

2025 Edition Revisions to the SUDAS Standard Specifications

To update your printed manual, print this packet. Then remove the old sheets and place the revised sheets in your manual. Some pages are completely new and do not replace an existing sheet. Also, some pages do not contain revisions, but are included due to changes on the other side or a change in the page number. **PLEASE READ CAREFULLY - PAY ATTENTION TO THE SECTION NUMBER!** Included shading to help distinguish between divisions. Questions can be directed to Beth Richards - brich@iastate.edu. The current edition of the manual, with the latest revisions incorporated, can be found at www.iowasudas.org.

Div	Section	pg #	Summary of Revision(s)
	Manual introductory info		Updated the Contributors and Acknowledgments and general table of contents pages. <i>Note - if you want to replace the small business card for the spine of your manual, you can print a copy from our website.</i>
1	1070, 2.04, C	7-10	Added language prohibiting the storage of flammable and combustible materials from under overhead structures in the right-of-way.
	1080, 1.06, B, 2	4	Modified language to clearly define working days will be charged for concrete curing time of pavements and structural concrete when it is the controlling item of work.
2	2010, 2.04, C, 5	10	Revised Table 2010.03 to include multiaxial configuration for geogrid.
3	3010, 1.08, A, 2 and D	2-3	Modified language to more clearly define incidental removal of soil material and costs associated with removal and replacement of unsuitable trench materials.
4	Table of Contents	v-vi	Updated table of contents based on changes made in Division 4.
	Figure 4040.233	1	Revised note 9 to clarify using a fork type rodent guard on subdrain outlet to ditch.
	4050	ALL	Created cleaning specifications for non-rehab projects, which resulted in changing the section title.
5	Table of Contents	ii	Updated table of contents based on changes made in Division 5.
	5010, 3.06, E	12-14	Language was mistakenly deleted and Iowa DNR has since adopted the 2012 Edition of the Recommended Standards for Water Works (previously referenced the 2007 Edition). Affected pages that followed.
	6010, 1.08, G	4	Added "removal of existing fillet" and "replacement of fillet" to the includes items.
6	6010, 3.05, A	17	Added "install replacement fillet as necessary".
7	Table of Contents	i, iii	Updated table of contents based on changes made in Division 7.
	7010	ALL	Replace ENTIRE SECTION (excluding figures). Revised cold weather protection language and minimum flexural strength requirements.
	Figure 7010.101	1-8	Added elliptical dowel bars.
	7020	5-16	Revised cold weather protection language. Affected pages that followed.
	Table of Contents	iii-iv	Updated table of contents based on changes made in Division 8.
8	8030	ALL	Replace ENTIRE SECTION (excluding figures). Added language to allow the use of automated flagger assistance devices.
9	Table of Contents	iv-vi	Updated table of contents based on changes made in Division 9.
	9010, 1.03, A, 1	1	Revised the seed tag submittal requirement.
	9020, 1.08, A	2	Changed measurement and payment of sod to be in square yards rather than squares.

9 (con't)	9040	ALL	Replace ENTIRE SECTION (figures as listed below). Revised specs based on current practices and to match the current Erosion Control Technology Council's (ECTC) guidelines.
	Figures 9040.101-108	ALL	Revised to match current practices.
	Figures 9040.117-120	ALL	Revised to match current practices.
	9060, 3.01, A and C, 1	6	Minor chain link fence installation clarifications
	Figure 9072.221	2	Added a clarification dimension to the Type A wall detail.

Contributors and Acknowledgments

In 2024, SUDAS staff held many meetings to accomplish the various revisions reflected in the 2025 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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David Carney	Program Director
Beth Richards	Program Specialist

* Denotes an officer

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2.02 CONVENIENCE AND SAFETY (Continued)

4. The Engineer may appoint an authorized representative on the work site to monitor the materials used and the work done by the Contractor. The Engineer's authorized representative is not a safety inspector and is not responsible for monitoring, directing, or otherwise ensuring the safety of the Contractor, its subcontractors, its suppliers, or any others that may be on the work site.
5. Construction of the work included in the contract is by its nature dangerous work; and the Contractor is hereby notified that it is the Contractor's sole responsibility to provide as safe a working site as possible given the nature of the work. It is the Contractor's responsibility to notify and advise its employees, subcontractors, suppliers, and everyone on the worksite of the dangers associated with the work, and provide them with appropriate safety information to protect them from those dangers.

2.03 WORK AREA

- A. The Contractor shall confine its work to the Jurisdiction's premises, including construction easements and construction limit lines as shown in the contract documents and verified by the Engineer. The Contractor shall not enter upon or place materials on any private property for which the Jurisdiction has not obtained an easement for such use. The Contractor agrees to defend, indemnify, and hold the Jurisdiction harmless from all suits and actions of every kind and description resulting from the Contractor's use of private property. Before beginning construction, the Contractor shall check with the Engineer for any special instructions concerning easements.
- B. Temporary buildings, storage sheds, shops and office, etc., may be erected by the Contractor only with the prior approval of the Engineer and shall be built with labor and materials furnished by the Contractor without expense to the Jurisdiction. Such temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor, at its expense, after the completion of the work.

2.04 PROJECT AREA FOR THE WORK

- A. **Acquisition:** Existing and proposed additional right-of-way or easements shown on the plans and/or in the contract documents will provide, without cost to the Contractor, adequate space for the performance of the work. If the contract documents do not contain a notice to the Contractor of non-acquired additional right of way or easements, as shown on the plans, and the Contractor provides documentation acceptable to the Engineer, compensation will be allowed for loss or damage occasioned by delays in securing said right-of-way or easements; and, if the need to acquire such additional right-of-way or easements is the sole and only cause of the impossibility of completing the work within the specified time, the Jurisdiction may grant an extension of time if requested by the Contractor. Before beginning construction, the Contractor shall obtain from the Engineer a list of any easements or right-of-way not acquired and any special instructions pertaining to properties affected by the work.
- B. **Location:** Property lines, limits of easements, and limits of construction permits are indicated on the plans, and it shall be the Contractor's responsibility to confine its construction activities within those limits.
- C. **Use:** The Contractor shall confine its equipment, storage of materials, and operation of work to the limits indicated by laws, ordinances, permits, or direction of the Engineer and shall not unreasonably encumber the premises with its materials.

No storage of flammable products or combustible materials shall be allowed below overhead portions of bridges, other highway structures, or existing overhead structures spanning or encroaching the public right-of-way or easements. When not in use, materials or products that present risk of fire hazards must be stored at least 15 feet from the footprint of overhead structural elements.

2.04 PROJECT AREA FOR THE WORK (Continued)

The Contractor shall comply with the Engineer's instructions regarding signs and advertisements.

D. Encroachments: Any damage resulting to persons or property from the Contractor's encroachment beyond the specified limits shall be the sole responsibility of the Contractor.

2.05 EXPLOSIVES

A. Use: The Contractor shall not blast any rock or other materials or allow the same to be done in prosecution of the work, unless it secures the Engineer's approval, proper insurance coverages, and a blasting permit when required.

B. Safety: The Contractor is solely responsible for all damage resulting from blasting operations performed by the Contractor or its agents. The Contractor shall use the utmost care to not endanger life or damage property; and whenever ordered by the Engineer, the number and size of the charges shall be reduced. Suitable coverages or mats shall be provided to confine all materials lifted by blasting within the limits of the excavation or trench. All explosives shall be stored in a secure manner and clearly marked according to all applicable laws and regulations.

C. Regulations: The Contractor shall abide by all existing Federal, State, and Local regulations regarding the use of explosives, including, but not limited to, Uniform Fire Code, Article 77, and National Fire Protection Association 495, Explosive Materials Code of the National Fire Codes.

2.06 TRAFFIC CONTROL**A. General:**

1. The Contractor shall maintain traffic and shall provide and maintain traffic control devices according to the contract documents. If there is no specific traffic control plan, then the Contractor's traffic control devices shall meet the requirements of and be placed according to the current edition of MUTCD.
2. During construction, areas to be maintained for traffic shall be kept clear of all hazardous materials, including but not limited to construction debris, dust, and mud.

B. Closing Streets to Traffic:

1. Upon the Engineer's approval, the Contractor may close streets or parts of streets to vehicular traffic as soon as the construction work is started; such streets or parts of streets shall remain closed as long as construction work or condition of the finished work requires. The Engineer will determine how many streets or parts of streets may be closed by the Contractor at one time, and may refuse to allow the closing of additional streets until some of the improvement is finished and opened to traffic.
2. The Contractor shall notify the Engineer 48 hours in advance (excluding weekends) of closing any roads, streets, or public thoroughfares. No road or street shall be closed without prior approval from the Engineer.
3. The Contractor shall not remove, relocate, or reset any permanent Jurisdictional traffic control devices unless authorized to do so by the Engineer or contract documents. If a sign must be removed or relocated for any phase of construction, the Contractor shall notify the Engineer of the necessity for removal. The Engineer shall arrange for the removal, relocation, or resetting of permanent traffic control devices by Jurisdictional personnel as needed to allow the work to proceed. If Jurisdictional personnel are not available, the authorized Jurisdictional representative may give authorization to the Contractor to remove, relocate, or reset the permanent traffic control devices.

2.06 TRAFFIC CONTROL (Continued)

4. In the event the Contractor removes or relocates a traffic control sign without prior notice to or authorization from the Engineer, the Contractor shall bear all responsibility and liability to any person sustaining bodily injury or property damage on account thereof.

2.07 PROTECTION OF ABOVEGROUND AND UNDERGROUND FACILITIES

- A. The Engineer has attempted to show on the plans all aboveground and underground facilities, including public and private utilities, which may be affected by the work. The location, depth, and size of each such facility shown on the plans is approximate only and is not guaranteed. Other underground facilities may exist and their location may not be presently known or identified. It is the Contractor's responsibility to determine the existence and exact location of all such facilities located within the construction area to avoid damage.
- B. Where existing facilities are shown in the contract documents or encountered within the construction area, it shall be the responsibility of the Contractor to notify the operators of those facilities prior to beginning any construction activities. The Contractor shall allow access to those facilities for necessary modification of services. The Contractor shall support, sustain, and protect existing pipes, conduits, poles, wires, and other apparatus located under, over, along, across, or adjacent to the work site. If such utilities are damaged through Contractor's negligence, they will be repaired by the agencies having control of same, but the cost of such repairs shall be paid by the Contractor.
- C. The Contractor shall, prior to commencing any excavation or other operation that may affect underground facilities, notify the "Iowa One Call" underground facility locate system, established pursuant to Iowa Code Chapter 480. The Contractor shall, if requested by the operator of an underground facility, assist in the location of its facilities; provided, however, the Jurisdiction shall not be responsible to the Contractor or to any operator of an underground facility for the cost of locating such facility, or for any damage to such facility that occurs in attempting to locate it, or for any damage to the facility occasioned by the Contractor's performance of work under the contract.
- D. Claims for additional compensation will not be allowed to the Contractor for any interference, delay, or additional work occasioned by the location or adjustment of aboveground or underground facilities, or connections thereto.

