stained faces in the paving areas.
d. Construct the concrete base to comply with PCC sidewalk construction specifications.
2. HMA Setting Bed:
a. Place $3 / 4$ inch depth control bars on the base to serve as guides for the striking board. Shim depth control bars as necessary to adjust bedding thickness and to ensure the top surface of pavers will be at the required finished grade.
b. Place HMA bedding material between the parallel depth control bars. Pull striking board over bars several times. After each pass, spread fresh bedding material over low or porous spots to produce a smooth and even setting bed. After placing and smoothing each section, advance depth control bars to next section. After removal of depth control bars and shims, carefully fill any depressions that remain.
c. While still hot, roll the HMA bedding with a power roller to a nominal depth of $3 / 4$ inch.
d. Ensure the joints in the concrete base do not project through the HMA setting bed.
e. Apply neoprene modified asphalt adhesive over the top surface of the cooled asphalt setting bed with notched trowel with serration not exceeding $1 / 16$ inch. Allow adhesive to dry to the touch before placing pavers.

## 3. Brick Pavers:

a. Place the pavers by hand in straight courses with hand tight joints and uniform top surface.
b. Sweep dry joint filler into joints until the joints are completely filled.
c. Fog surface lightly with water to cure cement.
d. Clean any cement stains from brick surface. Remove stains from other concrete surfaces.

### 3.06 BRICK SIDEWALKS (Continued)

4. Protection: Protect newly laid pavers at all times using panels of plywood. Panels can be advanced as work progresses; however, keep the plywood protection in areas that will be subjected to movement of materials, workers, and equipment. Take precautions in order to avoid depressions and protect paver alignment until cured and ready for pedestrian or vehicle traffic.

### 3.07 DETECTABLE WARNING INSTALLATION

A. Manufactured Panels:

1. Comply with Figure 7030.210.
2. Install according to manufacturer's recommendations.
3. Set panels in fresh concrete.
B. Brick Pavers:
4. Comply with Figure 7030.203.
5. Install according to Section 7030, 3.06.

### 3.08 TESTING

A. Slope for Sidewalks, Curb Ramps, Turning Spaces, and Shared Use Paths:

1. Complete slope measurements and documentation according to lowa DOT Materials I.M. 363.
2. At no additional cost to the Contracting Authority, remove and replace all sections not meeting PROWAG requirements as detailed in SUDAS Design Manual Section 12A-2.
B. Smoothness for Shared Use Paths and Driveways:
3. Check finished surface with a 10 foot straightedge placed parallel to the centerline. Mark areas showing high spots of more than $1 / 4$ of an inch in 10 feet.
4. If directed by the Engineer, correct marked areas by grinding down with an approved grinding tool to an elevation where the area will not show deviations in excess of $1 / 8 \mathrm{inch}$.
3.09 GRANULAR DRIVEWAY SURFACING

Comply with Iowa DOT Section 2315.

### 3.10 CLEANING

A. Remove all litter and construction materials or tools immediately after the end of the curing period.
B. Remove excess dirt from the site.
C. Broom clean completed sidewalks, shared use paths, and driveways.

### 3.11 TESTING

A. General: When testing is specified in the contract documents as the Contractor's responsibility, provide testing using the services of an independent testing laboratory approved by the Engineer.
B. Concrete Compression Tests: When the concrete volume placed on a single day exceeds 20 cubic yards, comply with the following test requirements. When deficiencies are encountered, comply with Section 7010, 3.07, E.

1. Prepare at least two test cylinders per day.
2. If the concrete volume placed on a single day exceeds 200 cubic yards, prepare two test cylinders for each 200 cubic yards placed.
3. Provide 7 and 28 calendar day tests according to ASTM C 39. Minimum compressive strength is 2,000 psi at 7 days and 4,000 psi at 28 days.
C. HMA Density and Thickness Tests: When the area of HMA placed on a single day exceeds 100 square yards, comply with the following test requirement. When deficiencies are encountered, comply with Section 7020, 3.04, A.
4. Prepare at least two cores per day.
5. If the area of HMA placed on a single day exceeds 2,000 square yards, prepare two cores for each 2,000 square yards placed.

### 3.12 SIDEWALK AND CURB RAMP COMPLIANCE

Compliance with cross slopes and grades, as well as all other elements, for sidewalks and curb ramps is crucial. If the construction cannot be completed as specified in the contract documents, it may be necessary to adjust slopes within the accepted legal limitations. Contact the Engineer prior to placement of the concrete if changes from the values specified in the contract documents are being made.

END OF SECTION

## PAVEMENT REHABILITATION

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Full and Partial Depth PCC Patches
B. Full and Partial Depth HMA Patches
C. Full Depth Composite Patches
D. Diamond Grinding
E. Milling
F. Cleaning and Filling Joints and Cracks
G. Curb and Gutter Replacement
H. Dowel Bar Retrofit

### 1.02 DESCRIPTION OF WORK

A. Construct full depth PCC, HMA, and composite patches.
B. Construct partial depth PCC and HMA patches.
C. Grind existing PCC pavement surface for profile improvement using a diamond grinder.
D. Mill the surface of HMA or PCC pavement to improve the surface profile and cross-section in preparation for resurfacing.
E. Clean and fill longitudinal and transverse joints and random cracks in PCC and HMA pavement.
F. Remove existing pavement and curb and gutter.
G. Install epoxy coated dowel bars on transverse joints and cracks.

### 1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. PCC mix design.
B. HMA mix design.

### 1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

### 1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. PCC: See Section 7010.
B. HMA: See Section 7020 .

### 1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.
1.07 SPECIAL REQUIREMENTS

None.
1.08 MEASUREMENT AND PAYMENT

## A. Full Depth Patches

1. Measurement: Measurement will be in square yards for each type of full depth patch. Patches less than 2 square yards in area will be considered 2 square yards.
2. Payment: Payment will be made at the unit price per square yard for each type of full depth patch.
3. Includes: Unit price includes, but is not limited to, sawing, removing, and disposing of existing pavement and reinforcing; restoring the subgrade; furnishing and installing tie bars and dowel bars; furnishing and placing the patch material, including the asphalt binder and tack coat; forming and constructing integral curb; surface curing and pavement protection; joint sawing and filling; and placing backfill and restoring disturbed surfaces.
B. Subbase Over-excavation:
4. Measurement: Measurement will be in tons of subbase material placed for authorized over-excavation.
5. Payment: Payment will be made at the unit price per ton of subbase material.
6. Includes: Unit price includes, but is not limited to, removal of existing subbase or subgrade, disposal of materials removed, furnishing and placing subbase material, and any additional excavation required for subbase placement.

## C. Partial Depth Patches:

1. Measurement: Measurement will be in square feet for each type of partial depth patch. Patches less than 1 square foot in area will be considered 1 square foot.
2. Payment: Payment will be made at the unit price per square foot for each type of partial depth patch.
3. Includes: Unit price includes, but is not limited to, sawing, removing, and disposing of existing pavement; furnishing tack coat or bonding agent; furnishing and placing the patch material; curing; joint filling (PCC patches only); placing backfill; and restoring disturbed surfaces.
4. Extra Payment: When partial depth patches are constructed to full depth at the direction of the Engineer, payment will be at 2 times the unit price per square foot for each type of partial depth patch.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

## D. Crack and Joint Cleaning and Filling, Hot Pour:

1. Measurement: Measurement will be in linear feet measured along the cracks or joints.
2. Payment: Payment will be made at the unit price per linear foot of crack and joint cleaning and filling.
3. Includes: Unit price includes, but is not limited to, furnishing crack and joint filler material and routing, sawing, cleaning, and filling joints or cracks.

## E. Crack Cleaning and Filling, Emulsion:

## 1. Crack Cleaning and Filling, Emulsion:

a. Measurement: Measurement will be in linear feet measured along the cracks. Map cracked areas will not be measured.
b. Payment: Payment will be made at the unit price per linear foot of crack cleaning and filling.
c. Includes: Unit price includes, but is not limited to, furnishing emulsified crack filler material, cleaning cracks, placing soil sterilant, and filling cracks.
2. Hot Mix Asphalt for Crack Filling:
a. Measurement: Measurement will be in tons of HMA used for filling cracks greater than 1 inch. Quantity will be based upon scale tickets. Mixture not used in the work will be deducted based upon scaled weights.
b. Payment: Payment will be made at the unit price per ton for HMA used in filling cracks over 1 inch.
c. Includes: Unit price includes, but is not limited to, cleaning, applying tack coat, and furnishing and placing HMA for crack filling.

## F. Diamond Grinding:

1. Measurement: Measurement will be in square yards for the area of diamond grinding.
2. Payment: Payment will be made at the unit price per square yard of diamond grinding.
3. Includes: Unit price includes, but is not limited to, diamond grinding pavement, testing for smoothness according to the contract documents, and removal of slurry and residue from the project site.

## G. Milling:

1. Measurement: Measurement will be in square yards for the area of milling.
2. Payment: Payment will be made at the unit price per square yard of milling.
3. Includes: Unit price includes, but is not limited to, milling pavement; furnishing water; and salvaging, stockpiling, and removing cuttings and debris.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

## H. Pavement Removal:

1. Measurement: Measurement will be in square yards. No deduction in area will be made for manholes, storm sewer intakes, valve boxes, or other structures less than 2 square yards in area. Pavement removal for patching is included as part of the patching item and will not be measured separately.
2. Payment: Payment will be made at the unit price per square yard.
3. Includes: Unit price includes, but is not limited to, sawing, breaking, removing, and disposing of existing pavement and reinforcing steel.

## I. Curb and Gutter Removal:

1. Measurement: Measurement will be in linear feet measured along the back of curb.
2. Payment: Payment will be made at the unit price per linear foot of curb and gutter removed.
3. Includes: Unit price includes, but is not limited to, sawing, breaking, removing, and disposing of existing curb and gutter.

## J. Dowel Bar Retrofit:

1. Measurement: Measurement will be by count of the number of dowel bars satisfactorily placed.
2. Payment: Payment will be made at the contract unit price per bar.
3. Includes: Unit price includes, but is not limited to, cutting the slots, preparing the slots, placing and grouting the bars, and curing the surface.
K. Sampling and Testing: Required sampling and testing for pavement repair and rehabilitation work is incidental to other project costs and will not be paid for separately.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. PCC:

1. Standard Patching: Use Class C mix complying with Section 7010. Comply with Iowa DOT Materials I.M. 401. Construct all patches as standard patches unless otherwise specified in the contract documents.
2. High Early Strength Patching: Use Class M mix complying with Section 7010. Do not use calcium chloride unless otherwise specified in the contract documents.
3. Partial Depth Patching: Use a coarse aggregate in concrete mix complying with lowa DOT Article 4109.02, Gradation No. 5 in the Aggregate Gradation Table.
B. HMA: Provide a minimum Low Traffic (LT) mixture complying with Section 7020, unless otherwise specified in the contract documents. Provide mixture with an asphalt binder meeting or exceeding PG 58-34S.
C. Crack and Joint Filler Material:
4. Hot Pour Crack and Joint Filler: Comply with lowa DOT Section 4136.
5. Emulsified Asphalt Crack Filler: Provide CRS-2 or CRS-2P emulsions complying with Iowa DOT Section 4140.
6. HMA for Filling Cracks:
a. Provide a $3 / 4$ inch, $1 / 2$ inch, or $3 / 8$ inch HMA mixture complying with Section 7020 , or a similar mixture from a commercial source subject to approval from the Engineer.
b. Upon approval of the Engineer, a high performance bituminous cold premix may be used, depending on the availability of the specified hot mix asphalt.
7. Blotting Material: Provide sand complying with lowa DOT Sections 4124 or 4125 , or similar sand approved by the Engineer.
8. Soil Sterilant: Provide soil sterilant as specified in the contract documents.
D. Primer or Tack Coat Bitumen: Comply with lowa DOT Article 2303.02.
E. Epoxy for Bonding Dowel and Tie Bars: Comply with lowa DOT Materials I.M. 491.11.
F. Tie Bars and Dowel Bars: Provide epoxy coated bars complying with lowa DOT Section 4151.
G. Subbase Material: Unless otherwise specified in the contract documents, use modified subbase complying with Section 2010.
H. Liquid Curing Compound: Comply with lowa DOT Section 4105.
I. Sand-cement Grout: Provide a sand-cement grout mixture with a ratio of one part water to one part sand and two parts cement.
J. Preformed Compression Relief Material: Provide $1 / 4$ inch polystyrene, $1 / 4$ inch polyethylene, $1 / 4$ inch Styrofoam, or 3/16 inch waxed coated cardboard.