2.08 PROTECTION OF PROPERTY

- A. The Contractor shall continuously maintain adequate protection of all its work from damage and shall protect the Jurisdiction's property and adjacent private property from injury or loss arising in connection with the work. The Contractor shall repair or restore any such damage, injury, or loss to Jurisdiction property or adjacent private property.
- B. Protect existing facilities, trees, and shrubs to remain in place. Any damage to existing trees or shrubs, branches, and root systems to remain and to be protected shall be repaired and/or pruned by an experienced tree surgeon or arborist. Do not disturb soil within 10 feet of the drip line of trees without notifying the Engineer. The Contractor shall mark the 10 foot limit from the drip line.
- C. The Contractor shall continuously maintain its work area by undertaking mowing, weed control, and solid waste management in a manner matching the maintenance level of the area properties. Failure to do so within three working days after direction from the Engineer may cause the Jurisdiction to do the work and the cost thereof deducted from the Contractor's next payment.

2.09 LAND MONUMENTS

- A. The Contractor will be required to preserve all center stones, land monuments, or other property marks the Contractor may find in prosecuting the work. The Contractor shall notify the Engineer of the finding of any land monuments and shall not remove or disturb same until permission is given to do so, at which time the Contractor shall properly remove said landmarks under the direction of the Engineer.
- B. For every land monument lost or destroyed by the Contractor, the Contractor may be charged, and such amount shall be deducted from any monies due or may become due to the Contractor under the contract.

2.10 DUST CONTROL

During construction operations, the Contractor shall be responsible for the control of dust to a degree compatible with the area in which the construction is being performed and with existing environmental regulations. In the event the Contractor does not control dust as specified, the Jurisdiction reserves the right to order dust control to be performed by other forces and withhold the cost thereof from any monies due or may become due to the Contractor under the contract.

2.11 ENVIRONMENTAL AND HISTORIC ITEMS

If contaminated soils, historical artifacts, or other environmental or historic items are encountered, stop work and notify the Engineer.

2.12 RAILROAD CROSSINGS

The authority for performing work beneath, at grade, or over railroad tracks will have been previously secured by the Jurisdiction. It shall be the Contractor's responsibility to contact the railroad company officials prior to beginning the work on railroad property or easements. The Contractor shall perform the work without damage to the facilities and property of the railroad or its lessees, and in strict observance of requirements for the safety of the railroad property and operations. All such work will be subject to the inspection of the railroad's representative. The Contractor shall protect, indemnify, and hold the Jurisdiction harmless from any and all damages resulting from its operations on railroad property or easements or in the construction of railroad crossings according to Section 1070, Part 3 - Bonds and Insurance.

2.13 BORROW AND WASTE SITES

- A. Unless borrow or waste sites are designated on the plans or specified in the special provisions, the Contractor shall secure and operate such sites at its own expense.
- B. In all cases, borrow and waste sites shall be operated in such a manner as to meet Federal, State, and local safety, environmental, and health requirements. Site operations, or the result of such operation, that create a definite nuisance or result in damage to public or private property will not be permitted. In all cases, sites shall be approved by the Engineer before use.

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. As an incentive to the Contractor to expedite the work, working days will not be charged for Saturdays the Contractor does work, unless a mandatory six-day work week is specified. Working days will be charged for Sundays and recognized legal holidays if the contractor does work on the controlling item or work requiring inspection.

When cure time of pavements and structural concrete is the controlling item of work, working days will be charged; this will not include Saturdays, Sundays, and recognized legal holidays according to the paragraph above.

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.

2.04 FOUNDATION MATERIALS**A. Select Subgrade Materials:**

1. All soils required for select subgrade materials must be approved by the Engineer. Approval of materials and their use will be based on AASHTO M 145.
 - a. Cohesive soils must meet all of the following requirements:
 - 1) 45% or less silt size fraction.
 - 2) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
 - 3) Plasticity index greater than 10.
 - 4) A-6 or A-7-6 soils of glacial origin.
 - b. Granular soils must meet all of the following requirements:
 - 1) Density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density).
 - 2) 15% or less silt and clay.
 - 3) Plasticity index of 3 or less.
 - 4) A-1, A-2, or A-3 (0).
2. Crushed stone, crushed PCC, crushed composite pavement, or RAP; mixtures of gravel, sand, and soil; or uniformly-blended combinations of the above; as approved by the Engineer.
3. The Engineer may authorize a change in select subgrade materials subject to materials available locally at time of construction.

B. Granular Stabilization Materials:

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

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

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

C. Subgrade Treatment:

1. **Cement:** Comply with [Section 7010, 2.01, A](#).
2. **Asphalt:** Comply with AASHTO M 140.
3. **Fly ash:** Provide Class C meeting the requirements of ASTM C 618 with a minimum of 22% CaO; the Loss of Ignition requirements in Table 1 will not apply. Approval of source required.
4. **Lime:** Hydrated lime should meet requirements of ASTM C 207, Type N or AASHTO M 216, and others.

2.04 FOUNDATION MATERIALS (Continued)**5. Geogrid:**

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

Table 2010.02: Geogrid (Rectangular or Square)

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

¹ Geogrids meeting the requirements of [Iowa DOT Article 4196.01, B](#) and [Materials I.M. 496.01](#) will be acceptable.

² Dr. Thomas C. Kinney, P.E. and US Army Corps of Engineers.

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

Table 2010.03: Geogrid (Multiaxial)¹

Property	Test Method	Units	Type 3	Type 4
Resistance to loss of load capacity				
Chemical resistance	EPA 9090 Immersion	%	100	100
Ultra-violet light and weathering (500 hrs)	ASTM D 4355	%	80	80
Junction efficiency	GRI-GG2-87 GRI-GG1-87	% of ultimate tensile strength	93	93
Radial stiffness (min.)	ASTM D 6637	lb/ft @ 0.5% strain	15,000	20,000
Rib pitch				
Continuous parallel rib pitch ²	N/A	in.	3.2	3.2
Mid-rib depth ²	N/A	in.	0.04-0.06	0.05-0.08
Mid-rib width ²	N/A	in.	0.035-0.045	0.047-0.055
Node thickness	N/A	in.	0.11	0.13
Rib aspect ratio ³	N/A	in.	> 1.0	> 1.0

¹ Values shown are minimum average roll values according to ASTM D 4759, unless indicated otherwise.

² Nominal dimensions.

³ Ratio of the mid-rib depth to the mid-rib width.

- 6. Geotextiles:** Use a woven or non-woven permeable fabric, manufactured of polymer fibers, meeting the requirements of [Iowa DOT Article 4196.01, B, 5](#).

TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Trench Excavation for Pipe Systems
- B. Trench Foundation Stabilization
- C. Pipe Bedding and Backfill

1.02 DESCRIPTION OF WORK

- A. Excavate trench for pipe installation.
- B. Stabilize trench and install pipe bedding materials.
- C. Place backfill material in trench.

1.03 SUBMITTALS

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

- A. Gradation reports for bedding materials.
- B. Results of required testing.
- C. Dewatering plan.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

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

1. Standard trench excavation.
2. Removal and disposal of excess backfill material resulting from pipe installation.
3. Removal of abandoned private utilities encountered during trench excavation.
4. Furnishing and placing granular bedding material.
5. Placing and compacting backfill material.
6. Dewatering including, but not limited to, all equipment such as generators, pumps, rock for sump pits, discharge piping, and any extra excavation needed to facilitate dewatering according to stormwater regulations, as applicable.
7. Sheet piling, shoring, and bracing.
8. Adjusting the moisture content of excavated backfill material to the range specified for placement and compaction.
9. Temporary support for existing water, sewer, gas, telephone, electric, and other utilities or services that cross the trench.

B. Rock Excavation:

1. **Measurement:** Measurement will be by cubic yards of rock removed.
2. **Payment:** Payment will be at the unit price per cubic yard for the quantity of rock removed.
3. **Includes:** Unit price includes, but is not limited to, furnishing the equipment and labor to break up, remove, and properly dispose of rock encountered in the trench.

C. Trench Foundation:

1. **Measurement:** Measurement will be in tons for the quantity of stabilization material required to replace material removed by over-excavation. Measurement will be based on the scale tickets for the material delivered and incorporated into the project. Trench foundation required to correct unauthorized over-excavation will not be measured.
2. **Payment:** Payment will be at the unit price per ton for the quantity of stabilization material furnished and placed.
3. **Includes:** Unit price includes, but is not limited to, removal and disposal of over-excavated material required to stabilize trench foundation; and furnishing, hauling, and placing stabilization material.

1.08 MEASUREMENT AND PAYMENT (Continued)**D. Removal, Disposal, and Replacement of Unsuitable Backfill Material:**

1. **Measurement:** Measurement will be in cubic yards for the quantity of backfill material required to replace unsuitable backfill material removed during standard trench excavation. Measurement will be based on compacted material in place.
2. **Payment:** Payment will be at the unit price per cubic yard for the quantity of the suitable replacement backfill material furnished.
3. **Includes:** Unit price includes, but is not limited to, removal, hauling, and disposal costs of the unsuitable material and the furnishing, hauling, and placing of the suitable replacement backfill material. Unit price does not include landfill costs for contaminated materials.

E. Special Pipe Embedment or Encasement:

1. **Measurement:** Measurement will be by the linear foot along the centerline of pipe for each type of special embedment or encasement.
2. **Payment:** Payment will be at the unit price per linear foot for each type of special pipe embedment or encasement.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing all required special pipe embedment or encasement materials.

F. Trench Compaction Testing: If the contract documents specify that the Contractor is responsible for trench compaction testing, measurement and payment will be as follows.

1. **Measurement:** Lump sum item; no measurement will be made.
2. **Payment:** Payment will be at the lump sum price for trench compaction testing.
3. **Includes:** Lump sum price includes, but is not limited to, all payments associated with retesting resulting from failure of initial tests.

PART 2 - PRODUCTS**2.01 MATERIALS EXCAVATED FROM A TRENCH**

- A. Standard Trench Excavation:** All materials encountered during trench excavation, except rock and over-excavation.
- 1. Suitable Backfill Material:** Class II, Class III, Class IVA, or Class IVB as defined in Section 3010, 2.02.
 - 2. Unsuitable Backfill Material:** Includes, but is not limited to, the following materials:
 - a. Soils not classified as suitable backfill material, as defined in Section 3010, 2.02.
 - b. Individual stones or concrete chunks larger than 6 inches and averaging more than one per each cubic foot of soil.
 - c. Frozen materials.
 - d. Stumps, logs, branches, and brush.
 - e. Trash, metal, or construction waste.
 - f. Soil in clumps or clods larger than 6 inches, and without sufficient fine materials to fill voids during placement.
 - g. Environmentally contaminated soils.
 - h. Materials removed as rock excavation or over-excavation.
 - 3. Topsoil:** Class V material. Comply with Section 3010, 2.03.
- B. Rock Excavation:** Boulders or sedimentary deposits that cannot be removed in trenches without continuous use of pneumatic tools or blasting.
- C. Over-excavation:** Excavation of unsuitable or unstable material in trenches below the pipe zone, comply with [Figure 3010.101](#).

2.02 BEDDING MATERIAL**A. Class I Material:**

1. Crushed stone complying with the following gradation:

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

2. The Engineer may allow the use of gravel or authorize a change in gradation subject to materials available locally at the time of construction.
3. The Engineer may authorize the use of crushed PCC for pipe sizes up to 12 inches.
4. Use aggregates having a percentage of wear, Grading A or B, not exceeding 50%, determined according to AASHTO T 96.

Section 4040 - Subdrains and Footing Drain Collectors (Continued)

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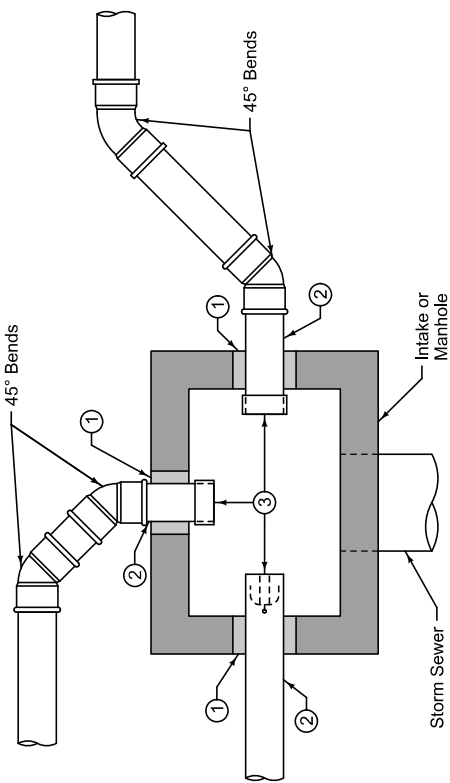
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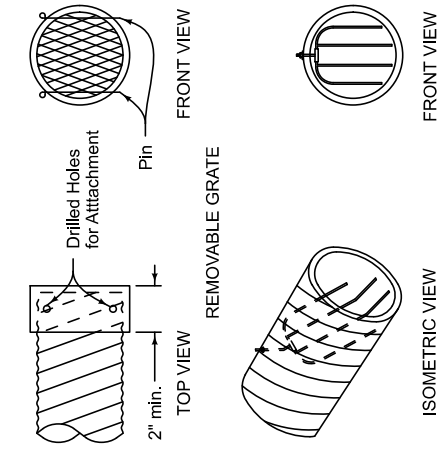
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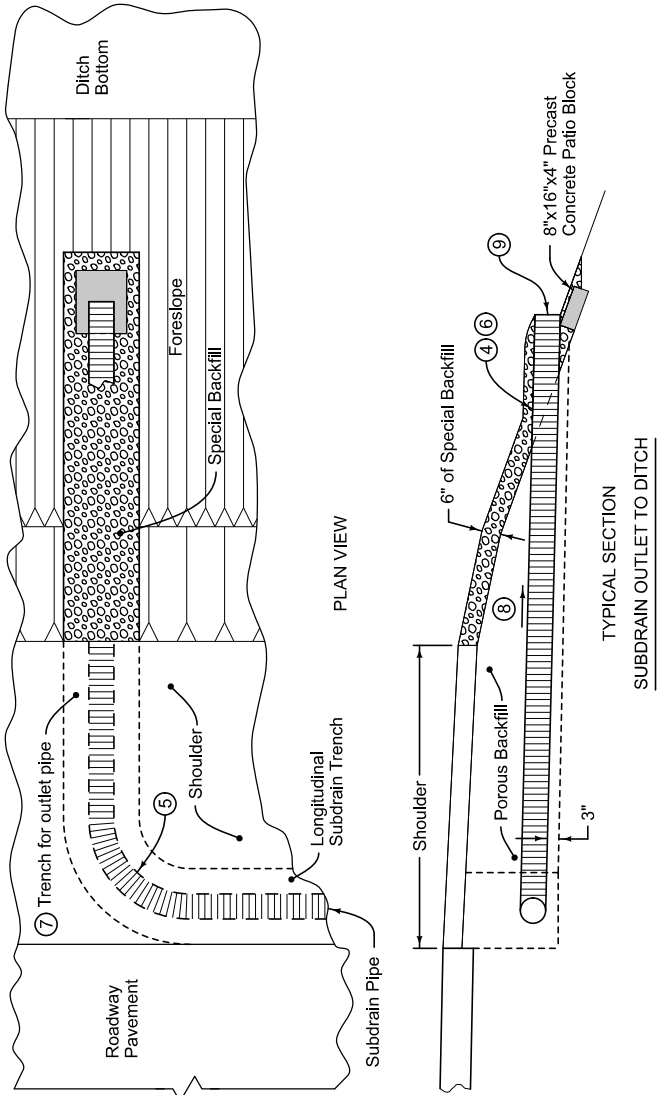
PLAN VIEW
OUTLET INTO STRUCTURE



REMOVABLE GRATE
RODENT GUARD DETAILS

Transverse and backslope subdrains require only single outlets. Install double outlet pipes on all longitudinal subdrain systems, except at the beginning and end of the system. At these locations, install a single outlet pipe.

- ① Fill annular space with non-shrink grout.
- ② Outlets through intake walls to be CMP, corrugated, double-walled HDPE, or PVC.
- ③ Extend outlet pipe into structure as required to install removable rodent guard.
- ④ Construct subdrain outlet to ditch with the same type and size of pipe as used for the subdrain.
- ⑤ Provide a minimum 1 foot radius for all bends or use two 45° fittings
- ⑥ If a CMP outlet is specified in the contract documents, construct the final 10 to 12 feet of the subdrain outlet to ditch with CMP 2 inches larger than the subdrain pipe. Connect pipes with a manufactured coupler or concrete collar.
- ⑦ Provide a minimum trench width of 12 inches for a single outlet and 24 inches for a double outlet.
- ⑧ Provide a 6 inch minimum drop in elevation between longitudinal subdrain and outlet.
- ⑨ For subdrain outlet to ditch, only use fork type rodent guard.



TYPICAL SECTION
SUBDRAIN OUTLET TO DITCH

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SUDAS Standard Specifications

SUBDRAIN OUTLETS

PIPE CLEANING AND REHABILITATION**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Pipe Cleaning
- B. Cured-in-place Pipe (CIPP) Main Lining
- C. Cured-in-place Pipe (CIPP) Point Repair
- D. Cured-in-place Pipe (CIPP) Service Repair
- E. Pressure Testing and Grouting of Sewer Joints
- F. Spot Repairs by Pipe Replacement

1.02 DESCRIPTION OF WORK

- A. Pipe Cleaning:
 - 1. Mainline pipe cleaning (not associated with a rehabilitation or pre-inspection) is light sewer cleaning with a hydraulic flusher and includes cleaning the sewer and associated manholes, including drop connections and benches, to remove all deposits settled (DS).
 - 2. Pre-rehabilitation cleaning and inspection is light sewer cleaning with a hydraulic flusher. Does not include root cutting or removal of deposits or protruding service connections.
 - 3. Additional sewer cleaning is heavy sewer cleaning including an unlimited number of passes with high velocity hydro cleaning equipment / hydraulic spinner nozzle, cutting roots, removing deposits of attached encrustation (DAE), and removing deposits of attached grease (DAGS). Does not include lateral cuts.
- B. CIPP lining for mainline, service (lateral) repair, and point repair.
- C. Pressure testing and grouting of sewer joints.
- D. Pipe spot repairs.

1.03 SUBMITTALS

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

A. CIPP Rehabilitation:

- 1. **Thickness Design:** Submit design calculations for CIPP wall thickness based upon ASTM F 1216, prepared and signed by a licensed Professional Engineer in the State of Iowa.
- 2. **Resin:** Certificate of compliance with ASTM F 1216 or D 5813.
- 3. **Tube:** Certificate of compliance with ASTM F 1216 or F 2019. If glass fiber reinforcement is used, CIPP strain corrosion testing according to ASTM D 3681.
- 4. **Wet Out and Curing:** Complete description of the manufacturer's recommended wet out procedure and curing method for the type of lining proposed.

1.03 SUBMITTALS (Continued)

5. **Safety Procedures:** Submit documentation of National Institute of Occupational Safety and Health (NIOSH) testing, health hazard evaluation, and recommended safety procedures for CIPP workers and public. The safety plan is to include emission stacks a minimum of 6 feet tall and a method to establish a safe perimeter around manholes/emission stacks a minimum of 15 feet in diameter. Based on active air monitoring, workers must wear suitable Personal Protection Equipment (PPE) when initially opening and entering the transport truck or storage unit holding the liner.

B. Grouting Sewer Joints and Service Connections:

1. **Grout:** Description of chemical grout materials to be used.
2. **Additives:** Description of additives to be used including strengthening agents, shrinkage reducers, dye, viscosity modifiers, gel time modifier, freeze/thaw inhibitor, or others.
3. **Root Inhibitor:** Description of chemical root deterrent.
4. **Procedures:** Manufacturer's published recommendations for storing, mixing, testing, and handling chemical grouts.

C. Installer Information: When requested by the Contracting Authority, submit the following prior to the preconstruction meeting.

1. Installer name.
2. Completed project list for last five years including for each project and year completed, client name/address/contact person/phone number, footages installed by pipe diameter, and number of lateral reinstatements.
3. Detailed installation procedures, including estimated times for each task, lateral reinstatement methods, number of required excavations, and other items unique to each product.
4. Video of installation process, if available.
5. Evidence of properly trained personnel.
6. Related ASTM standards or any nationally recognized standards for product installation.
7. Available equipment list.
8. Detailed procedures for repairing the product in the event of future damage or failure and for tapping future service connections, including and required specialized equipment or training.
9. Videos of two rehabilitated sewer sections showing before and after conditions.
10. Additional information may be required. The submittal of prequalification information in no way implies that the product, manufacturer, or installer will be deemed to be qualified. The Contracting Authority, in its sole discretion, will determine whether a product, manufacturer, or installer does or does not qualify as an approved equal.

1.04 SUBSTITUTIONS

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

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

A. Product Information:

1. Product name.
2. Year product first available in the United States.
3. Total footage or number of line segments installed in the United States.
4. Results of all available product testing, including but not limited to leakage, physical properties, pipe stiffness, chemical resistance, strain-corrosion, external loading, flow characteristics, infiltration/inflow reductions, structural capacity, and external hydrostatic loading capacity.
5. Samples of before and after product.
6. Design method.
7. Typical lining thickness for pipe sizes included in the project.

B. Manufacturer Information:

1. Manufacturer name.
2. Years of experience manufacturing the product.
3. Country of manufacture of all product components.
4. Quality control procedures for product manufacture, including inspection requirements, testing procedures, and allowable tolerance levels.
5. Related ASTM standards, or other nationally recognized standards for product manufacturing.

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. Prior to start of work, notify all affected parties 24 hours in advance as to the length of time their service will be blocked.
- B. Unless otherwise specified, the Jurisdiction will provide water at no cost for cleaning and installation of cured-in-place pipe. Utilize an approved double check backflow assembly or open gap.

1.07 SPECIAL REQUIREMENTS (Continued)

- C. Establish a Public Information and Notification Program for contacting each home or business connected to the affected sanitary sewer, informing them of the work to be done and when the sewer will be off-line. The following specific steps are part of the Public Information and Notification Program.
1. Provide written notice to be delivered to each affected home or business describing work, schedule, how the work affects them, and a local telephone number of the Contractor they can call to discuss the project or their problems.
 2. Personally contact each home or business on the day lateral verifications using closed circuit video inspection are to be performed. The homeowner or business will be asked to run water down their drain to verify each lateral. If the homeowner is unavailable, attempt other arrangements (cleanouts) to drain water through the lateral to verify each connection.
 3. Provide written notice and personally contact the home or business the day prior to beginning inversion of the section of sewer to which they are connected.
 4. Personally contact all homes or businesses that cannot be reconnected within the time stated in the written notice.
 5. Furnish and service portable toilets for use by the home or business occupants if so required by any affected served business or homeowner.