### 2.01 MATERIALS (Continued)

K. Epoxy Coated Dowel Bars: Comply with Figure 7010.101 and lowa DOT Section 4151 for the length and diameter specified. Uniformly coat dowel bars with approved bond breaker according to lowa DOT Article 4151.02, B. Include tight fitting nonmetallic end caps that allow a minimum of $1 / 4$ inch movement at each end.
L. Dowel Chairs: Prevent movement of the dowel bar during grout placement with epoxy coated or nonmetallic dowel chair devices which provide a minimum clearance of $1 / 2$ inch between the bottom of the bar and the surface upon which the bar is placed and also between the bar and the end walls of the slot.
M. Caulking Filler: Any commercial caulk designed as a concrete sealant that is compatible with the grout material being used.
N. Foam Core Inserts: Provide $3 / 8$ inch $\pm 1 / 8$ inch thick closed cell foam core board filler faced with film, foil, or poster board material on both sides.
O. Rapid Set Patch Material: Provide a shrinkage compensated rapid set patch material meeting lowa DOT Materials I.M. 491.20 and the following strength requirements:

- 3 hour minimum compressive strength of 3,000 psi according to ASTM C 39 .
- 24 hour minimum compressive strength of $5,000 \mathrm{psi}$ according to ASTM C 39.
- 24 hour bond to dry PCC strength of 1,000 psi according to ASTM C 882 .

Extend rapid set patch material according to the manufacturer's recommendations using pea gravel meeting lowa DOT Section 4112 and the following gradation:

| Sieve Size | Percent Passing |
| :---: | :---: |
| $1 / 2$ inch | 100 |
| $3 / 8$ inch | 85 to 100 |
| No. 8 | 0 to 8 |

## PART 3 - EXECUTION

### 3.01 GENERAL

A. Conduct all operations to minimize inconvenience to traffic. Confine operations to one traffic lane, unless the road is to be closed to traffic. Minor encroachment into the adjacent lane, such as for sawing and installing forms, will be acceptable with the use of a flagger according to MUTCD.
B. Do not remove pavement for either full depth or partial depth patching unless the patch can be completed before the end of the working day.
C. Construct full depth and partial depth patches to the dimensions specified in the contract documents or as marked by the Engineer in the field. Construct all full depth patches to full panel width.
D. Make saw cuts parallel or perpendicular to the centerline.
E. Remove and dispose of materials not designated for salvage.
F. Restore the area outside the pavement by placing and compacting backfill material, placing topsoil, and sodding or seeding as specified in the contract documents.
3.02 FULL DEPTH PATCHING

## A. Pavement Removal:

1. Saw pavement to full depth at the edges of the patch. A second saw cut, 2 inches inside the initial saw cut, may be required to prevent damage to adjacent pavement.
2. Do not damage pavement that is to remain. Do not use heavy equipment adjacent to new concrete until the opening strength is achieved.

## B. Restoring Subgrade or Subbase:

1. Excavate 2 inches below the bottom of the existing pavement. If more than 2 inches is excavated, place and compact new subbase material as required to bring the subbase to a level 2 inches below the bottom of the existing pavement. Correct unauthorized overexcavation at no additional cost to the Contracting Authority.
2. Compact the exposed subgrade or subbase by a minimum of four complete passes with a plate-type vibratory compactor with a minimum force rating of 3,500 pounds.
3. When unstable material or excessive moisture is encountered, the Engineer may order removal and replacement of the unstable material.
a. Remove existing unstable subgrade or subbase, or both, to the depth directed by the Engineer.
b. Place and compact new subbase material as required to bring the subbase to a level 2 inches below the bottom of the existing pavement.

## C. Placing PCC Patches:

1. Equipment: Comply with lowa DOT Article 2301.03, A, specifications on equipment for standard concrete pavement.

### 3.02 FULL DEPTH PATCHING (Continued)

2. Tie Bars and Dowel Bars: Comply with Section 7010 and the figures in Sections 7010 and 7040 .
a. When there is a common line between two adjacent patches, a bent bar may be placed in a keyway and later straightened.
b. Coat dowel bars extending into the patch area with a bond breaker. Do not coat tie bars.
3. Forms: Comply with Section $7010,3.02$, D, as well as the following.
a. Use forms on all exposed edges and along the centerline for patches that extend into an adjacent lane, unless full pavement width patches are constructed.
b. Rigid wood forms may be used in lieu of steel.

## 4. Placing, Consolidation, and Finishing the Concrete:

a. Moisten the subbase or subgrade, or cover with a single layer of polyethylene film lapped at 12 inches for large areas.
b. Except for preplanned joints, place the patch continuously until the patch is completed.
c. When a delay of 45 minutes cannot be avoided, construct a day's work ('DW') joint.
d. Carefully place concrete into the patch area to avoid segregation; spread into place and consolidate with a mechanical vibrator. Place full lane width patches over 25 feet in length with a suitable finishing machine that has at least one vibrating screed. Avoid excessive vibrating.
e. Finish patches per Section 7010, 3.02, H.
f. For joints with tie bars, tool the edge. For joints with dowel bars, saw to a depth of approximately $11 / 8$ inch, leaving an opening of at least $3 / 8$ inch in width to provide a reservoir for joint filler.
g. Texture the patch to match the adjacent surface.
5. Curing: Comply with Section 7010, 3.02, I. Cure the concrete, including exposed vertical edges, immediately after the concrete has been finished and the surface water has evaporated.
6. Joints: Construct and fill joints according to Section 7010, 3.02. Place joints at locations specified in the contract documents.
7. Pavement Protection: Comply with Section 7010, 3.04.
8. Use of Pavement: Comply with opening strength requirements of Section 7010, 3.05. Maturity testing is not required.

## D. Placing HMA Patches:

1. Use equipment complying with lowa DOT Article 2303.03. Use of a paving machine is not required.
2. Apply tack coat to the vertical edges of the remaining pavement at a rate of 0.10 to 0.15 gallons per square yard.
3. Place HMA patch mixture in lifts that will not exceed 3 inches in thickness after compaction, with the top lift not exceeding 2 inches in thickness when compacted.
4. Compact each lift while hot by rolling or compacting with a vibratory compactor. Subsequent lifts may be placed as soon as the preceding lift has been properly compacted.

### 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 $\mathrm{T} / 2$ 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.
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 lowa 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.

### 3.04 DIAMOND GRINDING (Continued)

E. For multiple passes, ensure overlaps do not exceed 1 inch . Begin at the crown of the roadway, proceeding toward the pavement edge with each subsequent pass. Ensure each subsequent pass is at least as deep as the previous pass in order to provide transverse drainage. All passes are to begin and end at the same station location. Ensure no unground areas are left between passes. For grinding adjacent to an unground turn lane or other pavement surface, feather smoothly from the edge of the ground surface to the unground surface leaving no more than a $1 / 8$ inch ridge. If street surface to be ground includes a curb and gutter section, extend grinding to within 4 inches of the curb face and feather to provide proper drainage.
F. Assemble and adjust the grinding head as necessary during the project to produce the following tolerances on pavements with the indicated coarse aggregates. Both the distance between grooves and the texture depth must be within the specified range to be in compliance. Assemble the grinding head to produce the tolerances indicated below for the type of coarse aggregate in the pavement.

|  | Crushed Stone | Gravel/Quartzite |
| :--- | :---: | :---: |
| Width of Land Area Between <br> Grooves* | $0.090^{\prime \prime}$ to $0.110^{\prime \prime}$ | $0.080^{\prime \prime}$ to $0.095^{\prime \prime}$ |
| Texture Depth** | Target of $1 / 8^{\prime \prime}$ with average <br> between $1 / 16^{\prime \prime}$ and $3 / 16^{\prime \prime}$ |  |

*Based on an average of a minimum of ten measurements across the ground width for one pass.
**Based on an average of a minimum of six measurements across the ground width for one pass.
G. Prior to enforcement of the tolerances listed above, a test area 300 feet long and the width of the grinding head will be allowed for a new head that has been restacked, provided a surface texture in reasonable conformance with the specifications, as determined by the Engineer, is being produced.
H. Ensure the transverse slope of the ground pavement is uniform to a degree that there are no depressions or misalignment of slope greater than $1 / 4$ inch in 12 feet when tested by string line or straightedge placed perpendicular to the centerline.
I. Continuously remove all slurry or residue resulting from the grinding operations with a wellmaintained vacuum system and remove from the project limits. Ensure residue from grinding operations does not flow across lanes occupied by public traffic or into gutters, storm sewers, ditches, or other drainage facilities.
J. Measure smoothness with a 10 -foot straightedge. Regrind high spots to ensure no surface deviations greater than $1 / 8$ inch remain. When profilograph testing is specified in the contract documents, comply with lowa DOT Materials I.M. 341 and the following requirements:

1. Prior to performing any grinding work, provide a control profilogram for each lane and/or segment over 50 feet in length that is to be ground. Ensure pavement is relatively clean and free of debris prior to establishing the control profilogram.
2. Ensure each segment of the finished ground surface has a final profile index less than or equal to $35 \%$ of the control profilogram trace or 22 inches per mile, whichever is greater, and does not include any bumps exeeding $1 / 2$ inch in 25 feet.
3. Depressed pavement areas due to subsidence or other localized causes and areas where the maximum cut restricts further grinding will be excluded from testing with the profilograph when approved by the Engineer.
K. Recheck smoothness following any regrinding activities to ensure compliance with the above requirements.

### 3.05 MILLING

A. Use equipment complying with lowa DOT Article 2531.03, A.
B. Mill the entire pavement area designated to the depth specified in the contract documents. Mill in straight lines. Make sufficient passes, or cuts, such that all irregularities or high spots are eliminated.
C. Control milling operations to provide a surface that is true within a nominal tolerance of $1 / 4$ inch and $1 / 4$ inch at longitudinal joints where adjacent passes meet. The profile may be inspected by checking with a 10 foot surface checker placed parallel to the centerline. Correct variations greater than $1 / 4$ inch.
D. Load cuttings directly into dump trucks and remove the remaining small cuttings and debris from the street. Sweep the scarified surface with a rotary broom before opening to traffic. Unless otherwise specified in the contract documents, all materials removed are property of the Contractor.
E. Do not operate metal tracked equipment on streets, other than those being milled.
F. Ensure excessive dust does not become airborne during construction. Additional water may be required at any time for dust control.
G. Mill around manholes and utility valves. Correct any damage to manholes or valves by the milling operation at no additional cost to the Contracting Authority.
H. Do not leave a vertical drop of more than 2 inches at the centerline or lane line overnight. Taper the ends of milled sections subject to traffic to provide a uniform and gradual transition.

### 3.06 <br> CRACK AND JOINT CLEANING AND FILLING, HOT POUR

A. General:

1. Use equipment complying with lowa DOT Articles 2541.03 (HMA) and 2542.03 (PCC).
2. Rout or saw joints and cracks with an average opening of $3 / 8$ inch or less to provide a minimum sealant reservoir of $3 / 8$ inch wide by a nominal $1 / 2$ inch deep.

## B. Crack and Joint Cleaning:

1. Clean cracks or joints of existing joint filler material, backer rod, vegetation, dirt, and other foreign material.
2. Clean joints or cracks by air blasting or by other methods as necessary to remove debris.
3. If specified in the contract documents, clean wet sawn joints with high pressure water immediately after sawing to remove residue produced by the sawing operation.
4. When cleaned joints or cracks are contaminated before being filled, clean them again before filling.

## C. Crack and Joint Filling:

1. Ensure cracks and joints are dry prior to placement of filler material.

### 3.06 CRACK AND JOINT CLEANING AND FILLING, HOT POUR (Continued)

2. Heat, handle, and apply joint filler material to the proper level as specified in the contract documents and as recommended by the manufacturer.
a. PCC Pavement: Do not overfill joint or crack with filler material. Immediately remove filler material placed on the pavement surface.
b. HMA Pavement: Slightly overfill the entire crack reservoir with filler material. Smooth with a narrow V -shaped squeegee immediately after placement of the filler material to within $1 / 2$ inch on each side of the crack edge.
3. Place joint filler material when the pavement and ambient air temperatures are $40^{\circ} \mathrm{F}$ or higher. When near this minimum, additional air blasting or drying time, or both, may be necessary to ensure a satisfactory bond to the joint surfaces.
4. Lanes may be opened to traffic only after the filler material has set sufficiently so it will not pick up under traffic. Blotting material may be applied to the filler material, but only after the surface has set to avoid penetration of the blotting material into the filler material.

### 3.07 CRACK CLEANING AND FILLING, EMULSION

Use emulsified asphalt for filling cracks in HMA surfaces only. Do not use on PCC pavements.

## A. General:

1. Clean cracks with either high pressure air or water equipment. Do not use water when freezing temperatures exist or are forecasted.
2. Ensure vegetation is removed from cracks. Alternative cleaning methods may be necessary to remove vegetation.
3. When specified in the contract documents, apply a soil sterilant in crack prior to placing the filler material.
4. For filling cracks, use a hand operated wand or pouring pot, capable of placing the filler material into the crack and filling to the adjacent surface. Use a spout or nozzle small enough to place the filler material into the crack without soiling the adjacent surface.
5. Immediately after placement of the filler material, tightly spread the emulsion using a 2 inch, or less, V-shaped rubber-edged squeegee. Take proper measures to hold the filler in place and prevent runout at edge of pavement or at low areas.

## B. Cracks Wider Than 1 inch:

1. Clean the cracks of loose and spalled material, sand, and other foreign debris to a depth of 3 inches using high pressure water.
2. When specified in the contract documents, utilize additional methods to clean cracks of old crack filler.
3. Blow the cleaned cracks free of water with high pressure air.
4. Lightly apply a tack coat to the crack surfaces.

### 3.07 CRACK CLEANING AND FILLING, EMULSION (Continued)

5. Fill the cracks with hot mix asphalt.
a. Ensure mix is warm and pliable when placed.
b. Rod and tamp the mix into place level with the adjacent surface.
c. Place mixture prior to filling cracks with emulsion.
6. Place a thin application of emulsion over the hot mix asphalt and tightly spread with a squeegee.
C. Cracks $\mathbf{1 / 4}$ inch to $\mathbf{1}$ inch in Width:
7. Clean the cracks of loose and spalled material, sand, and other foreign debris with high pressure air or high pressure water. Clean crack down to sound material, but a depth greater than 3 inches will not be required.
8. When specified in the contract documents, utilize additional methods to clean cracks of old crack filler.
9. Fill cracks with emulsion filler material.

## D. Cracks Less Than $\mathbf{1 / 4}$ inch in Width:

1. Clean sufficiently to remove sand and other foreign debris.
2. Fill cracks with emulsion filler material.

## E. Map-cracked (Alligator) Areas:

1. Cover area with emulsion filler material.
2. Spread emulsion over area with squeegee, working emulsion into cracks. Provide a thin, smooth application.
3. Promptly cover the filler material with a light application of blotter material.

### 3.08 PAVEMENT REMOVAL

A. Saw full depth at pavement removal limits.
B. Extend pavement removal limits to existing joint lines as directed by the Engineer.
C. Protect existing pavement, beyond removal limits, from damage. Remove to a new saw line and replace, at no additional cost to the Contracting Authority, all concrete broken or damaged beyond the removal limits designated by the Engineer.

### 3.09 CURB AND GUTTER REMOVAL

A. Saw longitudinally along the existing gutter joint or at a location directed by Engineer. Saw transversely at the curb and gutter removal limits.
B. Remove existing curb and gutter without damaging the existing pavement to remain.

### 3.10 DOWEL BAR RETROFIT

## A. Cutting and Preparing Slots:

1. Cut slots to the required width and depth with gang saw capable of cutting a minimum of three slots in each wheel path simultaneously. Multiple cuts in each slot may be required.
2. Use 30 pound maximum pneumatic hammers operated at a 45 degree angle or less to remove concrete from the slots. Prevent damage to surrounding concrete. Smooth and level the bottom of the slots with a lightweight bush hammer.
3. Sandblast or waterblast to clean exposed surfaces of slot and fill transverse contraction joint on the bottom and sides of the slot with caulking filler.

## B. Placing Dowel Bars:

1. Set dowel bars at the depth shown on the plans with chair devices.
2. Ensure dowel bars are parallel to the centerline of the pavements and to the pavement surface.
3. Place dowel bars within $1 / 4$ inch of required alignment.
4. Center dowel bars over transverse joints or cracks so a minimum of 6 inches extends into adjacent panel.
5. Cut foam core material and place at center of dowel bar so the material is flush with the pavement surface or slightly recessed and in line with the joint or crack. Maintain foam core material in vertical position, tight to the slot edges during grout placement.

## C. Grouting:

1. Thoroughly moisten all surfaces of the slot immediately prior to filling with grout. Remove any excess water with compressed air.
2. Produce grout with a portable mixer and place immediately after mixing and before grout has attained initial set. Do not retemper grout with water.
3. Place grout according to manufacturer's recommendations. Consolidate with hand held vibrator. If pavement is to be diamond ground place grout $1 / 8$ inch higher than surrounding pavement. Place grout flush if the pavement is not to be ground.
4. Thoroughly coat grout with white pigment curing compound immediately after placement.
D. Re-establish Joints or Cracks: After grout has attained sufficient strength, re-establish joint or crack above the foam core insert within 8 hours of grout placement by means of sawing. If foam board is visible, sawing is not required.

END OF SECTION








## PERMEABLE INTERLOCKING PAVERS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Subgrade Preparation
B. Placement of Storage Aggregate
C. Placement of Filter Aggregate
D. Placement of Bedding Course
E. Placement of Permeable Interlocking Pavers
F. Quality Control
G. Protection of the Pavement

### 1.02 DESCRIPTION OF WORK

Construct permeable interlocking pavement for mitigation of stormwater runoff.

### 1.03 SUBMITTALS

A. Sample Pavers: Representative of the type and color proposed for the project.
B. Installation Instructions: Manufacturer's published installation instructions.
C. Material Certification: Submit certification letter from paver manufacturer indicating compliance with the ASTM specifications and the contract documents.
D. Bedding, Filter, and Storage Aggregates: Submit 5 pound samples of each aggregate type. Include aggregate type, source, gradation, and compacted void content.
E. Project Details: Include schedule, construction procedures, and quality control plan that describes material staging; paving direction; details of placement and compaction of the storage, filter, and bedding aggregate; and the paver installation procedures.
F. Involved Parties: Submit a list of all subcontractors, material suppliers, and testing laboratories.

### 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

Install a 5 foot by 5 foot mock-up paver area on the prepared substrate to determine joint sizes, lines, laying patterns, paver edge treatments, colors, and texture of the project. If approved by the Engineer, it may be incorporated into the project.

### 1.08 MEASUREMENT AND PAYMENT

A. Class 10, Class 12, or Class 13 Excavation: Comply with Section 2010, 1.08, E.
B. Engineering Fabric:

1. Measurement: Measurement will be in square yards for the surface area covered with engineering fabric. Both horizontal and vertical areas covered with engineering fabric will be measured.
2. Payment: Payment will be made at the unit price per square yard of engineering fabric.
3. Includes: Unit price includes, but is not limited to, placing and securing filter fabric and any overlapped areas.

## C. Underdrain:

1. Measurement: Each type and size of pipe installed will be measured in linear feet from end of pipe to end of pipe along the centerline of pipe, exclusive of outlets. The vertical height of cleanouts; the vertical height of observation wells; and lengths of elbows, tees, wyes, and other fittings will be included in the length of pipe measured.
2. Payment: Payment will be made at the unit price of each type and size of pipe.
3. Includes: Unit price includes, but is not limited to, furnishing and placing pipe, cleanouts, observation wells, and pipe fittings.

## D. Storage Aggregate:

1. Measurement: Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. Payment: Payment will be made at the unit price per ton of storage aggregate.
3. Includes: Unit price includes, but is not limited to, furnishing, hauling, placing, and compacting storage aggregate.

## E. Filter Aggregate:

1. Measurement: Measurement will be in tons based upon scale tickets for the material delivered and incorporated into the project.
2. Payment: Payment will be made at the unit price per ton of filter aggregate.
3. Includes: Unit price includes, but is not limited to, furnishing, hauling, placing filter, and compacting aggregate.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

## F. Permeable Interlocking Pavers:

1. Measurement: Measurement will be in square yards for the area of each type of permeable interlocking pavers installed. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. Payment: Payment will be made at the unit price per square yard of each type of permeable interlocking pavers.
3. Includes: Unit price includes, but is not limited to, testing, placement of bedding course, installing permeable interlocking pavers, placing joint/opening fill material, refilling joint after 6 months, and pavement protection.

## G. PCC Edge Restraint:

1. Measurement: Measurement will be in linear feet for each type and size of PCC edge restraint. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. Payment: Payment will be at the unit price per linear feet for each type and size of PCC edge restraint.
3. Includes: Unit price includes, but is not limited to, final trimming of subgrade or subbase, bars and reinforcement, joints and sealing, surface curing and pavement protection, safety fencing, and boxouts for fixtures.

## PART 2 - PRODUCTS

### 2.01 ENGINEERING FABRIC

Comply with lowa DOT Section 4196, requirements for subsurface drainage.
2.02 UNDERDRAIN
A. Provide slotted or perforated pipe(s) complying with the requirements for Type 1 Subdrain in Section 4040.
B. Provide 6 inch diameter collector pipes unless otherwise specified in the contract documents.
C. Provide 4 inch diameter lateral pipes unless otherwise specified in the contract documents.

### 2.03 <br> AGGREGATE

Provide crushed stone with $90 \%$ fractured faces. Wash all stone materials to ensure less than $2 \%$ passing the No. 200 sieve.
A. Storage Aggregate: Aggregate complying with lowa DOT Section 4122, Gradation No. 13, Class 2 durability (AASHTO M 43/ASTM D 448, Size 2).
B. Filter Aggregate: Aggregate complying with lowa DOT Section 4115, Gradation No. 3, Class 2 durability (AASHTO M 43/ASTM D 448, Size 57).
C. Bedding/Joint/Void Filler Aggregate: Crushed stone complying with lowa DOT Section 4125, Gradation No. 29 (AASHTO M 43/ASTM D 448, Size 8).

### 2.04 PERMEABLE INTERLOCKING PAVERS

A. Interlocking Concrete Pavers: Comply with ASTM C 936 for minimum $31 / 8$ inch thick pavers.
B. Clay Brick Pavers: Comply with ASTM C 1272 for minimum $23 / 4$ inch thick, Type F brick for PX applications.

### 2.05 <br> PCC EDGE RESTRAINT

Provide PCC edge restraint complying with Section 7010. A PCC edge restraint may be standard curb and gutter section, a vertical curb section, or a narrow concrete slab.

## Section 8030 - Temporary Traffic Control

Page No.
Part 1-General
1.01 Section Includes
1.02 Description of Work 1
1.03 Submittals 1
1.04 Substitutions 1
1.05 Delivery, Storage, Handling, and Salvaging 1
1.06 Scheduling and Conflicts 1
1.07 Special Requirements 1
1.08 Measurement and Payment 2

Part 2 - Products
2.01 General 3
2.02 Signs 3
2.03 Channelizing Devices 3
2.04 Miscellaneous Products 4
2.05 Equipment 4
2.06 Flaggers 4

Part 3 - Execution
3.01 Installation 5
3.02 Maintenance 5
3.03 Quality Control 5

Figures
Temporary Traffic Control General Information
8030.101

Work off of Pavement with Minor Encroachment onto Traveled Way
8030.102

Work in Center of Low Volume Street
8030.103

Lane Closure on Low Volume Street (Self-Regulating)
8030.104

Lane Closure for Short-Term or Moving Operations Using a Single Flagger
8030.105

Lane Closure on Two-Lane Road Using Two Flaggers
8030.106

Work in Vicinity of Roadway-Rail Grade Crossing

## Section 8030 - Temporary Traffic Control (Continued)

Traffic Control for Outside Lane Closure of Street with Continuous Left Turn Lane
Traffic Control for Closure of Continuous Left Turn Lane
Lane Closure on Multi-Lane Street
Lane Closure at an Intersection
Lane Closure on the Far Side of an Intersection
Closure of Turn Lane
Closure in Center of Intersection
Moving Operations on Two Lane Roads
Street or Road Closure
Sidewalk Detour
Sidewalk Diversion
Closure of Marked or Unmarked Crosswalk

## Figure No.

8030.108
8030.109
8030.110
8030.111
8030.112
8030.113
8030.114
8030.115
8030.116
8030.117
8030.118
8030.119

### 2.05 POLES, HEADS, AND SIGNS (Continued)

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 lowa DOT Article 2408.03, B.
h. Provide non-shrink grout (complying with lowa DOT Materials I.M. 491.13) or a rodent guard (complying with lowa DOT Materials I.M. 443.01) for placement between the pole base and the foundation.
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.

## 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 lowa DOT Materials I.M. 453.08.
b. Anchor Bolts:
3) Use straight full-length galvanized bolts.
4) Comply with ASTM F 1554, Grade 105, S4 ( $-20^{\circ} \mathrm{F}$ ).
5) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
6) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
7) Do not bend or weld anchor bolts.
c. Nuts:
8) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
9) Use heavy hex.
10) Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.
11) Nuts may be over-tapped according to the allowance requirements of ASTM A 563.
12) 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 $850^{\circ} \mathrm{F}$. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

### 2.05 POLES, HEADS, AND SIGNS (Continued)

## 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 $41 / 2$ inches and provided with a pole cap. Supply base collar for poles with shaft lengths greater than 10 feet.
c. Pedestal Base: Cast aluminum, square in shape, with a handhole.
1) Handhole: Minimum of 6 inches by 6 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools.
2) Base: Minimum weight of 20 pounds with a four bolt pattern uniformly spaced on a $121 / 2$ inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.
2. Anchor Bolts: Four $3 / 4$ inch by 15 inch steel, hot dip galvanized anchor bolts complying with ASTM F 1554, Grade 36, with right angle bend at the bottom end, complete with all hardware required for installation.

## E. Pedestrian Push Button Post:

1. Material:
a. Post: Standard weight (Schedule 40) pipe complying with ASTM F 1083, galvanized inside and out; $21 / 2$ inches in diameter.
b. Cap: Waterproof cap complying with ASTM F 626.
c. Anchor Bolts: Four $1 / 2$ inch by 24 inch steel, hot dip galvanized anchor bolts complete with all hardware required for installation.
d. Non-shrink Grout: Comply with lowa DOT Materials I.M. 491.13 or a rodent guard (complying with lowa DOT Materials I.M. 443.01) for placement between the post base and the foundation.
e. Base Plate: Provide a 5 inch square, $1 / 2$ inch thick galvanized steel base plate with a $41 / 2$ inch bolt circle.