1.08 MEASUREMENT AND PAYMENT**A. Pipe Cleaning and Inspection:****1. Mainline Cleaning:**

- a. **Measurement:** Measurement will be made for each diameter range of sewer main cleaned. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.
- b. **Payment:** Payment will be made at the unit price per linear foot for each diameter of cleaning.
- c. **Includes:** Unit price includes, but is not limited to, sewer cleaning, debris removal and transport, post CCTV inspection for Engineer review, and logging of active service taps (if specified). Unit price also includes disposal and associated costs for all debris removed from sewer.

2. Pre-Rehabilitation Cleaning and Inspection:

- a. **Measurement:** Measurement will be made for each diameter range of sewer main cleaned and inspected prior to rehabilitation. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.
- b. **Payment:** Payment will be made at the unit price per linear foot for each diameter of pre-lining cleaning and inspection.
- c. **Includes:** Unit price includes, but is not limited to, pre-cleaning CCTV inspection, light sewer cleaning, debris removal and transport, post cleaning CCTV inspection for Engineer review, and identification and logging of active service taps. Unit price also includes disposal and associated costs for all debris removed from sewer.

3. Additional Sewer Cleaning:

- a. **Measurement:** Measurement will be made on an hourly basis for additional sewer cleaning for each diameter range. Hours will start with the initial cleaning work following the Engineer's approval to proceed and will extend until mechanical cleaning ceases. Time for removal, transporting, and disposal of debris is not included. Diameter ranges: 4 to 12 inch, 15 to 24 inch, and 27 to 30 inch.

1.08 MEASUREMENT AND PAYMENT (Continued)

- b. Payment:** Payment will be made at the unit price per hour for additional sewer cleaning.
- c. Includes:** Unit price includes, but is not limited to, heavy sewer cleaning; root cutting; deposit cutting; and post cleaning CCTV inspection for Engineer review.

4. Debris Removal, Transportation, and Disposal:

- a. Measurement:** Measurement will be made on a per ton basis for decanted and pressed debris removed as a part of additional pipe cleaning.
- b. Payment:** Payment will be made at the unit price per ton for additional pipe cleaning based on tickets from an approved landfill site.
- c. Includes:** Unit price includes, but is not limited to, removing, decanting, transporting, disposing, and paying associated costs for all debris removed from sewer as a part of additional cleaning.

B. Remove Protruding Service Connections:

- 1. Measurement:** Each protruding service connection removed will be counted. Quantity will be based on number of protruding service connections identified in the pre-rehabilitation CCTV inspection and removed from the post-rehabilitation CCTV inspection.
- 2. Payment:** Payment will be made at the unit price for each protruding service connection removed.
- 3. Includes:** Unit price includes, but is not limited to, removal of protruding service connections and debris removal.

C. CIPP Lining:**1. CIPP Main Lining:**

- a. Measurement:** Each size of main pipe lining will be measured in linear feet along the centerline of the pipe lining from center of manhole to center of manhole.
- b. Payment:** Payment will be made at the unit price per linear foot for each size of pipe lining.
- c. Includes:** Unit price includes, but is not limited to, furnishing and installing the liner and appurtenances, CCTV inspection immediately prior to lining, bypass pumping unless otherwise specified, sliding foil, post-lining CCTV inspection, and all costs associated with the public information and notification program.

2. Building Sanitary Sewer Service Reinstatement:

- a. Measurement:** Each active sanitary sewer service reinstated, including those reinstated by excavation, will be counted.
- b. Payment:** Payment will be made at the unit price for each active sewer service reinstated.
- c. Includes:** Unit price includes, but is not limited to, reinstating sanitary sewer service connections, removal of debris, and coordination with service owners.

3. CIPP End Seal:

- a. Measurement:** Each size of CIPP end seal installed will be counted.
- b. Payment:** Payment will be made at the unit price for each CIPP end seal installed.
- c. Includes:** Unit price includes, but is not limited to, end seal and installation.

1.08 MEASUREMENT AND PAYMENT (Continued)**D. CIPP Point Repair:**

1. **Measurement:** Each diameter of CIPP point repair will be counted. Repairs in excess of 10 feet in length will be counted as multiple repairs.
2. **Payment:** Payment will be made at the unit price for each diameter of CIPP point repair.
3. **Includes:** Unit price includes, but is not limited to, furnishing and placing point repair liner, bypass pumping unless otherwise specified, sewer cleaning, removal of obstructions, debris removal, pipe preparation, and pre and post repair CCTV inspection.

E. CIPP Service Repair:

1. **CIPP Service Pipe, Connection:**
 - a. **Measurement:** Each size combination of main and service connection diameters repaired will be counted.
 - b. **Payment:** Payment will be made at the unit price for each size combination of CIPP service pipe, connection.
 - c. **Includes:** Unit price includes, but is not limited to, furnishing and placing service connection liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.
2. **CIPP Service Repair, Partial Pipe:**
 - a. **Measurement:** Each size combination of main and service diameters and specified service length lined will be counted.
 - b. **Payment:** Payment will be made at the unit price for each size combination of CIPP service repair, partial pipe.
 - c. **Includes:** Unit price includes, but is not limited to, furnishing and installing service repair liner, bypass pumping unless otherwise specified, documentation, and all costs associated with the public information and notification program.

F. Pressure Testing and Grouting of Sewer Joints and Service Connections:

1. **Pressure Testing of Mainline Sewer Joints:**
 - a. **Measurement:** Each mainline sewer joint tested will be counted. Separate measurement will be made for each diameter of sewer main. Visually leaking joints, whether tested or not, will be counted if they are grouted.
 - b. **Payment:** Payment will be made at the unit price for each sewer joint tested.
 - c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, control testing, and documentation.
2. **Injection Grouting of Mainline Sewer Joints:**
 - a. **Measurement:** Each mainline sewer joint grouted will be counted. Separate measurement will be made for each diameter of sewer main.
 - b. **Payment:** Payment will be made at the unit price for each sewer joint grouted.
 - c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, material testing, pressure testing after grouting, re-grouting of failed joints, and documentation. Unit price does not include the quantity of chemical grout used.
3. **Pressure Testing of Service Connections:**
 - a. **Measurement:** Each sewer service connection tested will be counted. Separate measurement will be made for service connections on each diameter of sewer main.
 - b. **Payment:** Payment will be made at the unit price for each service connection tested.
 - c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, and documentation.

1.08 MEASUREMENT AND PAYMENT (Continued)**4. Injection Grouting of Service Connections:**

- a. **Measurement:** Each service connection grouted will be counted. Separate measurement will be made for service connections on each diameter of sewer main.
- b. **Payment:** Payment will be made at the unit price for each service connection grouted.
- c. **Includes:** Unit price includes, but is not limited to, bypass pumping unless otherwise specified, material testing, pressure testing after grouting, and documentation. Unit price does not include the quantity of chemical grout used.

5. Chemical Grout:

- a. **Measurement:** Each gallon of chemical grout used for sealing mainline sewer joints and service connections will be counted.
- b. **Payment:** Payment will be made at the unit price for each gallon of chemical grout used.
- c. **Includes:** Unit price includes, but is not limited to, grout additives; root inhibitor; and supplying, mixing, and measurement of chemical grout.

G. Bypass Pumping

1. **Measurement:** Lump sum item, no measurement will be made.
2. **Payment:** Payment will be made at the lump sum price for bypass pumping.
3. **Includes:** Lump sum price includes, but is not limited to, development and submittal of the bypassing plan, all staffing, equipment, and appurtenances necessary to accomplish the approved bypassing plan, including reserve equipment.

H. Spot Repairs by Pipe Replacement: Both of the following methods will be used for measurement and payment of spot repairs by pipe replacement.**1. Spot Repairs by Count:**

- a. **Measurement:** Each spot repair location will be counted.
- b. **Payment:** Payment will be made at the unit price for each spot repair.
- c. **Includes:** Unit price includes, but is not limited to, uncovering and removing existing pipe and furnishing and placing bedding and backfill material for replacement pipe.

and;

2. Spot Repairs by Linear Foot:

- a. **Measurement:** Each spot repair will be measured in linear feet along the centerline of the replacement pipe.
- b. **Payment:** Payment will be made at the unit price per linear foot of spot repair.
- c. **Includes:** Unit price includes, but is not limited to, furnishing and installing replacement pipe and connections.

I. Pavement Removal and Replacement: Comply with [Section 7040](#).**J. Sod:** Comply with [Section 9020](#).**K. Seeding:** Comply with [Section 9010](#).

PART 2 - PRODUCTS**2.01 CIPP MAIN LINING**

A. Fabric Tube and Resin: Comply with ASTM F 1216 for heat cure or ASTM F 2019 and D 5813 for UV light cure.

B. CIPP Lining Dimensions:

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

C. Structural Requirements:

1. Design the CIPP liner according to ASTM F 1216.
2. Unless otherwise specified in the contract documents, assume fully deteriorated conditions and the following properties for design at each location:

Table 4050.01: CIPP Main Lining Design Values

Design Criteria	Value
Factor of safety, N	2.0
Soil modulus, E'_s	1,000 psi
Soil density, ω	120 lb/ft ³
Live load, W_s	H20
Ovality reduction factor, C	As specified for each location
Height of soil above pipe, H	As specified for each location
Height of water above top of pipe, H_w	1/2 depth of cover
Long term flexural strength, σ_L	Use value for 50 year design

3. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.
4. Design for internal pressure or vacuum is not required.

D. CIPP Lubricant: Provide a non-toxic, oil based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

E. CIPP End Seal:

1. **Hydrophilic Gasket Sleeve:** Provide a seamlessly molded gasket and retaining ring system complying with ASTM F 3240.
2. **Expansion Band System:**
 - a. Provide a one-piece rubber gasket and a pair of stainless-steel expansion bands in a system manufactured specifically for CIPP end seal applications.
 - b. Provide bands with positive locking mechanism permanently securing the bands in their expanded position after tightening.
 - c. Comply with material requirements of ASTM C 923 for rubber gasket and stainless steel.

2.02 CIPP POINT REPAIR

A. General: Utilize a repair system that complies with the following requirements.

1. Meet or exceed the material requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.
2. Provides a full wrap section sized to create a circular liner equal to the inner diameter of the pipe. Ensure one end of the CIPP point repair sheet overlaps the second end by a minimum of 10% to allow for variation in pipe diameter.
3. Sufficient strength to bridge missing pipe segments and ability to stretch to fit irregular pipe sizes.
4. Uniform thickness and 10% extra resin.
5. Utilizes a thermoset resin system comprised of a base resin and hardener that cure at ambient temperatures.
6. Has a shrinkage value of less than 0.5% when measured according to ISO 2577 or ASTM D 6289.
7. Designed against corrosion and typical chemicals found in domestic sewage.

B. Liner Length: Minimum length as specified in the contract documents. Lengths beyond 10 feet may be completed with multiple liners.

C. Structural Requirements: Design the CIPP point repair according to the structural requirements for CIPP main lining described herein. Assume an ovality of 2% unless otherwise specified in the contract documents.

2.03 CIPP SERVICE REPAIR

A. General: Utilize a repair system that provides the following.

1. Full circumferential CIPP liner inside the main pipe and a tube that extends continuously from the sewer main into the service for the distance specified in the contract documents.
2. Installation of system from within the sewer main without the need for excavation or access through a clean out.
3. The ability to seal a combination of tees and wyes of varying angles.
4. The ability to seal the connection of the service to the mainline in a continuous, tight fitting, watertight pipe within a pipe that eliminates infiltration and root intrusion between the liner and host pipe.