## F. Traffic Signs:

1. Comply with lowa 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, and sheeting.


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## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. Provide pavement marking materials that comply with lowa DOT Section 2527.
B. Pavement marking materials include:

1. Wet, retroreflective removable tape markings
2. Painted Pavement Markings:
a. Waterborne and solvent based paint pavement markings
b. Durable paint pavement markings
c. High-build waterborne paint pavement markings
3. Regular marking tape
4. Temporary delineators
5. Raised pavement markers
6. Channelizer markers
7. Preformed polymer tape
8. Removable, nonreflective preformed tape
9. Profiled pavement marking tape
10. Intersection marking tape

## PART 3 - EXECUTION

### 3.01 EQUIPMENT

A. General: Utilize equipment complying with lowa DOT Section 2527.
B. Pavement Marking Equipment:

1. Capable of placing two lines simultaneously with either line in a solid or intermittent pattern in yellow or white.
2. Capable of applying reflectorizing spheres at the required rate with a pressurized system.
3. All guns in full view of the operator at all times.
4. Equipped with a metering device to register the accumulated length of each gun, each day.
5. Designed so the pressure gages of each proportioning pump are visible to the operator at all times during operation to monitor fluctuations in pressure.
6. Capable of applying paint without dilution.

## C. Pavement Marking Removal:

1. Operates without the release of dust.
2. Recovers all removed material.
3. Includes a waste collection and transfer system and for dry wastes, ensure the system incorporates high-efficiency particulate absorption (HEPA) methods and equipment.

## D. Pavement Grooving:

1. Utilize grooving equipment with stacked diamond cutting heads mounted on a floating head with controls capable of providing uniform depth and alignment.
2. If pavement is grooved by dry cutting, provide equipment that is self vacuuming.
3. When requested, make available to the Engineer a caliper, depth gage, or depth plate, for use in measuring groove depth.

### 3.02 <br> CONSTRUCTION

A. General:

1. Comply with the requirements of the MUTCD for traffic control during all pavement marking operations.
2. Install all pavement markings according to the product manufacturer's published recommendations.

## TEMPORARY TRAFFIC CONTROL

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Temporary Traffic Control Devices
B. Installation
C. Maintenance
D. Quality Control

### 1.02 DESCRIPTION OF WORK

This part of the specifications includes materials, equipment, and procedures for traffic control during construction. Furnish, erect, operate, maintain, move, and remove all traffic control devices required. Comply with the current edition of the MUTCD as adopted by the lowa DOT.

### 1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Submit a traffic control plan for review and approval prior to installation.
B. Submit proposed modifications to the traffic control plan for review and approval prior to making changes.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

Comply with Division 1 - General Provisions and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

### 1.07 SPECIAL REQUIREMENTS

A. When a bid item for Temporary Traffic Control is included on the proposal form, comply with this section for measurement and payment
B. When the proposal form does not include a bid item for temporary traffic control, all costs incurred by the contractor for temporary traffic control are incidental to other work and will not be paid for separately.
C. Provide 10 calendar days advance notification of a pedestrian path closure to the Engineer and the National Federation of the Blind of lowa (www.nfbi.org).

### 1.08 MEASUREMENT AND PAYMENT

## A. Temporary Traffic Control:

1. Measurement: Lump sum item; no measurement will be made.
2. Payment: Payment will be at the lump sum price for temporary traffic control. Proportional payments will be made equal to the percentage of the dollar amount paid on the original contract amount.
3. Includes: Lump sum price includes, but is not limited to, installation, maintenance, and removal of temporary traffic control; total roadway closures with installation and removal of detour signing as shown in the contract documents; removal and reinstallation or covering of permanent traffic control devices that conflict with the temporary traffic control plan; monitoring and documenting traffic control conditions; and flaggers. When required in the contract documents, the following are also included in traffic control unless a separate bid item is provided: portable dynamic message signs, temporary barrier rail, temporary flood lighting, and pilot cars.

## PART 2 - PRODUCTS

### 2.01 GENERAL

Use products and materials complying with Part 6 of the MUTCD.
SIGNS
A. Material: Sheet aluminum, galvanized steel, plywood, or flexible roll-up material complying with lowa 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 <br> $(\mathbf{m p h})$ | Minimum Sign <br> Size | Minimum Uppercase <br> Letter Size | Minimum Plaque Size |
| :---: | :---: | :---: | :---: |
| $<25$ | $30^{\prime \prime} \times 30^{\prime \prime}$ | $4^{\prime \prime}$ | $18^{\prime \prime} \times 18^{\prime \prime}$ |
| $25-35$ | $36^{\prime \prime} \times 36^{\prime \prime}$ | $5^{\prime \prime}$ | $18^{\prime \prime} \times 24^{\prime \prime}$ |
| $>35$ | $48^{\prime \prime} \times 48^{\prime \prime}$ | $7^{\prime \prime}$ | $24^{\prime \prime} \times 30^{\prime \prime}$ |

C. Retroreflective Sheeting: Comply with lowa DOT Article 4186.03.
D. Posts:

1. Wood Posts: Comply with lowa DOT Section 4164.
2. U-Shaped Rail Steel Posts: 3.0 pounds per foot.
3. Perforated Square Steel Tube Posts: $21 / 4$ or $21 / 2$ inch square 12 gage perforated steel tubing.
E. Portable Sign Stands: Crashworthy per the test and evaluation criteria of NCHRP Report 350 or Manual on Assessing Safety Hardware (MASH). Must be stable in windy conditions.

### 2.03 <br> CHANNELIZING DEVICES

Channelizing devices include cones, channelizers, tubular markers, vertical panels, drums, and barricades.
A. Retroreflective Sheeting: Comply with lowa 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.

## MISCELLANEOUS PRODUCTS

A. Orange Mesh Safety Fence: Comply with lowa DOT Article 4188.03.
B. Temporary Barrier Rail: Unless otherwise specified, use precast concrete units. Comply with lowa 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 lowa 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 lowa 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 lowa DOT Flagger's Handbook to and review by each flagger.
2. Presentation of the current lowa 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 3 - EXECUTION

### 3.01 INSTALLATION

A. General: Install temporary traffic control devices according to the Section 8030 figures and Part 6 of the MUTCD.
B. Sign Posts: For durations more than 3 consecutive calendar days, mount the signs on fixed posts. For durations 3 consecutive calendar days or less, mount the signs on fixed posts or movable skids.
C. Temporary Barrier Rail: Place at locations specified in the contract documents. Tie and anchor units as shown on lowa DOT Standard Road Plan BA-401.
D. Sandbags: Use sandbags to anchor all traffic control devices subject to movement by wind. Do not place sandbags on tops of barricades, drums, or vertical panels.
E. Conflicting Signs: Cover or remove signs with messages conflicting with temporary traffic control as approved or directed by the Engineer.
F. Modifications: Submit proposed traffic control plan modifications to the Engineer for review and approval prior to making changes.

### 3.02 MAINTENANCE

A. General: Promptly repair, replace, reposition, or clean traffic control devices, as needed, or as directed by the Engineer.
B. Non-working Hours: At the end of working hours, remove, cover, or turn down traffic control devices intended for working hours only.

### 3.03 QUALITY CONTROL

A. Traffic Control Technician: Maintain a traffic control technician on staff, responsible for the Contractor's traffic control quality control program, that has attended and passed the exam in one of the following classes:

1. ATSSA Traffic Control Technician
2. IMSA Work Zone Traffic Control
3. Minnesota DOT Traffic Control Supervisor
4. Texas Engineering Extension Service Work Zone Traffic Control
B. Monitoring and Documentation: Provide 24 hour mobile phone number for the traffic control technician. On a daily basis, perform the following quality control work associated with monitoring and documenting traffic control conditions.
5. Review all traffic control operations for compliance with the contract documents.
6. Monitor traffic operations and submit proposed traffic control plan changes to the Engineer for approval.
7. Coordinate all changes to the traffic control plan.
8. Coordinate all traffic control operations, including those of subcontractors and suppliers.

### 3.03 QUALITY CONTROL (Continued)

5. Maintain a traffic control diary to be submitted at the end of the project or as requested by the Engineer, with the following information:
a. Listing and locating traffic control used each day, referenced to appropriate plan sheet or standard.
b. All reviews of traffic control devices and operations, whether satisfactory or unsatisfactory, and corrections made.
c. Approved changes to traffic control specified in the contract documents.
d. Incidentals affecting the efficiency and safety of traffic.
e. A list of trained flaggers used.

END OF SECTION



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## Table of Contents

Section 9010 - Seeding Page No.
Part 1-General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 2
1.05 Delivery, Storage, and Handling ..... 2
1.06 Scheduling and Conflicts ..... 2
1.07 Special Requirements ..... 2
1.08 Measurement and Payment ..... 2
Part 2 - Products
2.01 Seed ..... 4
2.02 Seed Mixtures and Seeding Dates ..... 8
2.03 Fertilizer ..... 12
2.04 Sticking Agent ..... 12
2.05 Inoculant for Legumes ..... 12
2.06 Water ..... 12
2.07 Mulch ..... 13
Part 3 - Execution
3.01 Equipment ..... 15
3.02 Area of Seeding ..... 16
3.03 Finish Grading and Topsoil ..... 16
3.04 Conventional Seeding ..... 16
3.05 Hydraulic Seeding ..... 19
3.06 Pneumatic Seeding ..... 20
3.07 Watering ..... 20
3.08 Re-seeding ..... 20
3.09 Clean Up ..... 20
3.10 Acceptance and Warranty ..... 21
Section 9020 - Sodding
Page No.
Part 1-General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1
1.05 Delivery, Storage, and Handling ..... 1
1.06 Scheduling and Conflicts ..... 1
1.07 Special Requirements ..... 2
1.08 Measurement and Payment ..... 2
Part 2 - Products
2.01 Sod ..... 3
2.02 Fertilizer ..... 3
2.03 Stakes ..... 3
2.04 Water ..... 3
Part 3 - Execution
3.01 Preparation of Sodbed ..... 4
3.02 Fertilizing - First Application ..... 4
3.03 Sod Installation ..... 4
3.04 Watering ..... 5
3.05 Fertilizing - Second Application ..... 5
3.06 Maintenance ..... 5
3.07 Clean Up ..... 5
3.08 Acceptance ..... 5
Section 9030 - Plant Material and Planting
Part 1 - General
1.01 Section Includes ..... 1
1.02 Description of Work ..... 1
1.03 Submittals ..... 1
1.04 Substitutions ..... 1

### 2.07 MULCH

## A. For Conventional Seeding:

1. Material used as mulch may consist of the following:
a. Dry cereal straw (oats, wheat, barley, or rye)
b. Prairie hay
c. Wood excelsior composed of wood fibers, at least 8 inches long, based on an average of 100 fibers, and approximately 0.024 inch thick and 0.031 inch wide. The fibers must be cut from green wood and be reasonably free of seeds or other viable plant material.
2. Do not use other hay (bromegrass, timothy, orchard grass, alfalfa, or clover).
3. All material used as mulch must be free from all noxious weed, seed-bearing stalks, or roots and will be inspected and approved by the Engineer prior to its use.
4. The Contractor may use other materials, subject to the approval of the Engineer.

## B. For Hydraulic Seeding:

1. Wood Cellulose:
a. Use material that is a natural or cooked cellulose fiber processed from whole wood chips, or a combination of up to $50 \%$ of cellulose fiber produced from whole wood chips, recycled fiber from sawdust, or recycled paper (by volume).
b. Product contains a colloidal polysaccharide tackifier adhered to the fiber to prevent separation during shipment and avoid chemical co-agglomeration during mixing.
c. Form a homogeneous slurry of material, tackifier, and water.
d. Use a slurry that can be applied with standard hydraulic mulching equipment.
e. Dye the slurry green to facilitate visual metering during application.
f. Do not use materials that have growth or germination-inhibiting factors or any toxic effect on plant or animal life when combined with seed or fertilizer.
2. Bonded Fiber Matrix (BFM):
a. Manufactured to be applied hydraulically.
b. Dyed green to facilitate visual metering.
c. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
d. Meet the following requirements:
1) Contain non-toxic tackifiers that upon drying become insoluble and nondispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
2) Contain no germination or growth inhibiting factors and do not form a waterresistant crust that can inhibit plant growth.
3) Hydraulic mulch that is completely photo-degradable or biodegradable.
4) Contain a minimum of $90 \%$ organic material according to ASTM D 2974.
5) Have a rainfall event ( R -factor) of $140<\mathrm{R}$ according to ASTM D 6459.
6) Have a cover factor of $\mathrm{C} \leq 0.03$ according to ASTM D 6459 .
7) Vegetation Establishment of $400 \%$ minimum according to ASTM D 7322.
8) Water Holding Capacity $600 \%$ minimum according to ASTM D 7367.
3. Mechanically-Bonded Fiber Matrix (MBFM):
a. Manufactured to be applied hydraulically.
b. Dyed green to facilitate visual metering.
c. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.

### 2.07 MULCH (Continued)

d. Meet the following requirements:

1) Contain non-toxic tackifiers that upon drying become insoluble and nondispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
2) Contain no germination or growth inhibiting factors and do not form a waterresistant crust that can inhibit plant growth.
3) Hydraulic mulch that is completely photo-degradable or biodegradable.
4) Contain a minimum of $90 \%$ organic material according to ASTM D 2974.
5) Have a rainfall event ( R -factor) of $175<\mathrm{R}$ according to ASTM D 6459.
6) Have a cover factor of $\mathrm{C} \leq 0.01$ according to ASTM D 6459.
7) Vegetation establishment of $500 \%$ minimum according to ASTM D 7322.
8) Water holding capacity of $700 \%$ minimum according to ASTM D 7367.
C. For Pneumatic Seeding: Use compost meeting the following requirements.
1. Derived from a well-decomposed source of organic matter.
2. Produced using an aerobic composting process, meeting Code of Federal Regulations (CFR) 503 for time, temperature, and heavy metal concentrations.
3. No visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
4. Certified by the U.S. Composting Council's Seal of Testing Assurance (STA) program.
5. Conforms to chemical, physical, and biological parameters of AASHTO MP 10-03, with the following additional requirements:
a. Follow U.S. Composting Council's TMECC guidelines for all testing.
b. Organic Matter Content: 30\% minimum.
c. pH : between 6.0 and 8.0.
d. Maturity (growth screening): Minimum $90 \%$ emergence for all compost to be vegetated.
e. Particle Size:

| Sieve Size | Percent Passing* |
| :---: | :---: |
| $2^{\prime \prime}$ | 100 |
| $1^{\prime \prime}$ | $90-100$ |
| $3 / 4^{\prime \prime}$ | $65-100$ |
| $3 / 8^{\prime \prime}$ | $0-75$ |

[^3]
## PART 3 - EXECUTION

### 3.01 EQUIPMENT

A. Aerial Equipment: When aerial application of seed and fertilizer is specified, use aerial equipment capable of providing a uniform distribution of seed and fertilizer on the specified area.
B. Compost Blower: A compost blower is pneumatic equipment to blow compost over the desired area. It may be equipped with a supplemental seed injection system. Use equipment with sufficient power to cover the required area without driving on the prepared seedbed.
C. Cultipacker: Use a pull-type cultipacker with individual rollers or wheels. Cultipackers with sprocket-type spacers between the wheels may be used. The cultipacker must produce a corrugated surface on the area being compacted. Operate the cultipacker separately from all other operations, and do not attach the cultipacker to the seeder or disk, unless combined cultipacker seeder is manufactured to operate as a unit. Make provisions for addition of weight.
D. Disk: When preparing a seedbed on ground having heavy vegetation, use a disk with cutaway blades. Make provisions for the addition of weight to obtain proper cutting depth.
E. Drop Seeder: Use one piece of equipment containing pulverizer rollers in front of the seed tubes, ground driven seed meters, maximum seed tube spacing of 3 inches delivering seed between the pulverizer rollers and packer wheels, and packer wheels that press and firmly pack seed into the soil.
F. Endgate Cyclone Seeders: Endgate cyclone seeders must be suitably mounted. Movement must be provided by mechanical means. The seed drops through an adjustable flow regulator onto a rotating, power driven, horizontal disk or fan.
G. Expanded Mesh Roller: Use equipment that is an open grid type or a cultipacker type, modified by covering with expanded metal mesh.
H. Field Tiller: Use equipment designed for the preparation of the seedbed to the degree specified.
I. Gravity Seeders: Gravity seeders must provide agitation of the seed, have an adjustable gate opening, and uniformly distribute seed on the prepared seedbed. Use a seed hopper equipped with baffle plates spaced no more than 2 feet apart. The baffle plates must extend from the agitator shaft to within approximately 2 inches of the top of the seed hopper. Wind guards are required to facilitate seeding when moderate wind conditions exist and when ordered by the Engineer. Place wind guards in front or in back (or both) of the seed outlet and extend them to near the ground line. This seeder may be used for application of fertilizer.
J. Hand Cyclone Seeders: Hand cyclone seeders are carried by the person dispensing seed. The seed drops through an adjustable flow regulator onto a rotating, hand driven, horizontal disk or fan.
K. Hydraulic Seeder: Use hydraulic seeding equipment with a pump rated at no less than 100 gallons per minute. Inoculant, seed, and fertilizer may be applied in a single operation. The equipment must have a suitable working pressure and a nozzle adapted to the type of work. Supply tanks must have a means of agitation. Calibrate tanks and provide them with a calibration stick or other approved device to indicate the volume used or remaining in the tank.
L. Mowers: Use mowers that are rotary, flail, disk, or sickle type. Do not use mowers that bunch or windrow the mowed material.

### 3.01 EQUIPMENT (Continued)

M. Mulch Anchoring Equipment: Use mulch anchoring equipment designed to anchor straw or hay mulch into soil by means of dull blades or disks. It should have flat blades or disks, may have cutaway edges and must be spaced at approximately 8 inch intervals. The mulch anchoring equipment must be pulled by mechanical means and weigh approximately 1,000 pounds. When directed by the Engineer, increase the weight by addition of ballast.
N. Native Grass Seed Drill: Use a native grass seed drill designed to provide uniform distribution of native grass and wildflower seeds. Provide separate seed boxes to apply both small seeds as well as fluffy bearded seeds. If a no-till attachment is specified, use an attachment of the same manufacturer as the drill.
O. Pneumatic Seeder: Use an air blown system with sufficient power and hose to reach 300 feet.
P. Pulverizer: Use equipment designed to break up compacted soil to prepare a seedbed.
Q. Rotary Tiller: Use equipment with rotary-type blades designed for the preparation of seedbed to the degree specified.
R. Slit Seeder: Use a gas, diesel or electric powered mechanical slit seeder that is capable of cutting vertical grooves a maximum of $1 / 4$ inch deep into the soil with a maximum horizontal blade spacing of 3 inches, deposits metered seed directly after the formation of the vertical grooves, and contains packer wheels that press and firmly pack seed into the soil.
S. Slope Harrow: Use a slope harrow, consisting of a rolling weight attached by heavy chain to a tractor. The chain must be of suitable length, with picks attached, and a means of rotating the picks as the rolling weight is pulled in a direction parallel to the movement of the tractor.
T. Spike Tooth Harrow: Use equipment designed to provide adjustment of the spike teeth to level the ground, or to be used as specified by the Engineer.
U. Straw Mulching Machine: Use a machine to uniformly apply mulch material over the desired area without excessive pulverization. Excessive pulverization is the general absence of straw longer than 6 inches after distribution.

## AREA OF SEEDING

Place seed only in the areas specified in the contract documents. Repair damaged areas that are disturbed outside the contract limits at the expense of the Contractor. Do not disturb areas having a satisfactory growth of desirable grasses or legumes.

### 3.03 FINISH GRADING AND TOPSOIL

See Section 2010 for finish grading and topsoil placement.

### 3.04 CONVENTIONAL SEEDING

A. Order of Operations: 1) fertilizing, 2) seedbed preparation, 3) seed preparation/application, and 4) mulching.
B. Fertilizing:

1. Apply fertilizer immediately prior to seedbed preparation. Incorporate the fertilizer into the top 2 to 3 inches of topsoil during the seedbed preparation. Equipment that results in ruts or excessive compaction will not be allowed.
2. Do not apply fertilizer with native grass, wildflower, or wetland seeding.

### 3.04 CONVENTIONAL SEEDING (Continued)

## C. Seedbed Preparation, Permanent:

1. Limit preparation of seedbed to areas that will be seeded immediately upon completion.
2. Work areas accessible to field equipment to a depth of no less than 3 inches. Use mechanical rotary tillage equipment for the preparation of seedbed on earth shoulders, urban or raised medians, and rest areas. Prepare by hand areas inaccessible to field machinery, to a depth of no less than 2 inches. Use care that the entire width of the shoulder and areas around headwalls, wingwalls, flumes, and other structures are prepared in the manner specified. Where weed growth has developed extensively, they may be disked into the ground. If weed growth develops sufficiently to interfere with proper seedbed preparation, mow the weeds and remove them from the project at no additional cost to the Contracting Authority.

Use crawler type or dual-wheeled tractors for seedbed preparation. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Harrow ridging in excess of 4 inches due to operation of tillage equipment prior to rolling with the cultipacker. Roll the area with no less than one pass of the cultipacker prior to permanent seeding.
3. Shape and fine grade to remove rills or gullies, water pockets, undesirable vegetation, and irregularities to provide a smooth, firm, and even surface true to grade and crosssection. For Type 1 (lawn seeding), prepare to a fine texture and without soil lumps. Coordinate preparation of all ditches designated for special ditch control with the seedbed preparation. Till parallel to the contours.
4. Smooth the seedbed with a cultivator-type tillage tool having a rake bar or a rock rake. Pick up and remove all debris, such as rocks, stones, concrete larger than 2 inches (1/2 inch maximum for lawn seeding), or roots and other objectionable material that will interfere with the seeding operation. A spring tooth cultivator may be used in lieu of a rock picker. Remove the rock by hand after each use of the cultivator; repeat the process until the soil is relatively free of rock as determined by the Engineer.
5. Choose equipment to minimize soil compaction. Operate equipment in a manner to minimize displacement of soil and disturbance of the design cross-section. Roll the area with at least one pass of the cultipacker. Remove ruts that develop during the sequence of operations before subsequent operations are performed. This must be completed just prior to seeding and the work approved by the Engineer before the seeding application.
D. Seedbed Preparation, Temporary: Till the soil to a minimum depth of 5 inches with a disk, harrow, or field cultivator.

## E. Seeding:

1. Seed Preparation:
a. Thoroughly mix all seed specified for the contract prior to placing the seed in the seed hopper. Provide 48 hours notice prior to mixing the seed, and give the Engineer an opportunity to witness the seed mixing. The mixing of a certified blue tag seed mix at an approved (by lowa Crop Improvement Association) seed conditioner's facility need not be witnessed.
b. Treat all legume seed with a commercial sticking agent to be applied prior to application of inoculant, or as a mixture when the sticking agent is compatible with other materials. A sticking agent is not required if a liquid formulation of inoculant is used. Use mechanical mixing equipment to apply sticking agent and inoculant on seed quantities over 50 pounds.

### 3.04 CONVENTIONAL SEEDING (Continued)

c. Inoculate all legumes with a standard product humus culture before being mixed with other seeds for sowing.
d. Inoculate all legumes with a standard culture at the rate specified by the manufacturer of the inoculant according to lowa DOT Article 4169.04. Do not expose inoculated seed to direct sunlight for more than 30 minutes. Re-inoculate seed that is not sown within 8 hours after inoculation prior to use. Pre-inoculated seed with manufacturer's recommended protective coating may be used in lieu of seed with Contractor-applied inoculant.
e. When the gravity or cyclone seeder is used for application of seed, inoculate legume seed according to the manufacturer's recommended procedures, before mixing with other grass seeds for sowing. Furnish and apply inoculant.
2. Seed Application, Permanent:
a. Prior to seeding, the seedbed will be inspected and approved by the Engineer. Use methods and procedures consistent with equipment manufacturer's recommendations; however, do not operate ground-driven equipment at speeds greater than 10 mph .
b. On all areas accessible to machinery, sow seed with a gravity seeder, endgate cyclone seeder, or seed drill.
c. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be allowed, but no other hand-seeding methods will be accepted.
d. The application of grass and legume seed with hand seeders on early spring work must be performed as separate operations. No mixing of the two types of seed will be allowed.
e. All seeded areas will have one pass with a roller or cultipacker to firm the soil.
3. Seed Application, Temporary:
a. On areas accessible to field machinery, sow seed with an endgate cyclone seeder.
b. On areas inaccessible to field machinery, the use of hand-operated cyclone seeders will be allowed, but no other hand-operated seeding methods will be accepted.
c. Cover the seed and fertilizer by lightly tilling the seeded area with a disk, rigid harrow, spring tooth harrow, or field cultivator.
4. Seeding Outside of the Specified Seeding Dates: With the agreement of the Engineer and at the full responsibility of the Contractor, seeding operations for all seed types may be conducted outside the specified seeding dates. Should the seeded areas require reseeding, it must be done as specified and at no additional cost to the Contracting Authority.
a. Dormant Seeding: When winter dormant seeding is allowed or specified by the Jurisdiction, complete it when air temperatures are consistently below $40^{\circ} \mathrm{F}$ and prior to December 25 of a given year. Dormant seeding is not allowed on snow.

1) Prepare the seedbed before the ground freezes.
2) To ensure protection of the seed, apply on a frosty morning or before a predicted snow.
3) Seeding may be done by hand or with seeding equipment.
4) For hydraulic seeding, apply the fertilizer at no more than 0.5 pounds nitrogen per 1000 square feet, followed by the seed.
b. Frost Seeding (Overseeding):
5) Complete frost seeding, also referred to as overseeding, in the spring when the ground is friable from frost action (February 1 to April 1).
6) Frost seeding is not allowed on more than 1 inch of snow.
7) Seeding can be done with a hand-operated cyclone seeder or other equipment.
8) Seedbed preparation will not be required provided the ground is friable from frost action.

### 3.04 CONVENTIONAL SEEDING (Continued)

## F. Mulching:

1. Mulch all conventionally seeded areas the same day the seed is sown. Uniformly distribute the mulch over the required areas at a rate of 1.5 tons/acre for dry cereal straw, or native grass straw. Prairie hay is not suitable for Type 1 (lawn seeding).
2. Work the mulch into the soil with mulch anchoring equipment designed to anchor the mulch into the soil by means of dull blades or disks with a minimum of two passes. Operate equipment in a manner to minimize displacement of the soil and disturbance of the design cross-section.
3. Do not operate mulch-blowing equipment on slopes steeper than 2.5 to 1 or on slopes that may rut. Use attachments to apply mulch without traversing slopes.
4. Do not mulch when wind velocities exceed 15 mph .