B. Liner Length:

1. **CIPP Service Connection Repair:** Provide service liner with a length of 12 to 24 inches to seal the connection between the main line and the wye or tee.
2. **Partial Service Pipe:** Provide service liner with a length between 12 and 24 inches, as specified in the contract documents, to seal the connection from the main line to the first service pipe joint.
3. **Main Pipe Liner Length:** Provide main pipe liner with a length of 18 inches minimum.

2.03 CIPP SERVICE REPAIR (Continued)**C. Fabric Tube:**

1. Provide a fabric tube consisting of one or more layers of absorbent non-woven felt fabric, felt/fiberglass, or fiberglass complying with the requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.
2. Provide nominal fabric tube wall thickness to the nearest 0.5 mm increment as required by the thickness design. Ensure the wet-out fabric tube has a uniform thickness that, when compressed at installation pressures, meets or exceeds the design thickness after cure.
3. Coat inside (after installation) of fabric tube with an impermeable, flexible membrane that will contain the resin and facilitate vacuum impregnation.
4. Mark the fabric tube with the name of the lining system manufacturer and manufacturing lot or production footage. Ensure print is visible during final CCTV inspection.

D. Resin:

1. Provide a chemical-resistant thermoset (heat or UV light) resin and catalyst system or epoxy resin and catalyst / hardener system that, when cured within the fabric tube, complies with requirements of ASTM F 1216 or ASTM F 2019 and ASTM D 5813.
2. Method of cure may be by heat source, UV light, or ambient temperature.
3. Provide resin to tube ratio as recommended by the manufacturer.

E. Structural Requirements:

1. Design the cured-in-place service liner according to ASTM F 1216 utilizing the following assumptions, unless otherwise specified in the contract documents:

Table 4050.02: CIPP Service Design Values

Design Criteria	Value
Factor of safety	2.0
Soil modulus	1,000 psi
Soil density	120 pcf
Live load	H20
Depth of cover	As specified for each location
Groundwater	1/2 depth of cover
Ovality	2%

2. Set the long term (50 year extrapolated) creep retention factor at 50% of the initial design flexural modulus as determined by ASTM D 790 unless long term test data according to ASTM D 2990 substantiates a different retention factor.

2.03 CIPP SERVICE REPAIR (Continued)

3. Comply with the following minimum structural properties:

Table 4050.03: Minimum Structural Properties for CIPP Service

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

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

2.04 CHEMICAL GROUT

- A. Grout:** Provide a chemical grout (chemical sealing material) complying with ASTM F 2304 or ASTM F 2454.
- B. Additives:** Strengthening agents, shrinkage reducers, dyes, viscosity modifiers, gel time modifiers, and freeze/thaw inhibitors, are allowed at the Contractor's discretion. Provide additives compatible with the chemical grout and complying with chemical grout manufacturer's requirements.
- C. Root Inhibitor:** When specified in the contract documents, provide a root deterrent chemical to control root regrowth. Ensure root inhibitor is compatible with chemical grout and additives and complies with grout manufacturer's requirements.

2.05 SEWER DYE

Provide tracer dye complying with NSF/ANSI 60.

2.06 PIPE REPAIR COUPLINGS FOR SPOT REPAIRS BY PIPE REPLACEMENT

- A. Style:** Full circle, fully lined, bolted.
- B. Length:** As recommended by the manufacturer for pipe diameter; 12 inches, minimum.
- C. Materials and Manufacturer:**
- Shells, armors, side bars, lugs, Turner lifting bars; complying with ASTM A 240, Type 304 stainless steel.
 - MIG welds, fully passivated.
 - Rubber gasket complying with ASTM D 2000, AA415 with full coverage and a grid pattern.
 - Stainless steel armor bonded to gasket to bridge lug area.
- D. Nuts and Bolts:** 1/2 inch or 5/8 inch diameter, complying with ASTM A 240, Type 304 stainless steel, and Teflon coated threads.

2.07 SEWER MAIN PIPE (FOR SPOT REPAIRS)

- A. Comply with [Section 4010](#).
- B. Use materials for pipe replacement as specified in the contract documents or approved by the Engineer.

PART 3 - EXECUTION**3.01 SEWER CLEANING AND INSPECTION****A. General:**

1. Provide equipment specifically designed and constructed for sewer cleaning and inspection.
2. Use sewer cleaning equipment manufacturer's recommended size tools for various pipe sizes.
3. Utilize equipment recommended by the manufacturer to protect the manhole and pipe during cleaning and inspection operations.
4. Perform all cleaning and removal operations under CCTV observation to monitor the progress of the work and to monitor the sewer line for damage. Continue until the condition of the host pipe meets the requirements of the liner manufacturer.
5. Flush all debris to downstream manhole. Screen, collect, and remove debris from sewer.
6. Dispose of all sanitary sewer debris and material at a location directed by the Owner. If specified in the contract documents, pay for all disposal fees.

B. Pre-Cleaning Inspection:

1. Complete CCTV inspection of sewer prior to initiating cleaning.
2. Inspect each pipe segment between manholes or access points in a single, continuous run where possible.
3. If line is impassable due to debris or obstructions, reverse setup and inspect from opposite manhole or access point.

C. Sewer Pipe Cleaning:

1. Perform light cleaning with hydraulic flusher or high velocity cleaning equipment to remove loose debris.
2. Complete up to three passes in an attempt to remove all debris from line.
3. If the light cleaning fails to leave the sewer line in a condition ready for lining, contact Engineer for authorization to proceed with additional sewer cleaning.

D. Additional Sewer Cleaning:

1. Notify Engineer prior to performing heavy cleaning as required to remove obstructions, grease, rock, sticks, deposits attached grease (DAGS), deposits attached encrustation (DAE), and roots, so the sewer is ready for lining. This item does not include cutting/grinding protruding service lines.
2. Utilize bucket machines with Teflon or equivalent covers, rotating nozzles, saws or cutters, or high velocity hydro-cleaning equipment.
3. Keep all the debris removed during additional cleaning separate from debris removed during light cleaning. Prior to removal, decant and press debris onsite. Discharge decanted water into a sanitary sewer prior to obtaining the tonnage of the material removed from the sewer..

3.01 SEWER CLEANING AND INSPECTION (Continued)

4. Notify Engineer prior to use of mechanical/hydraulic spinner nozzle, chain flail, or other devices that may damage pipe or service connections.
5. If deposits and obstructions cannot be removed by tools normally used in the sewer cleaning industry, notify the Engineer immediately
6. Maintain a log of time spent performing additional pipe cleaning on each line segment.

E. Remove Protruding Service Connection:

1. Grind or cut services that protrude more than 1/2 inch into the sewer main as approved by the Engineer.
2. Utilize a remote grinding/cutting device specifically designed to remove concrete, vitrified clay, PVC, and other types of pipe materials.
3. Notify the Engineer if ductile iron, steel, cast iron, or other non-typical service materials are encountered to review the ability and risks of removing the protruding services.
4. Grind or cut protruding service flush to the main sewer pipe without scouring or damaging the main sewer or service connection.
5. Notify the Engineer immediately if the sewer main or service pipe are not structurally sound.

F. Post-Cleaning CCTV Inspection: Complete inspection according to Section 4060 and the following.

1. Complete CCTV inspection of sewer upon completion of all sewer cleaning, obstruction removal, and protruding service removal activities.
2. Identify active and inactive service connections by the following:
 - a. Observe each service connection and identify active connections by active sewage flow or evidence of recent sewage flow.
 - b. If the status of the connection is inconclusive, run water down adjacent services to verify the location of each service.
 - c. Dye test connections if necessary to verify active status.
 - b. Accurately measure and log the location and clockwise position of all active service connections.

G. Groundwater: If significant groundwater infiltration is present, which could result in resin loss, resin contamination, reduction in CIPP thickness, or inadequate curing, notify the Engineer prior to installing CIPP liner.**H. Inspection Reporting:**

1. Provide a copy of the pre-cleaning and post-cleaning video inspections. Include on-screen continuous footage, pipe diameter, direction of viewing, manhole number, and street location reference in the recording. Affix labels to the recording media to include the name of the project, the date, and the location of the inspection.
2. Provide a written report of the inspections. Include true to scale drawings of all sewer defects and observation locations. Reference the time stamp on each line item entry on the written report.

3.02 BYPASSING SEWAGE

- A. Submit a bypassing plan to the Engineer for review.
- B. When sewer line flows exceed the values in Table 4050.04, or the depth recommended by the manufacturer of the sewer rehabilitation practice being implemented, reduce flows to acceptable levels.
 1. Plug the line at a point upstream of pipe to be rehabilitated if bypassing is required.
 2. Pump flow to a downstream point or adjacent system as directed by the Engineer.
 - a. Provide pump and bypass lines of adequate capacity to handle all flows.
 - b. Provide adequate reserve pumps on-site for emergency use and for storm flows.
- C. Rehabilitation and inspection work may be completed without bypassing in certain situations including low flow conditions, adequate upstream storage, use of a flow-through packer, or other situations approved by the Engineer. If proposed work will be completed without bypassing, have equipment and plan of action available to implement bypass pumping in the event the work is delayed or sewage levels in the upstream line are in danger of causing backups.

Table 4050.04: Maximum Depth of Flow During Inspection, Testing, and Rehabilitation

Main Diameter	CCTV Inspection	Joint Testing/Sealing
6" to 10"	20% of pipe diameter	25% of pipe diameter
12" to 24"	25% of pipe diameter	30% of pipe diameter
27" and up	30% of pipe diameter	35% of pipe diameter

3.03 CIPP MAIN LINING**A. General:**

1. Clean, prepare, and inspect the repair point according to Section 4050, 3.01
2. Install liner according to the manufacturer's published recommendations, ASTM F 1216, and ASTM F 2019.

B. Resin Impregnation:

1. Vacuum impregnate tube with resin (wet-out) at manufacturer's plant under quality controlled conditions or on-site in mobile wet-out unit.
2. Fill all voids in the tube material, adding 5% to 10% excess resin to allow for migration of resin into the voids and cracks.

C. Insertion:**1. General:**

- a. Perform pre-lining video inspection immediately prior to insertion of the wet-out tube.
- b. Insert the wet-out tube through an existing manhole or approved access.
- c. Ensure the tube is continuous between manholes with no joints. A single tube may span several manhole reaches as allowed by the equipment, properties of the CIPP, and time limits imposed by sewage flows to the host pipe.
- d. Insertion of CIPP indicates acceptance of the host pipe conditions and the suitability of the liner inserted into the host pipe. Repair any failure of CIPP liner due to inadequate cleaning, groundwater infiltration, or defects in the liner system at no additional cost to the Contracting Authority.

3.03 CIPP MAIN LINING (Continued)**2. Inverted Heat-Cured Liner:**

- a. Prior to installation of the liner, place a temperature sensor on the bottom of the host pipe to monitor the temperature of the outside of the liner during the curing process. Place sensor at the termination point or location most distant from the heat source.
- b. Insert the wet-out tube into the inversion device or standpipe with the impermeable plastic liner on the outside of the tube.
- c. Turn back the end of the liner to form a cuff and secure the cuff to the inversion device or standpipe.
- d. Apply air pressure or hydrostatic head as required to invert the tube into the host pipe with the impermeable liner on the inside of the pipe.
- e. Apply lubricant directly to the tube or pour lubricant into the standpipe during the inversion process to reduce friction.
- f. Maintain and adjust pressure as necessary to invert the tube from the point of insertion to the point of termination and to hold the tube tight against the wall, producing dimples at service connections.

3. Pull-In UV Light Cured Liner:

- a. If CIPP manufacturer recommends the use of a sliding foil for the existing pipe conditions, provide sliding foil which covers the lower third to lower half of the pipe circumference. Pull sliding foil into place.
- b. Fold the wet-out liner in half and pull into place through an existing manhole. Monitor pulling speed and tension to avoid exceeding the manufacturer's recommendations.
- c. Pull 1 to 2 feet of excess liner into the termination manhole.
- d. If the product is sensitive to elongation, measure the overall elongation of the tube after pull-in. Ensure the elongation of the tube is less than 2% of the overall length of the segment specified by the manufacturer.
- e. Expand the resin-impregnated tube as necessary to hold the tube tight against the wall, producing dimples at service connections.
- f. Perform CCTV inspection of the inflated liner prior to initiating cure. Confirm alignment and fit prior to initiating cure. Make corrections as necessary to provide a finished liner free of wrinkles and defects.

D. Curing:**1. Heat Cured:**

- a. Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete. Increase pressures to compensate for external ground water, if present.
- b. Cure liner using circulating heated water or steam. Ensure the temperature is sufficient to affect a cure in all sections of the pipe.
- c. Monitor and log the temperature from the sensor placed between the impregnated tube and the host pipe.
- d. Initial cure will occur during heat up and is achieved when exposed portions of the new pipe appear to be hard and sound and the temperature sensor indicates the liner has reached the temperature necessary to effect a cure in the resin.
- e. After initial cure is reached, raise the temperature to post-cure temperatures and hold for a period of time as recommended by the resin manufacturer.
- f. Cool the new pipe to a temperature of 100°F for water cure and 113°F for steam cure before relieving the internal pressure within the section.

2. UV Light Cured:

- a. Automatically record the time, rate of travel of the ultraviolet assembly, pressures, and amount of lamps in operation for each CIPP segment as documentation of correct curing of the fabric tube.
- b. Maintain consistent pressure, as recommended by the liner manufacturer, until curing is complete.

3.03 CIPP MAIN LINING (Continued)

- c. Draw the multi-lamp ultraviolet curing assembly through the pipe at a consistent, predetermined, speed that allows for cross-linking/polymerization of the CIPP resin.
- d. Adjust air pressure during curing as necessary to hold liner tight to the wall. Maintain pressure by adjustment of the outlet valve.
- e. Remove the temporary internal calibration hose installed by the manufacturer after curing is complete.

E. CIPP End Seal Installation:

1. **Hydrophilic Gasket Sleeve:** Install sleeve according to ASTM F 3240, sleeve manufacturer's published recommendations, and the following:
 - a. Do not install sleeve in host pipe more than 24 hours prior to CIPP lining.
 - b. Clean the first 6 inches of the main pipe to remove debris and visible grease deposits.
 - c. Install metal retaining clip at the leading edge of the sleeve. The metal clip may be held in place with adhesive tape if desired.
 - d. Install the sleeve in the main pipe so the leading edge is no more than 6 inches inside the end of the main pipe as measured from the manhole wall.
 - e. If the main pipe has a diameter of 18 inches or larger, utilize anchor screws to hold the sleeve in place.
2. **Expansion Band System:** Install system according to manufacturer's published recommendations and the following:
 - a. After installation of the CIPP liner, trim the end of the liner squarely a distance of 2 to 6 inches from the inside face of the manhole.
 - b. Clean the exposed face of the main pipe to remove debris and loose resin.
 - c. Slide the rubber gasket into the pipe, centering it over the end of the liner. Ensure one expansion band will seat against the liner and the other will seat against the main pipe.
 - d. Expand the expansion bands using a hydraulic expansion tool approved by the band manufacturer.

F. Service Reinstatement:

1. Do not leave sanitary service blocked for more than 24 hours.
2. Reinstatement active service lines from within the main with a CCTV camera and remote cutting tool. Do not reinstatement inactive service connections.
3. Machine the opening to full size of the service connection opening area. Ensure the bottom of the liner opening and service line are flush.
4. Ensure the opening does not have pipe fragments or CIPP fragments that may obstruct flow or snag debris.
5. In the event that service reinstatement results in a liner opening greater than 100% of the service connection opening, or damage to the service connection occurs, install a CIPP service repair to cover the over-cut service connection at no additional cost to the Contracting Authority.
6. If service connection cannot be reinstated remotely and requires excavation complete according to the local plumbing code at no additional cost to Contracting Authority.

3.03 CIPP MAIN LINING (Continued)

G. Inspection: Complete inspection according to Section 4060 and the following.

1. Perform CCTV video inspection of completed CIPP lining, including observance of reinstated service connections. Provide copy of video inspection to Jurisdiction.
2. Ensure the tube is free of dry spots, lifts (spots cured away from the sewer), and delaminations. Remove and replace deficient sections.
3. If the CIPP does not fit tight against the original pipe at its termination point, seal the space between the pipes by filling with a resin mixture or hydrophilic seal compatible with the CIPP.

3.04 CIPP POINT REPAIR

A. Preparation: Clean, prepare, and inspect the repair point according to Section 4050, 3.01.

B. Bypass Pumping: Develop a plan for flow diversion or stoppage. Review with Engineer prior to initiating repair.

C. Installation:

1. Bypass mainline flow according to the submitted bypass plan.
2. Install CIPP point repair according to system manufacturer's published recommendations.
3. Wet-out the liner with the entire volume of resin recommended by the manufacturer.
4. Load the wet-out liner onto the packer and secure in place. Ensure the ends of the packer extend beyond the ends of the liner.
5. Pull the packer into position within the pipe. Verify position with CCTV observation.
6. Apply air pressure to the packer to expand the CIPP point repair liner against the host pipe.
7. Maintain consistent pressure for the duration of the curing period.

D. Inspection: Complete inspection according to Section 4060 and the following.

1. Perform CCTV video inspection of completed CIPP point repair. Provide copy of video inspection to Jurisdiction.
2. Ensure the tube is free of foreign inclusions, dry spots, pinholes, wrinkles greater than 2% of the pipe diameter, and delamination. Remove and replace deficient sections.

3.05 CIPP SERVICE REPAIR

A. Preparation:

1. Prior to installation of the system, clean and prepare the interior of the host and service pipe in according to the manufacturer's written instructions.
2. Remove all debris and obstructions.

3.05 CIPP SERVICE REPAIR (Continued)

3. Perform a post cleaning CCTV inspection in preparation for installation of the lining system.
4. If any obstructions, joint misalignments, broken or collapsed pipe, or other conditions are identified that will prohibit proper installation of the system, notify the Engineer immediately.

B. Installation:

1. Install CIPP service repair according to system manufacturer's published recommendations and to the length specified in the contract documents.
2. Bypass main line flow according to the submitted bypass plan. Coordinate installation with service owner to prevent service line flows.
3. Wet-out the entire liner, including lateral and mainline portions, using vacuum impregnation.
4. Load the lining system inside or on a pressure apparatus and move into position in the mainline pipe at the service connection.
5. Align and verify the position of liner and service line via CCTV prior to initiating installation.
6. Apply air pressure to invert or expand the resin impregnated CIPP into the lateral pipe and push the main-line portion of the system against the main pipe. Maintain pressure until the curing process is complete.
7. Apply heat or UV light as required by the manufacturer to properly cure the liner.
8. If liner is heat cured, follow manufacturer's recommendations for cool-down before relieving pressure.
9. If liner is ambient cured, maintain pressure according to the manufacturer's recommendations before relieving pressure.
10. Remove frayed ends of the system.

C. Inspection and Documentation: Complete inspection according to Section 4060 and the following.

1. Provide Jurisdiction with video documentation of pre-installation conditions and post-installation conditions showing the repair.
2. Ensure the finished CIPP service repair is free of any leakage and visual defects including foreign inclusions, dry spots, lifts, pinholes, major wrinkles, and delamination. Repair any defects that could affect the structural integrity of the system or allow leaks.
3. Maintain a written log of installation conditions according to system manufacturer's recommendations. At a minimum, include time of wet out, time and location of insertion, time of inflation, bladder pressure requirements, required cure time, actual cure time, and cool down duration.
4. Submit documentation of results for CIPP liner material to Jurisdiction.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS**A. General:**

1. Clean, prepare, and inspect the repair point according to Section 4050, 3.01
2. Complete sewer joint and service connection testing and grouting according to the grout supplier and equipment manufacturer's published recommendations, ASTM F 2304, and ASTM F 2454.

B. Equipment:

1. **Joint Testing Device:** Provide a joint testing device (packer), with means for introducing air under pressure into the void area created by the expanded ends of the packer against the host pipe and a means of continuously measuring, viewing, and recording the static pressure of the test medium and grout within the void area only. Provide packer constructed in a manner to allow a limited amount of sewage to flow through at all times.
2. **Service Connection Testing Device:** Provide a service connection testing device with inflatable mainline end elements and a service line grouting plug that creates a void area extending beyond the main connection. Use a service line grouting plug sized to match the diameter of the service being grouted with an effective sealing length of at least 18 inches, unless otherwise specified in the contract documents.
3. **Pumping Equipment:**
 - a. Provide positive displacement metering grout pump and hose delivery system capable of supplying a mixed volume of grout at a minimum of 3 gallons per minute and 30 gallons of uninterrupted flow within 10 minutes.
 - b. Ensure pump system has sufficient discharge pressure (in excess of system pressure losses and groundwater) to deliver grout volume to fill void space within the gel set time of the chemical grout.
4. **Grout Tanks:** When using non-soluble additives, ensure grout tanks have mechanical mixing devices to keep additives in suspension.
5. **Measuring Equipment:** Provide means of measuring and recording the volume of mixed grout pumped for each grouted joint or service connection.

C. Control Tests:

1. Prior to beginning testing and grouting, perform a demonstration test in an above ground 8 inch nominal diameter test cylinder suitable to contain the full length of the packer and sustain the void test pressure. For service line testing, provide an 8 inch test cylinder with 6 inch service tee to receive the lateral bladder.
2. Equip the test cylinder with a pressure gauge to monitor internal pressure and a release valve to exercise a controlled release of pressurized air from the void area to test the packer under both sound and leaking conditions.
 - a. With the void release valve closed, inflate the packer and air test the void at 7 to 10 psi. Ensure the observed void pressure at the test cylinder pressure gauge is within $\pm 1/2$ psi of the test monitoring equipment.
 - b. Crack open the release valve to simulate a small leak. Ensure the pressure drop of the cylinder gauge is within $\pm 1/2$ psi of the test monitoring equipment.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

2. After entering each pipeline segment, but prior to commencement of joint testing, position the packer on a section of sound and clean sewer between two consecutive pipe joints and perform a pressure test. Pressurize packer to between 7 and 10 psi and hold for a period of 15 seconds with a pressure drop of less than 1.0 psi. Deflate packer and ensure that void pressure monitoring equipment drops $\pm 1/2$ psi of initial reading.
3. If any of the control tests are unsuccessful, clean equipment of excess grout or make necessary repairs and retest.