### 3.05 HYDRAULIC SEEDING

A. Order of Operations:

1. Seedbed preparation
2. Seed application, fertilizing, and mulching
B. Seedbed Preparation: Follow seedbed preparation for conventional seeding in Section 9010, 3.04.
C. Seed Preparation: Inoculant, in the quantities specified above, may be applied directly into the supply tank with seed, water, and other material.

## D. Seed Application, Fertilizing, and Mulching:

1. Application Process:
a. Combination: Place all material, seed, fertilizer, mulch, and tackifier (if applicable) in hydraulic mulching equipment specifically manufactured for hydraulic seeding.
b. Separate: At the Contractor's option and at no additional cost to the Contracting Authority, the hydraulic seeding, fertilizing, and mulching may be undertaken separately. If hydraulic seeding is done separately, add 50 pounds of wood cellulose fiber complying with Section 9010, 2.07, B as a tracer for each 500 gallons of water in the hydraulic seeder tank. If operations are undertaken separately, complete fertilizing and mulching application within 24 hours of completing seeding work. Do not separate the applications if inclement weather is forecasted within 24 hours of the scheduled application period.
2. Ensure the hydraulic equipment, pump, and application process do not damage or crack seeds.
3. Mix materials with fresh potable water using a combination of both recirculation through the equipment's pump, and mechanical agitation to form a homogeneous slurry.
4. Apply mixture within 1 hour after seed and fertilizer are placed in the hydraulic seeder.
5. If necessary, dampen dry, dusty soil, to prevent balling of the material during application.

### 3.05 HYDRAULIC SEEDING (Continued)

6. Apply the slurry evenly over all specified areas at component material rates specified.
a. Wood Cellulose Mulch:
1) Mulch: Minimum $3,000 \mathrm{lb} /$ acre dry weight.
2) Tackifier: Minimum $50 \mathrm{lb} / \mathrm{acre}$.
b. Bonded Fiber Matrix: Minimum $3,000 \mathrm{lb} /$ acre dry weight.
c. Mechanically-bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
7. Retain and count empty bags of mulch to ensure final application rate.
8. Hydromulching may be done over conventional seeding and/or fertilizing, if approved by the Engineer.
E. Native Grass, Wildflower, and Wetland Grass Seeding: Hydraulic seeding of native grasses, wildflowers, and wetland grasses is allowed only if approved by the Engineer. If allowed, increase specific seed rates by $25 \%$. Do not apply fertilizer.

### 3.06 PNEUMATIC SEEDING

A. Order of Operations: 1) seedbed preparation, 2) seed preparation, and 3) seed application.
B. Seedbed Preparation: Follow seedbed preparation for conventional seeding in Section 9010, 3.04.
C. Seed Preparation: Follow seed preparation for conventional seeding in Section 9010, 3.04. Pre-inoculate seed in the quantities specified above prior to placing in the seed equipment.
D. Seed Application:

1. Place all material, seed, fertilizer, and compost in equipment with a calibrated seeder attachment specifically designed for pneumatic seeding. Do not apply fertilizer with native grass, wildflower, or wetland seeding.
2. Apply compost to a 1 inch minimum depth on all designated disturbed areas. Apply the compost with a pneumatic (air blower) system with sufficient power and hose to reach 300 feet. Driving on the soil to apply compost will not be allowed.
3. Inject seed and fertilizer into the top $1 / 4$ inch to $1 / 2$ inch of compost during application with a calibrated seed injector at the specified rate. Do not inject native grasses and forbs more than $1 / 4$ inch.

### 3.07 WATERING

A. Provide water, equipment, transportation, water tanker, hoses, and sprinklers.
B. Use enough water to keep the soil and mulch moist to a depth of 1 inch and ensure growth of the seed. For turfgrass seeding areas, sufficiently water to keep the soil moist for a minimum of 21 days. If natural rainfall is adequate to keep the soil and mulch moist, artificial watering may not be needed.

## RE-SEEDING

A. When all work related to seeding, fertilizing, and/or mulching has been completed on an area, and is washed out or damaged, re-seed, fertilize, and/or mulch the area at the contract unit price(s) when so ordered by the Engineer.
B. When work related to seeding, fertilizing, and/or mulching has not been completed in an area and is washed out or damaged, re-seed, fertilize, and/or mulch the area as necessary at no additional cost to the Contracting Authority.

### 3.09 CLEAN UP

All work related to clean up throughout the project and upon completion is the responsibility of the Contractor, at no additional cost to the Contracting Authority.
A. Remove all excess materials, debris, and equipment upon completion of work.
B. Clean all paved surfaces open for public use at the end of each day and prior to forecasted precipitation.
C. Repair any damage resulting from seeding operations.
D. Remove hydraulic slurry and other excess debris related to seeding operations from buildings, landscaping, mulch, pavement, signs, sign posts, and any other areas not specified for application, at the end of each day.

### 3.10 ACCEPTANCE AND WARRANTY

A. Acceptance:

1. Guarantee in writing that all work has been completed as specified and provide the date that all activities were completed. When a warranty is a separately-bid item, this also establishes the beginning of the warranty period.
2. Acceptance will occur, provided seeded areas are in a live, healthy, growing, and wellestablished condition without eroded areas, bare spots, weeds, undesirable grasses, disease, or insects.
a. Projects without a separately-bid warranty will be accepted no sooner than 60 days from the date that all activities were completed.
b. When a warranty is established as a bid item and the warranty period excludes 60 days, projects may be accepted after all specified work, excluding the warranty, is satisfactorily completed, and a supplemental contract for the warranty is executed according to the Code of lowa Section 573.27.

## B. Warranty:

1. Required only when established as a bid item by the Engineer.
2. The warranty is to guarantee completed seeding areas for a maximum period of twelve months.
3. During the warranty period, correct and reseed any defects in the seeded areas and grass stand, such as weedy areas, eroded areas, and bare spots, until all affected areas are accepted by the Engineer.
4. Replace or repair to original condition, all damages to property resulting from the seeding operation or from the remedying of defects, at the Contractor's expense.
5. Replacement costs are the Contractor's responsibility, except for those resulting from loss or damage due to occupancy of the project in any part, vandalism, civil disobedience, acts of neglect on the part of others, physical damage by animals, vehicles, fire, or losses due to curtailment of water by local authority, or by "Acts of God."

END OF SECTION

### 2.17 TURF REINFORCEMENT MATS (TRM)

## A. Material Classification:

1. TRM Type 1: Use a TRM that is constructed of a web of mechanically or melt-bonded polymer netting, monofilaments, or fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion, or the placement of synthetic fibers between two high-strength, biaxially-oriented nets, mechanically bound by parallel stitching with polyolefin thread. Products may contain a degradable component.
2. TRM Type 2 and 3: Use a TRM that is constructed of a web of mechanically or meltbonded polymer netting, monofilaments, or fibers that are entangled or woven to form a strong and dimensionally stable mat. Non-woven bonding methods include polymer welding, thermal or polymer fusion, or the placement of fibers between two high-strength, biaxially oriented nets, mechanically bound by parallel stitching with polyolefin thread. Use only components that are $100 \%$ synthetic and resistant to biological, chemical, and ultraviolet degradation.
3. TRM Type 4: Use a high performance/survivability TRM that is composed of monofilament yarns woven into a resilient uniform configuration. Use a mat that has a matrix that exhibits very high interlock and reinforcement capacities with both soil and root systems and demonstrate a high tensile modulus. TRMs manufactured from discontinuous or loosely held together by stitched or glued, netting, or composites are not allowed in this category. Use only components that are $100 \%$ synthetic and resistant to biological, chemical, and ultraviolet degradation. Use this category when field conditions exist with high loading and/or high survivability requirements.
B. Properties and Performance: Meet the minimum material and performance requirements contained in the following table:

| Property ${ }^{1}$ |  | Test Method | Type 1 | Type 2 | Type 3 | Type 4 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Thickness | ASTM D 6525 | 0.25 in | 0.25 in | 0.25 in | 0.25 in |
|  | Tensile Strength ${ }^{2}$ | ASTM D 6818 | $125 \mathrm{lb} / \mathrm{ft}$ | $240 \mathrm{lb} / \mathrm{ft}$ | $750 \mathrm{lb} / \mathrm{ft}$ | 3,000 lb/ft |
|  | UV Resistance ${ }^{3}$ | ASTM D 4355 | $\begin{aligned} & 80 \% \text { @ } \\ & 500 \text { hrs } \end{aligned}$ | $\begin{gathered} \hline 80 \% @ \\ 1,000 \mathrm{hrs} \end{gathered}$ | $\begin{gathered} \hline 80 \% @ \\ 1,000 \mathrm{hrs} \end{gathered}$ | $\begin{gathered} 90 \% \text { @ } \\ 3,000 \mathrm{hrs} \end{gathered}$ |
|  | Maximum Shear Stress ${ }^{4}$ (Channel Applications) | ASTM D 6460 | $7 \mathrm{lb} / \mathrm{ft}^{2}$ | $10 \mathrm{lb} / \mathrm{ft}^{2}$ | $12 \mathrm{lb} / \mathrm{ft}^{2}$ | $15 \mathrm{lb} / \mathrm{ft}^{2}$ |
|  | Maximum Slope Gradient (Slope Applications) | N/A | 1:1 (H:V) or flatter | 1:1 (H:V) or flatter | $1: 1(\mathrm{H}: \mathrm{V})$ <br> or greater | $1: 1(\mathrm{H}: \mathrm{V})$ <br> or greater |

[^4]
### 2.18 INLET PROTECTION

## A. Drop-in Intake Protection:

1. Use a manufactured device that is inserted into the intake and is capable of trapping or filtering sediment from runoff prior to entering the storm sewer.
2. All components must be contained entirely below the surface of the intake grate.
3. Incorporate means of emergency outflow to prevent flooding if plugged with sediment.
B. Surface-applied Intake Protection:
4. Use devices or filter socks, placed around or over the intake, that are capable of trapping or filtering sediment from runoff prior to entering the storm sewer.
5. Do not allow the device to completely block or plug the intake, preventing inflow.

### 2.19 FLOW TRANSITION MATS

Comply with the following and lowa DOT Materials I.M. 469.10.

## A. Mat:

1. Constructed of $85 \%$ minimum UV resistant material with a maximum ground cover of 80\%.
2. Meet the requirements of the following table:

| Property | Test Method | Value |
| :--- | :---: | :---: |
| Mass/Unit Area (max.) | ASTM D 6566 | $3 \mathrm{lbs} / \mathrm{SF}$ |
| Minimum Thickness | ASTM D 6525 | 0.4 inch |
| Maximum Thickness | ASTM D 6525 | 1.1 inch |
| Tensile Strength | ASTM D 6818 | $550 \mathrm{lbs} / \mathrm{ft}$ |
| Minimum Percent Open Area | ASTM D 6567 | $20 \%$ |
| UV Stability | ASTM D 4355 | $85 \%$ |

## B. Anchoring Devices:

1. Furnish bullet tip style anchors made of a metal alloy attached to a wire rope.
2. Anchors capable of withstanding a minimum 300 pounds ( 136 kg ) of pull out resistance in cohesive soils.
3. Wire rope a minimum of 30 inches ( 762 mm ) in length with a minimum breaking strength of at least 300 pounds ( 136 kg ).
4. The top washer a minimum of 3 inches ( 76 mm ) in diameter and constructed of a UV resistant plastic.
5. Each anchor equipped to allow the retightening of the anchor when deemed necessary by the Engineer.

### 2.20 ENGINEERING FABRIC

Comply with lowa DOT Article 4196.01, B, 3 .

## PART 3 - EXECUTION

### 3.01 SWPPP PREPARATION

A. Prepare a SWPPP according to the requirements of the lowa DNR NPDES General Permit No. 2.
B. Ensure that controls utilized in the SWPPP conform to the type and quantity of erosion and sediment controls specified in the contract documents.
C. Submit the completed SWPPP to the Engineer for review and approval prior to filing the Notice of Intent.
D. Upon approval of the Engineer, file public notices, as required by the NPDES General Permit No. 2.
E. File the Notice of Intent and fee, as required by the NPDES General Permit No. 2.

### 3.02 SWPPP MANAGEMENT

Coordinate and carry out all requirements of lowa DNR NPDES General Permit No. 2 and any local ordinance requirements, including:
A. Update the SWPPP according to the requirements of the NPDES General Permit No. 2.
B. Revise the SWPPP and implement changes, as necessary, to prevent sediment or hazardous materials from being transported off the site.
C. Submit all SWPPP revisions to the Engineer for review and approval.
D. Perform and maintain records of weekly erosion and sediment control site inspections, unless otherwise specified in the contract documents.
E. Maintain records of transfer of responsibility under the NPDES General Permit No. 2.
F. Retain all records on-site, or as required by the NPDES General Permit No. 2.
G. After final stabilization, file a Notice of Discontinuation, according to the NPDES General Permit No. 2.
H. Provide all records and documentation to the Engineer upon completion of the project. Retain a copy of all records for the period required under the Permit.
I. Continue to perform the work required under this item throughout the duration of the project, and until final stabilization is achieved and a Notice of Discontinuation is filed.
3.03 EROSION AND SEDIMENT CONTROL INSPECTION
A. Perform inspections according to and at frequency required by the lowa DNR NPDES General Permit No. 2.
B. Schedule necessary maintenance or improvements for items that are included in the contract documents.
C. Notify the Engineer immediately of situations requiring attention beyond that provided for in the contract documents.