D. Sewer Main Joint Pressure Testing:

1. Test joints at a target pressure equal to $1/2$ psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).
2. Position the packer within the pipe so the packer straddles the pipe joint to be tested. Verify location via CCTV monitoring.
3. Expand the packer ends to isolate the joint from the remainder of the pipe and to create a void area between the pipe joint and testing device.
4. Pump air into void space until the pressure reaches the required test pressure.
5. Stop the flow of air into the void space and observe the void pressure for 15 seconds.
6. If the pressure is maintained with a drop of less than 1 psi, the joint will be considered as having passed the test.
7. If the pressure drops more than 1 psi during the test period, the joint will be considered as having failed and sealing will be required.
8. Deflate packer and verify the void pressure monitor drops to within $\pm 1/2$ psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

E. Service Line Pressure Testing:

1. Test service lines at a target pressure equal to $1/2$ psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).
2. Position the testing device within the line segment to straddle the service connection. Verify location via CCTV.
3. Align the service bladder with the service connection.
4. Apply air pressure to invert or inflate the bladder from the mainline assembly into the service pipe.
5. Expand the packer ends to isolate the section of the service connection to be tested.
6. Introduce air into the void area until a pressure equal to or up to 10% greater than the required test pressure is observed.
7. Stop the flow of air into the void space and observe the void pressure for 15 seconds.
8. If the pressure is maintained, with a pressure drop of less than 2 psi, the connection will be considered as having passed the test.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

9. If the pressure drops more than 2 psi during the test period, the connection will be considered as having failed and sealing will be required.
10. Deflate packer and bladder and verify the void pressure monitor drops to within $\pm 1/2$ psi of 0 psi. Clean equipment if pressure fails to return to 0 psi.

F. Sewer Main Joint Sealing by Injection Grouting: Perform joint sealing according to ASTM F 2304, equipment manufacturer, grout supplier, and the following:

1. Position packer over the faulty joint and expand packer ends, isolating the joint with a tight seal.
2. Pump two-part chemical sealant material into the ratio specified by the grout supplier.
3. Continue to pump grout, in stages if necessary, until "refusal" is achieved.
 - a. Refusal indicates the grout has flowed throughout the void, into the surrounding soil, forming a cohesive seal stopping further flow of grout.
 - b. Under pumping conditions, void pressure will slowly rise as grout is forced into the surrounding soil and begins to set. When void pressure spikes an additional 8 psi or more in a short pumping period of 1 to 5 seconds, the point of refusal is achieved.
 - c. If a quantity of grout equal to 1/2 gallon per inch diameter of pipe size is pumped without reaching the point of refusal, staging may be required. Staging is accomplished by repetitive cycles of pumping and curing until refusal is achieved. Notify Engineer for approval before staging is attempted.
 - d. If joint cannot be sealed by staging, abandon sealing operations at that joint and notify Engineer.
4. Upon reaching refusal, stop grout pumps and allow grout to cure for 30 to 40 seconds.
5. Deflate packer to break away the ring of gel formed in the void and move at least one packer length away from the joint in either direction.
6. Ensure pressure gauge reads zero pressure $\pm 1/2$ psi. If gauge does not return to zero clean equipment.
7. Reposition packer over joint and retest at a pressure equal to the initial test pressure.
8. If joint fails pressure test, repeat grouting and pressure testing procedure until the joint is sealed or Engineer determines grout consumption is too high and continued attempts to seal joint are abandoned.
9. Remove residual sealing materials that extend into the pipe or restrict the flow. Ensure sealed joint surfaces are left flush with existing pipe surface. Remove residual grout material from manhole; do not allow grout to be flushed down the sewer.

G. Service Connection Sealing by Injection Grouting: Perform service sealing according to ASTM F 2454, equipment manufacturer, grout supplier, and the following requirements.

1. Pump two-part chemical sealant material at the ratio specified by the grout supplier.
2. Continue to pump grout, in stages if necessary, until refusal is achieved.
 - a. Under initial pumping conditions, the void pressure will slowly rise to a range of approximately 2 to 4 psi.
 - b. Continue pumping until there is a sudden increase to over 8 psi in a few seconds, indicating refusal.

3.06 PRESSURE TESTING AND GROUTING OF SEWER JOINTS (Continued)

- c. If a quantity of grout equal to 1 gallon per foot of service line bladder plus 3 gallons is pumped without reaching the point of refusal, staging may be required.
 - d. Stage grouting by pumping additional grout equivalent to 1 gallon plus 0.25 gallons per foot of bladder, waiting 1 full minute and retesting. Do not exceed two stages unless approved by Engineer
3. Upon reaching refusal, stop grout pumps and allow grout to cure for 1 full minute.
 4. Deflate service packer, re-inflate, and repeat service line pressure testing.
 5. If the service connection test fails, repeat injection grouting and pressure testing procedures until service is sealed or Engineer determines grout consumption is too high and continued attempts to seal service are abandoned.
 6. Confirm flow after sealing of each service. If a grout blockage exists, immediately clear the service of the blockage.
 7. A thin film of residual grout inside the service, which does not significantly impede flow, is a normal result of sealing and is not considered a blockage.

H. Inspection and Reporting: Comply with ASTM F 2304 Section 12.9 as noted below.

1. **Inspection:** Complete inspection according to Section 4060 and the following.
 - a. Perform CCTV observation and recording of initial pressure testing, sealing operations (if required), and final pressure testing (if required) for each joint or service.
 - b. Perform final CCTV video inspection of sewer main rehabilitated by injection grouting after all grouting work is completed. Provide copy of video to the Jurisdiction.
2. **Reporting:** Upon completion of each pipe segment, submit a report showing the following information for each joint and service connection tested, grouted or both.
 - a. Identification of sewer pipe section tested.
 - b. Type of pipe material, diameter, and depth of pipe to surface at manholes.
 - c. Length of pipe sections between joints.
 - d. Test pressure used before and after sealing and duration of test.
 - e. Location of each joint or service connection tested and any joints or service connections not tested with and explanation for not testing.
 - f. Pass/fail results for each joint or service connection tested.
 - g. Volume of grout material used on each joint or service connection.
 - h. Grout mix record of the batches mixed including amount of grout and catalyst, additives, temperature of the grout solution in the tanks, and gel set time used.

3.07 SPOT REPAIRS BY PIPE REPLACEMENT

- A. Excavate trench according to [Section 3010](#).
- B. Remove existing pipe to the extent required and disconnect affected sewer services.
- C. Install replacement pipe of the same nominal size as the existing pipe.
 1. Use the materials as specified in the contract documents that comply with [Section 4010](#).
 2. Place bedding material according to [Section 3010](#).

3.07 SPOT REPAIRS BY PIPE REPLACEMENT (Continued)

- D. Install pipe repair coupling.
 - 1. Cut pipes to length required allowing no more than a 1/2 inch gap between butted pipe ends at coupling location. Cut pipes perpendicular to centerline.
 - 2. Clean the outside surface of the existing and replacement pipes as required to provide a positive seal with the pipe repair coupling.
 - 3. Wrap coupling around pipes, centered on butt joint, and tighten bolts according to manufacturer's recommendations.
- E. Reconnect sewer services.
- F. Place backfill in trench according to [Section 3010](#).

3.08 CLEANUP AND CLOSEOUT

- A. Verify that the services are reconnected and fully operable, with at least 90% of original capacity.
- B. Submit initial and final recordings in a digital format and on a device approved by the Engineer.
- C. Remove all equipment and debris.

END OF SECTION

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3.06 CONFLICTS**A. Horizontal Separation of Gravity Sewers from Water Mains:****1. Sanitary and Combined Sewers:**

- a. Separate gravity sanitary and combined sewer mains from water mains by a horizontal distance of at least 10 feet unless:
 - 1) The top of a sewer main is at least 18 inches below the bottom of the water main, and
 - 2) The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.
- b. Maintain the maximum feasible separation distance in all cases. 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, provide a linear separation of at least 2 feet and one of the following:
 - 1) Construct sanitary and combined sewers of water main materials meeting the requirements of Section 5010, 2.01.
 - 2) Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

2. Storm Sewers: Separate storm sewers and water mains by at least 10 feet measured edge-to-edge unless it is impossible to do so. When impossible to maintain a 10 feet horizontal separation, maintain a minimum separation of 3 feet and utilize one of the following within 10 feet measured edge-to-edge:

- a. Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
- b. Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
- c. Construct storm sewer pipe of water main materials.
- d. Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

B. Horizontal Separation of Water Mains from Sanitary and Combined Sewer Manholes:

Ensure water pipes do not pass through or come in contact with any part of a sanitary or combined sewer manhole. Maintain a minimum horizontal separation of 3 feet.

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

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

D. Vertical Separation of Sewers and Water Main Crossovers:**1. Sanitary and Combined Sewers:**

- a. Vertically separate sanitary and combined sewers crossing under water mains by 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, do not place the sewer closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.

3.06 CONFLICTS (Continued)

- b. Where the sanitary sewer crosses over or less than 18 inches below a water main, utilize one of the following within 10 feet measured edge-to-edge horizontally, centered on the crossing:
 - 1) Construct sanitary and combined sewers of water main material meeting the requirements of Section 5010, 2.01.
 - 2) Enclose the water main in a watertight casing pipe with an evenly spaced annular gap and watertight end seals.

2. Storm Sewers:

- a. Vertically separate storm sewers from water mains by at least 18 inches measured between the outside edges of the water main and the storm sewer. Maintain the maximum feasible separation distance in all cases. Ensure the sewer and water pipes are adequately supported. Use a low permeability soil for backfill material within 10 feet of the point of crossing.
- b. When impossible to maintain an 18 inch vertical separation when the water main crosses over the storm sewer, maintain a minimum vertical separation of 6 inches and utilize one of the following within 10 feet measured edge-to-edge centered on the crossing:
 - 1) Construct the water main of ductile iron pipe with gaskets impermeable to hydrocarbons.
 - 2) Enclose the water main in a watertight casing pipe with evenly spaced annular gap and watertight end seals.
 - 3) Construct storm sewer pipe of water main materials.
 - 4) Construct storm sewers of reinforced concrete pipe with gaskets manufactured according to ASTM C 443.

E. Surface Water Crossings: Comply with the Recommended Standards for Water Works, 2012 Edition.

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

3.07 TRANSITIONS IN PIPING SYSTEMS

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

3.08 STRUCTURE PENETRATIONS**A. Wall Pipes:**

1. Install where pipes penetrate and terminate at a wall or floor surface of a concrete structure, or where the pipe protrudes through the concrete wall or floor and the protrusion is otherwise unsupported.
2. Provide a waterstop flange near the center of the embedment length. The waterstop is to be cast integrally with the wall pipe, or fully welded to it around the pipe circumference.

B. Wall Sleeves:

1. Install where a pipe passes through a structure wall.
2. Sleeves in concrete walls are to be supplied with a waterstop collar, fully welded, and cast-in-place in the concrete.

3.09 WATER SERVICE STUB

- A. Install water service pipe, corporations, stops, and stop boxes according to local Jurisdiction requirements.
- B. Install 1 inch and smaller corporation valves tapped at 45 degrees above horizontal at a minimum distance of 18 inches from pipe bell or other corporation. Install 1 1/2 inch and 2 inch corporation valves tapped horizontal a minimum distance of 24 inches from pipe bell or other corporation.
- C. Construct trench and place backfill material according to [Section 3010](#).

3.10 WATER MAIN ABANDONMENT

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

A. For Each Pipe to be Abandoned by Capping:

1. Close valves and remove valve boxes as specified in the contract documents.
2. Construct thrust blocks on each end of the active pipes according to [Figure 5010.101](#).
3. Cut pipe to be abandoned a minimum of 5 feet from the closed valve on each end of the active pipes, leaving a minimum of 12 inches of pipe exposed beyond the thrust block.
4. Remove a minimum of 3 feet of the pipe to be abandoned.
5. Install a MJ cap using a retaining gland according to [Figure 5010.101](#) on the end of each pipe to be abandoned and each active pipe.