### 3.03 EROSION AND SEDIMENT CONTROL INSPECTION (Continued)

D. Provide copies of the inspection reports to the Engineer.

### 3.04 EQUIPMENT

Comply with Iowa DOT Article 2601.03.
3.05 COMPOST BLANKETS (Figure 9040.101)
A. Loosen the ground surface to a minimum depth of 1 inch.
B. Evenly spread compost, as specified in the contract documents, or as directed by the Engineer.
C. Divert concentrated flows away from the slope.
D. Do not operate heavy equipment over the compost blanket after placement, or throughout the required period of protection.
E. Inspect the ground under the blanket at regular intervals for signs of erosion.
3.06 FILTER BERMS (Figure 9040.102)
A. Install filter berm along the contour as specified in the contract documents, or as directed by the Engineer.
B. Turn the ends of the filter berm uphill to prevent runoff from flowing around the end of the berm.
C. When a vegetated berm is specified, apply seed to the surface of the berm.
D. Replace the berm when sediment accumulation reaches one-half of the height of the berm.

### 3.07 FILTER SOCKS (Figure 9040.102)

A. Installation:

1. Fill mesh filter sock with filler material to the size and length specified in the contract documents.
2. Place the filter sock along the contour as specified in the contract documents, or as directed by the Engineer.
3. Construct a "J-hook" at each end of a continuous run of filter sock, by turning the end of the sock uphill, as necessary to prevent runoff from flowing around the ends when water behind the sock ponds up to a level even with the top of the sock.
4. Drive stakes into the ground at a maximum spacing of 10 feet, and as required to secure the sock and prevent movement.
5. Repair or replace non-functioning filter socks that allow water to flow under the sock, are torn, or are otherwise damaged, due to inadequate installation.
6. Remove filter material from damaged socks that are located along streambanks, around intakes, in ditches, or in other locations where the material may be carried to surface waters.

### 3.07 FILTER SOCKS (Continued)

B. Removal: When specified in the contract documents, or as directed by the Engineer; remove the filter sock upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

1. Upon completion of the project, completely remove socks and filter material that are located along streambanks, around intakes, in ditches, or in other locations where the filter material may be carried to surface waters if the sock degrades and/or tears.
2. Slice the sock longitudinally. Remove and dispose of the filter sock material and stakes.
3. Spread the filter material and accumulated sediment to match finished grade and to ensure proper drainage.
4. If the site has been brought to finished grade and prepared for permanent seeding, spread and incorporate the filter material into the surface by tilling, or as required to break up any large particles and provide a finished surface suitable for permanent seeding.

## C. Replacement:

1. When accumulated sediment reaches a level one-half the height of the sock, or when the sock becomes clogged with sediment and no longer allows runoff to flow through, remove the sock as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing filter sock and accumulated sediment may be left in place, and a new filter sock installed up-slope from the existing filter sock.

### 3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Figures 9040.103 and 9040.104)

Install temporary RECPs according to the manufacturer's published installation recommendations, subject to the following minimum requirements:

## A. Slope Application:

1. Grade and smooth surface. Remove all rocks, clods, vegetation, or other obstructions that will prevent direct contact between the RECP and the soil surface.
2. When specified, prepare seedbed and place seed and fertilizer according to Section 9010 prior to placing RECP.
3. Install anchor trench at top of slope. Seed and fertilize trench after backfill and compaction, if seeding is specified.
4. Unroll the RECP down or horizontally across the slope.
5. Place consecutive blankets down the slope end-over-end, shingle style.
6. Overlap ends of consecutive rolls a minimum of 3 inches, and install anchors at a maximum spacing of 18 inches along all overlaps.
7. Overlap edges of adjacent rolls a minimum of 2 inches.
8. Install anchors at edge seams between rows.

### 3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)

## B. Channel/Ditch Application:

1. When specified, prepare seedbed and place seed and fertilizer according to Section 9010, prior to placing RECP.
2. Place end of first roll in the anchor slot at the center of the upstream channel and secure with anchors.
3. Position adjacent rolls in the anchor slot, overlapping adjacent rolls a minimum of 3 inches.
4. Place backfill material in anchor slot and compact. Unroll RECP over compacted slot and secure with anchors.
5. Unroll RECP downstream. Maintain a minimum 3 inch overlap between adjacent rolls. Secure edge lap with anchors.
6. Install intermittent staple check slots every 30 feet.
7. Construct end lap at end of roll and beginning of new roll. Overlap roll ends with upstream RECP on top.
8. Excavate longitudinal trench along both sides of the channel at the outside edges of installation. Place outer edges of RECP into longitudinal slot. Install anchors, place backfill material, and compact.
9. Terminate installation at downstream end with staple check.
10. Install anchors in a regular pattern over entire area covered according to manufacturer's published recommendations (minimum three anchors per square yard).
3.09 WATTLES (Figure 9040.105)
A. Installation:
11. Construct a shallow trench, 2 to 4 inches deep, matching the width and contour of the wattle.
12. Install wattle along contour of slope.
13. Turn ends of wattle uphill to prevent water from flowing around ends.
14. Place and compact excavated soil against the wattle, on the uphill side.
15. Drive stakes through the center of the wattle, into the ground at a maximum spacing of 4 feet along the length of the wattle, and as needed to secure the wattle and prevent movement.
16. Abut ends of adjacent wattles tightly. Wrap joint with a 36 inch wide section of silt fence and secure with stakes.
B. Removal: When specified in the contract documents, or as directed by the Engineer, remove the wattle upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.

### 3.09 WATTLES (Continued)

1. Completely remove the wattle netting, filler material, and stakes.
2. Spread the accumulated sediment to match finished grade and to ensure proper drainage.
3. When allowed by the Engineer, the wattle netting may be sliced open and the filler material spread out over the ground. Removal of netting and stakes and spreading of sediment is still required.
C. Replacement:
4. When accumulated sediment reaches a level one-half the height of the wattle, or when the wattle becomes clogged with sediment and no longer allows runoff to flow through, remove the wattle as described above, and replace according to the installation instructions above.
5. At the Engineer's option, the existing wattle and accumulated sediment may be left in place, and a new wattle installed up-slope from the existing wattle.

### 3.10 CHECK DAMS (Figure 9040.106)

A. Synthetic Permeable Check Dam (HDPE):

1. Install according to the manufacturer's recommendations.
2. When specified, provide an RECP under the check dam, installed according to the manufacturer's recommendations.
B. Triangular Foam Check Dam: Install according to the manufacturer's recommendations.
C. Rock Check Dam: Construct according to Figure 9040.107.
D. Removal: When specified in the contract documents, or as directed by the Engineer, remove check dams upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.
3. Remove the check dam and dispose of materials, or salvage to the contractor.
4. Remove the accumulated sediment or spread to match finished grade; ensure proper drainage.
5. Stabilize the area disturbed by removal operations.

### 3.11 TEMPORARY EARTH DIVERSION STRUCTURES (Figure 9040.108)

A. Ensure positive drainage along the diversion toward the outlet area.
B. Adequately compact fill to prevent failures or seepage.
C. Outlet the diversion to undisturbed and/or stabilized areas only.
D. Stabilize the surface of the earth diversion with temporary erosion control seeding, as specified in Section 9010.
3.12 LEVEL SPREADERS (Figure 9040.109)
A. Butt multiple timbers together, as necessary to provide the required length.
B. Ensure the spreader is installed level in all directions. Adjust as necessary during construction to maintain spreader in a level condition.
C. Excavate a depression behind the spreader to the depth specified in the contract documents. The depression may be over-excavated up to 1 foot to provide an area for sediment accumulation.
D. Grade as required to prevent flow around the ends of spreader.
E. Remove the accumulated sediment from the depression when the depth is reduced below that specified in the contract documents.
3.13 RIP RAP (Figures 9040.110 and 9040.111)

Install rip rap (revetment stone or erosion stone) as shown on Figures 9040.110 and 9040.111.
3.14 TEMPORARY PIPE SLOPE DRAINS (Figure 9040.112)
A. Place slope drain on undisturbed soil or well compacted fill.
B. Carefully compact cohesive soils around inlet ends of the drain in 6 inch lifts.
C. Discharge slope drain to a stable outlet or to a sediment retention device.

### 3.15 SEDIMENT BASIN OUTLET STRUCTURES (Figures 9040.113 and 9040.114)

A. Concrete Base: Construct the concrete base and anchor riser section, as shown on Figure 9040.115.

## B. Dewatering Device:

1. Drill holes in the riser section. The number, diameter, and configuration will be specified in the contract documents.
2. Wrap the perforated section of the riser pipe with metal hardware cloth.
C. Anti-vortex Device: If required by the contract documents, firmly attach the cylinder to the top of the riser by welding or other means. Comply with Figure 9040.116.

### 3.16 ANTI-SEEP COLLAR (Figure 9040.117)

A. General: Place backfill material and compact over-excavation areas to a minimum of $95 \%$ Standard Proctor Density per Section 3010.
B. Concrete Collar:

1. Place collars a minimum of 2 feet from pipe joints.
2. Provide Class C concrete per Section 6010.


## GABIONS AND REVET MATTRESSES

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Gabions
B. Revet Mattresses (Gabion Mattresses)

### 1.02 DESCRIPTION OF WORK

A. Assembly and installation of gabions.
B. Assembly and installation of revet mattresses.
1.03 SUBMITTALS

Comply with Division 1-General Provisions and Covenants, as well as the following:
Upon request, submit certification that products supplied comply with identified specifications.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

### 1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.
1.07 SPECIAL REQUIREMENTS

None.
1.08 MEASUREMENT AND PAYMENT
A. Gabions:

1. Measurement: Measurement will be the plan quantity in cubic yards for the total volume of each type of gabion installed.
2. Payment: Payment will be at the unit price per cubic yard for each type of gabion installed.
3. Includes: Unit price includes, but is not limited to, furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing gabion stone, engineering fabric, and anchor stakes.

### 1.08 MEASUREMENT AND PAYMENT (Continued)

B. Revet Mattresses:

1. Measurement: Measurement will be the plan quantity in cubic yards for the total volume of each type of revet mattress installed.
2. Payment: Payment will be at the unit price per cubic yard for each type of revet mattress installed.
3. Includes: Unit price includes, but is not limited to, furnishing and assembling wire mesh baskets, PVC coating (if specified in the contract documents), fasteners, furnishing and placing mattress stone, engineering fabric, and anchor stakes.
C. Excavation: Comply with Section 2010, 1.08, E.

## LANDSCAPE RETAINING WALLS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

A. Modular Block Retaining Walls
B. Limestone Retaining Walls
C. Landscape Timber Retaining Walls
1.02 DESCRIPTION OF WORK
A. Construction of modular block retaining walls.
B. Construction of limestone retaining walls.
C. Construction of landscape timber retaining walls.
1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Upon request, submit certification that products supplied comply with identified specifications.
B. Test results on modular blocks, if required.
C. Catalog cuts for modular retaining wall blocks and cap stones indicating the size, type, and color proposed for installation.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.
1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.
1.07 SPECIAL REQUIREMENTS

None.

### 1.08 MEASUREMENT AND PAYMENT

## A. Modular Block Retaining Wall:

1. Measurement: Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall, including coping or cap stones.
2. Payment: Payment will be at the unit price per square foot of retaining wall.
3. Includes: Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing wall units, geogrid (if necessary), leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, granular backfill material, suitable backfill material, and shoring as necessary.

## B. Limestone Retaining Wall:

1. Measurement: Measurement will be in square feet for the area of the face of retaining wall.
2. Payment: Payment will be at the unit price per square foot of retaining wall.
3. Includes: Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing leveling pad, limestone, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.

## C. Landscape Timbers:

1. Measurement: Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall.
2. Payment: Payment will be at the unit price per square foot of retaining wall.
3. Includes: Unit price includes, but is not limited to, excavation, foundation preparation, furnishing and placing leveling pad, landscape timbers, spikes, reinforcing bar, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.
D. Excavation and Suitable Backfill Material: If bid separately, excavation for wall construction and placement of suitable backfill material will be measured and paid according to Section 2010, 1.08.
E. Fence: Comply with Section 9060, 1.08, A.
F. Safety Rail: Comply with Section 9080, 1.08, C.

## SEGMENTAL BLOCK RETAINING WALLS

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

Segmental Block Retaining Walls
1.02 DESCRIPTION OF WORK

Constructing segmental block retaining walls.

### 1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Upon request, submit certification that products supplied comply with identified specifications.
B. Detailed design calculations (including soil bearing pressure), construction drawings, and shop drawings for all segmental block retaining walls, prepared by a licensed Professional Engineer in the State of lowa.
C. A detailed explanation of the design properties of geogrid reinforcement and quality control tests limits.
D. Test results on segmental blocks, if required.
E. Catalog cuts of segmental retaining wall blocks and cap stones indicating the size, type, and color specified for installation.

### 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. A licensed Professional Engineer in the State of lowa must prepare, sign, and seal detailed design calculations, construction drawings, and shop drawings for all segmental block retaining walls.
B. Ensure design complies with the National Concrete Masonry Association (NCMA) "Design Manual for Segmental Retaining Walls."

### 1.08 MEASUREMENT AND PAYMENT

## A. Segmental Block Retaining Wall:

1. Measurement: Measurement will be in square feet for the area of the face of retaining wall, measured from the top of the leveling pad to the top of the wall, including coping or cap stones.
2. Payment: Payment will be at the unit price per square foot of retaining wall.
3. Includes: Unit price includes, but is not limited to, design by a Licensed Professional Engineer in the State of lowa, excavation, foundation preparation, furnishing and placing wall units, geogrid, leveling pad, subdrain, porous backfill material for subdrain, engineering fabric for subdrain, suitable backfill material, and shoring as necessary.
B. Excavation and Suitable Backfill Material: If bid separately, excavation for wall construction and placement of suitable backfill material will be measured and paid according to Section 2010, 1.08.
C. Granular Backfill Material:
4. Measurement: Measurement will be in tons for material used in connection with segmental block retaining walls.
5. Payment: Payment will be at the unit price per ton of granular backfill material.
6. Includes: Unit price includes, but is not limited to, furnishing, transporting, placing, and compacting material.
D. Fence: Comply with Section 9060, 1.08, A.
E. Safety Rail: Comply with Section 9080, 1.08, C.

# COMBINED CONCRETE SIDEWALK AND RETAINING WALL 

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

Combined Concrete Sidewalk and Retaining Wall
1.02 DESCRIPTION OF WORK

Constructing combined concrete sidewalk and retaining wall.
1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
Upon request, submit certification that products supplied comply with identified specifications.
1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.
1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.
1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.
1.07 SPECIAL REQUIREMENTS

None.
1.08 MEASUREMENT AND PAYMENT
A. Combined Concrete Sidewalk and Retaining Wall:

1. Measurement: Measurement will be in cubic yards for the volume of combined sidewalk and retaining wall.
2. Payment: Payment will be at the unit price per cubic yard of combined sidewalk and retaining wall.
3. Includes: Unit price includes, but is not limited to, excavation; foundation preparation; furnishing and placing concrete and reinforcing steel; joint material; subdrain; porous backfill material; suitable backfill material; finishing disturbed areas; and shoring as necessary.
B. Fence: Comply with Section 9060, 1.08, A.
C. Safety Rail: Comply with Section 9080, 1.08, C.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

A. Combined Concrete Sidewalk and Retaining Wall:

1. Portland Cement Concrete: Comply with Section 6010, 2.03.
2. Reinforcing Steel: Comply with lowa DOT Section 4151.
3. Expansion Joint: Comply with lowa DOT Article 4136.02. Use resilient filler when the type is not specified.
B. Subdrain: Comply with Section 4040, 2.02. Minimum 4 inch diameter.
C. Porous Backfill Material (for Subdrain): Comply with Section 4040, 2.04.
D. Suitable Backfill Material: Comply with Section 2010.
E. Rodent-proof Hardware Cloth: Comply with Iowa DOT Materials I.M. 443.01.
F. Fence: If the contract documents require a fence, comply with Section 9060.
G. Safety Rail: If the contract documents require a safety rail, comply with Section 9080.

## PART 2 - PRODUCTS

### 2.01 STEPS

A. Concrete: Class C concrete complying with Section 6010, 2.03.
B. Reinforcing Steel: Comply with lowa DOT Section 4151 for epoxy coated reinforcement.
C. Expansion Joint: Comply with lowa DOT Section 4136.03, A.
D. Forms: Comply with lowa DOT Section 2403.

### 2.02 <br> HANDRAIL

$11 / 4$ 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 $21 / 2$ inch by $21 / 2$ 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.
3. Provide zinc coating complying with ASTM A 123.
4. Hot-dip galvanize components after fabrication.
5. For hot-dip galvanized components that will be powder coated, utilize the dry-kettle (prefluxing) 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:
7) Remove all tears, spikes, high spots, or other surface defects caused by the galvanizing process using hand or power tools.
8) Apply an alkaline solution, with a pH between 11 and 12 , to remove traces of oil, grease, and dirt.
9) Remove residual zinc oxide by spraying surface with a mild acidic solution ( pH of 3.5 to 4.5).
10) Apply conversion coating to the surface and apply sealing agent to prepare the surface for powder coating.
c. Aluminum Substrate:
11) Clean surface by power washing to remove contaminants.
12) 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.
13) Remove oils and surface contamination by solvent cleaning. Comply with the requirements of SSPC-SP 1.
14) Remove light deposits of aluminum reaction by-products by hand or power tool cleaning. Comply with SSPC-SP 2 or 3.
15) 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 reformation of aluminum oxide.
b) Chemical Treatment: Comply with ASTM D 1730 for Type B treatment.
16) 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.

## CONSTRUCTION SURVEY

## PART 1 - GENERAL

### 1.01 SECTION INCLUDES

Construction survey includes personnel, equipment, and supplies required for, but not limited to, the following:
A. Construction Survey:

1. Project Control
2. Grading
3. Bridges, Structural Walls, and Reinforced Box Culverts
4. Pipe Culverts
5. Sanitary and Storm Sewers
6. Water Mains
7. Paving
8. Replacement of Disturbed Monuments
9. Additional Items Included in the Contract Documents
B. Monument Preservation and Replacement

### 1.02 DESCRIPTION OF WORK

Construction survey and staking necessary for construction of the project as shown in the contract documents.
1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:
A. Documentation: Format the survey work documentation in a manner acceptable to the Engineer. Ensure documentation is sufficient to prove means and methods used to transfer design intent to construction stakes. Check tie-ins with existing roadways, structures, and utilities prior to staking; notify the Engineer if discrepancies are found.

1. Benchmarks: Submit descriptions and elevations of new permanent benchmarks. Establish benchmarks on existing durable fixtures not subject to frost action or disturbance.
2. Staking Records: Upon request, submit all field books, computer-aided design and drafting (CADD) files, digital log files, etc.
3. Monument Preservation and Replacement: If the contract documents include a bid item for monument preservation and replacement, submit copies of all documents developed for compliance with the requirements of lowa Code Section 355 and Iowa Administrative Code 193C to the Engineer.

### 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. Qualifications:

1. Perform construction survey directly by or under responsible charge of a Professional Engineer or Professional Land Surveyor licensed in the State of lowa.
2. Reset disturbed monuments with new monuments under the responsible charge of a Professional Land Surveyor licensed in the state of lowa.
B. Obtain Engineer's approval when interpolating grades or using cross-sections to obtain alignments and elevations.
C. The Jurisdiction will provide benchmarks, right-of-way corners, and primary control points from the original survey in the contract documents. Roadway alignment data will be provided as required for construction.
D. If the contract documents do not include a bid item for monument preservation and replacement, the Contracting Authority will be responsible for replacing disturbed monuments located within the project area and not noted for protection.
1.08 MEASUREMENT AND PAYMENT
A. Construction Survey: If the contract documents specify that the Contractor is responsible for construction survey, measurement and payment will be as follows.
3. Measurement: Lump sum item; no measurement will be made.
4. Payment: Payment will be at the lump sum price for construction survey.
5. Includes: Lump sum price includes, but is not limited to, the costs of resetting project control points, re-staking, and any additional staking requested beyond the requirements of this section.

### 3.03 CONSTRUCTION STAKING (Continued)

5. Perform an independent check of all the above stakes. Independent check can be performed by an independent survey crew or by arbitrary verification of the location of the stakes as placed in the field.
a. For an arbitrary verification, survey stakes and control points in an arbitrary coordinate system and then rotate digitally into the design file to verify accuracy with the contract documents.
b. Notify Contractor of any discrepancies within 24 hours of placing the stakes for each structure.

## C. Pipe Culverts:

1. Place stakes for offsets to ends of pipe, labeled with offset distance, and cut or fill to proposed flowline of the new culvert.
2. Place stakes for all bends in the pipe alignment. Provide two offset stakes, one along each pipe segment bearing, at bends to accurately place bend location.
3. For culverts over 100 feet in length, set offset stakes 50 feet and 100 feet from end of pipe and every 100 feet thereafter. Label stakes with offset distance and elevation reference to the flowline of the proposed pipe.

## D. Sanitary and Storm Sewers:

1. Place stakes for all manholes, intakes, cleanouts, and other structures associated with new sewer.
2. Provide offset stake for each structure set at 10 to 15 feet. Offset may be increased for deep sewers.
3. For back of curb intakes, set two offset stakes along the curb alignment to properly align the new grate. Stakes may also be offset perpendicular to the curb alignment as required to avoid conflicts with the proposed storm sewer.
4. Place stakes for all bends in the pipe alignment. Provide two offset stakes, one along each pipe segment bearing, at bends to accurately place bend location.
5. For pipe sections over 100 feet in length, set offset stakes 50 feet and 100 feet from end of pipe and every 100 feet thereafter. Label stakes with offset distance and elevation reference to the flowline of the proposed pipe.

## E. Water Mains:

1. Place stakes for proposed water main on line (no offset) at 100 foot intervals. Label stakes as centerline of water main with elevation reference to the top of the proposed pipe to ensure sufficient depth is achieved.
2. Place stakes for all hydrants, valves, bends, tees, and other appurtenances with appropriate offsets. Label stakes with offset distance and elevation reference to proposed finished grade adjacent to the hydrant, valve, bend, tee, or other appurtenance.
3. Place stakes at all crossings of storm sewers and sanitary sewers. Label stakes with top of pipe elevations at the crossing for water mains and sewer mains to ensure proper depth and vertical separation.

### 3.03 CONSTRUCTION STAKING (Continued)

## F. Paving:

1. Conventional Paving:
a. Set paving hubs at appropriate offsets around perimeter of paved areas. Place hubs at grade breaks (high and low points), points of horizontal deflection (bends), and 25 foot intervals in between. Label stakes with offset distance and elevation reference to the top of paving.
b. For paving areas wider than 60 feet, set paving hubs at appropriate offsets on 25 foot intervals along interior bays or drive lanes. Label stakes with offset distance and elevation reference to the top of paving.
c. Place stakes for curb drop locations for sidewalk ramps and driveways. Set hubs on both sides of the drop curb at the bottom of the drop to ensure the appropriate width of curb opening is achieved. Label stakes with offset distance and elevation reference to top of paving.
d. Place stakes for sidewalks and trails on one side only at appropriate offsets. Place stakes at 50 foot intervals in straight and level sections and 25 foot intervals for horizontal or vertical curves. Label stakes with offset distance and elevation reference to the top of paving.

## 2. Stringless Paving:

a. When stringless paving is used, set additional control points on each side of the pavement, as necessary, to meet the manufacturer's requirements for the equipment used. Furnish $x, y$, and $z$ coordinates and station offset information for each point. Points may be established horizontally using GPS, but transfer elevations of said points from an original benchmark located in the construction documents using a total station or level.
b. Provide grade check paving hubs at appropriate offsets around the perimeter of the paved areas. 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. Place stakes for curb drop locations for sidewalk ramps and driveways. Set hubs on both sides of the drop curb at the bottom of the drop to ensure the appropriate width of curb opening is achieved. Label stakes with offset distance and elevation reference to top of paving.
d. Provide grade check stakes for sidewalks and shared use paths at appropriate offset on one side only. Provide grade check stakes for sidewalks and shared use paths at a maximum interval spacing of 100 feet.

### 3.04 MONUMENT PRESERVATION AND REPLACEMENT

Comply with the requirements of lowa Code Section 355 and the lowa Administrative Code Section 193C for the replacement of all disturbed monuments within the project area.

END OF SECTION


[^0]:    * Measured to the nearest $1 / 2$ "

[^1]:    ${ }^{2}$ Certified plant inspection per lowa DOT Materials I.M. 527.
    3 The Contractor is responsible for developing the maturity curve for the specified mix, taking maturity readings, and delivering a copy of the results to the Engineer.

[^2]:    1 Use of PG 58-34 binder should consider the low temperature reliability in the project area, the availability and cost of different binders, and the ability of the contracting agency to provide on-going maintenance activities.
    ${ }^{2}$ Use of PG $58-28 \mathrm{H}$ should be considered if heavy truck or bus traffic is present
    ${ }^{3}$ For high traffic roadways use $58-34 \mathrm{H}$ binders
    4 If methods are used to retard reflective cracking, PG $58-28 \mathrm{~S}$ or H is recommended

[^3]:    *6 inch maximum particle length.

[^4]:    1 For TRMs containing degradable components, all values must be obtained on the non-degradable portion of the matting.
    2 Minimum Average Roll Values, machine direction only.
    3 Tensile strength of structural components retained after UV exposure.
    4 Minimum shear stress that fully-vegetated TRM can sustain without physical damage or excess erosion ( 0.5 in soil loss) during a 30 minute flow event in large scale testing. Acceptable large scale testing protocol includes ASTM D 6460 or independent testing conducted by the Texas Transportation Institute, Colorado State University, Utah State University, or other approved testing facility. Bench scale testing is not acceptable.