B. For Each Pipe to be Abandoned by Filling:

1. Close valves and remove valve boxes as specified in the contract documents.
2. Construct thrust blocks on each end of the active pipes according to [Figure 5010.101](#).
3. Cut pipe to be abandoned a minimum of 5 feet from the closed valve on each end of the active pipes, leaving a minimum of 12 inches of pipe exposed beyond the thrust block.

3.10 WATER MAIN ABANDONMENT (Continued)

4. Remove a minimum of 3 feet of the pipe to be abandoned.
5. Install a MJ cap using a retaining gland according to [Figure 5010.101](#) on each pipe to be abandoned and each active pipe.
6. Fill the pipe to be abandoned by pumping with flowable mortar, foamed cellular concrete, or CLSM complying with [Section 3010](#).

3.11 WATER MAIN REMOVAL

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

- A. Close valves as specified in the contract documents.
- B. Construct thrust block on each end of the active pipes according to [Figure 5010.101](#).
- C. Cut pipe to be removed a minimum of 5 feet from the closed valve on each end of the active pipes leaving a minimum of 12 inches of pipe exposed beyond the thrust block.
- D. Install a MJ cap using a retaining gland according to [Figure 5010.101](#) at the end of each active pipe.
- E. Remove and dispose of water main pipe. Furnish, place, and compact backfill material.

3.12 TESTING AND DISINFECTION

Test and disinfect according to [Section 5030](#).

END OF SECTION

1.08 MEASUREMENT AND PAYMENT (Continued)**D. Casting Extension Rings:**

1. **Measurement:** Each casting extension ring will be counted.
2. **Payment:** Payment will be at the unit price for each casting extension ring.
3. **Includes:** Unit price includes, but is not limited to, furnishing and installing each casting extension ring and reinstalling the casting lid.

E. Manhole or Intake Adjustment, Minor:**1. Manhole Adjustment, Minor:**

- a. **Measurement:** Each existing manhole adjusted to finished grade by addition or removal of adjustment rings or adjustment of adjustable casting will be counted.
- b. **Payment:** Payment will be made at the unit price for each minor manhole adjustment.
- c. **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).

2. Intake Adjustment, Minor:

- a. **Measurement:** Each existing intake adjusted to finished grade by addition or removal of adjustment rings or adjustment of adjustable casting will be counted.
- b. **Payment:** Payment will be made at the unit price for each minor intake adjustment.
- c. **Includes:** Unit price includes, but is not limited to, removing existing casting and existing adjustment rings, furnishing and installing adjustment rings, and furnishing and installing new casting.

F. Manhole or Intake Adjustment, Major:**1. Manhole Adjustment, Major:**

- a. **Measurement:** Each existing manhole 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.
- b. **Payment:** Payment will be at the unit price for each major adjustment.
- c. **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.

2. Intake Adjustment, Major:

- a. **Measurement:** Each existing 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.
- b. **Payment:** Payment will be at the unit price for each major adjustment.
- c. **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; placing backfill material; and compaction.

1.08 MEASUREMENT AND PAYMENT (Continued)**G. Connection to Existing Manhole or Intake:****1. Connection to Existing Manhole:**

- a. **Measurement:** Each connection made to an existing manhole will be counted.
- b. **Payment:** Payment will be made at the unit price for each sewer connection.
- c. **Includes:** Unit price includes, but is not limited to, coring or cutting into the existing manhole or intake, removal of existing fillet, pipe connections, replacement of fillet, grout, and waterstop (when required).

2. Connection to Existing Intake:

- a. **Measurement:** Each connection made to an existing intake will be counted.
- b. **Payment:** Payment will be made at the unit price for each sewer connection.
- c. **Includes:** Unit price includes, but is not limited to, coring or cutting into the existing manhole or intake, removal of existing fillet, pipe connections, replacement of fillet, grout, and waterstop (when required).

H. Remove Manhole or Intake:**1. Remove Manhole:**

- a. **Measurement:** Each manhole removed will be counted.
- b. **Payment:** Payment will be made at the unit price for each manhole.
- c. **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.

2. Remove Intake:

- a. **Measurement:** Each intake removed will be counted.
- b. **Payment:** Payment will be made at the unit price for each intake.
- c. **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.

3.04 ADJUSTMENT OF EXISTING MANHOLE OR INTAKE (Continued)

4. Replace infiltration barrier for sanitary sewer manhole using only new materials.

C. Major Adjustment (Adding, Removing, or Modifying Riser or Cone Section): When adjustment is greater than can be accomplished through adding or removing adjustment rings, a major adjustment will be required.

1. Remove casting.
2. Remove top.
3. Remove and replace or modify existing riser section and/or top section according to the method approved by the Engineer.
4. Install new frame and cover or grate. Existing casting may be reinstalled when specified in the contract documents.
5. Replace infiltration barrier for sanitary sewer manhole using only new materials.

3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE**A. General:**

1. Remove existing fillet as necessary to install pipe at required elevation and develop hydraulic channel.
2. Insert pipe into structure and trim end flush with inside wall of structure.
3. Install replacement fillet as necessary.
4. Place backfill material according to [Section 3010](#).

B. Concrete Collar:

1. For new pipes 12 inches or smaller, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to a minimum thickness and width of 6 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.
2. For new pipes larger than 12 inches, install two number 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to minimum thickness and width of 9 inches, providing a minimum of 4 inches of concrete extending beyond the pipe opening.

C. Sanitary Sewer:**1. General:**

- a. Core new openings in existing manholes unless otherwise specified in the contract documents.
- b. Divert flow as necessary. Obtain approval of the diversion plan from the Engineer. Maintain sanitary sewer service at all times unless otherwise specified in the contract documents.

2. Cored Opening:

- a. Insert flexible watertight connector into new opening.
- b. Install and tighten internal expansion sleeve to hold flexible connector in place.
- c. Insert pipe through flexible connector and tighten external compression ring.
- d. Do not install grout or concrete collar for cored opening with flexible connector.

3.05 CONNECTION TO EXISTING MANHOLE OR INTAKE (Continued)

- 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.

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:**
 - a. Core new openings in existing manholes or intakes for all pipes less than 12 inches in diameter.
 - b. Opening to be no greater than 2 inches larger than the outside diameter of the pipe.
 - c. Leave a minimum of 6 inches of manhole or intake wall above and on the sides of the pipe.
- 3. Fill Opening:** Fill opening between manhole or intake wall and outside of pipe with non-shrink grout or construct a concrete collar around the pipe according to Section 6010, 3.05, B.

3.06 DROP CONNECTION TO SANITARY SEWER MANHOLE**A. Internal:**

1. Core opening in existing manhole wall and install flexible watertight connector.
2. Cut incoming pipe so a maximum of 2 inches extends into the manhole.
3. Allow 1 inch clearance between bottom of incoming pipe and top of the receiving bowl. Connect receiving bowl to manhole with stainless steel anchor bolts as recommended by the manufacturer.
4. Install flexible coupler connecting the receiving bowl and the drop pipe.
5. Mount drop pipe on the side of the manhole with stainless steel brackets spaced a maximum of 4 feet apart. Provide a minimum of two brackets per pipe segment.
6. Remove existing concrete fillet as required to accommodate bottom elbow.

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PORTLAND CEMENT CONCRETE PAVEMENT**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Pavement
- B. Curb and Gutter

1.02 DESCRIPTION OF WORK

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

1.03 SUBMITTALS

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

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

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, HANDLING, AND SALVAGING

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

- A. Aggregate Storage:** Comply with [Iowa DOT Article 2301.02, C.](#)
- B. Cement and Fly Ash:** Comply with [Iowa DOT Article 2301.02, C.](#)
- C. Admixtures:** Store in suitable weather tight enclosures which will preserve quality.
- D. Reinforcing Steel:** Store off ground on timbers or other supports.

1.06 SCHEDULING AND CONFLICTS

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

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

1.07 SPECIAL REQUIREMENTS

None

1.08 MEASUREMENT AND PAYMENT**A. PCC Pavement:**

1. **Measurement:** Measurement will be in square yards for each different thickness of PCC pavement. The area of manholes, intakes, or other fixtures in the pavement will not be deducted from the measured pavement area.
2. **Payment:** Payment will be at the unit price per square yard for each thickness of PCC pavement.
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 (excluding cold weather protection; see Section 7010, 1.08, N), safety fencing, concrete for rigid headers, boxouts for fixtures, pavement smoothness testing, and quality control for stringless paving.

B. Air Content Deficiency:

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

C. Pavement Smoothness Deficiency:

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

D. PCC Pavement Thickness Deficiency:

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

E. Curb and Gutter:

1. **Measurement:** Measurement will be in linear feet measured along the face of the curb for each different width and thickness of curb and gutter.
2. **Payment:** Payment will be at the unit price per linear feet of curb and gutter.
3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection (excluding cold weather protection; see Section 7010, 1.08, N), 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 (excluding cold weather protection; see Section 7010, 1.08, N), and boxouts for fixtures.

G. Concrete Median:

1. **Measurement:** Measurement will be in square yards of concrete median. When the curb is integral with the pavement, the width will be measured from back of curb to back of curb.
2. **Payment:** Payment will be at the unit price per square yard of concrete median.
3. **Includes:** Unit price includes, but is not limited to, final subgrade/subbase preparation, bars and reinforcement, joints and sealing, surface curing and pavement protection (excluding cold weather protection; see Section 7010, 1.08, N), and boxouts for fixtures.

H. PCC Railroad Crossing Approach:

1. **Measurement:** Measurement will be in square yards of railroad crossing approach.
2. **Payment:** Payment will be at the unit price per square yard of railroad crossing approach.
3. **Includes:** Unit price includes, but is not limited to, excavation for modified subbase and subdrain, furnishing and installing subdrain, furnishing and installing subdrain outlet or connection to storm sewer, furnishing and installing porous backfill material, furnishing and placing modified subbase material, furnishing and installing reinforcing steel and tie bars, furnishing and placing concrete, furnishing, placing, and compacting asphalt.

I. PCC Pavement Samples and Testing:

1. **Measurement:** Lump sum item; no measurement will be made.
2. **Payment:** Payment will be at the lump sum price for PCC pavement samples and testing.
3. **Includes:** Lump sum price includes, but is not limited to, certified plant inspection, pavement thickness cores, 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.

1.08 MEASUREMENT AND PAYMENT (Continued)

- 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 (excluding cold weather protection; see Section 7010, 1.08, N), safety fencing, concrete for rigid headers, boxouts for fixtures, and pavement smoothness.
- L. Pavement Removal:** Comply with [Section 7040](#).
- M. Fixture Adjustment:** Comply with [Section 6010](#) for adjustment of manholes and intakes and [Section 5020](#) for adjustment of water valves and fire hydrants.
- N. PCC Cold Weather Protection:**
- 1. Measurement:** When cold weather protection is required and authorized by the Engineer, measurement will be in square yards of the area of PCC pavement to be protected. 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 of \$2.50 per square yard. Payment will be limited to protection necessary only within the contract period and with prior authorization of the work by the Engineer. No price modifications will be made for quantity underruns or overruns for this item. Cold weather protection necessary after the completion date, after all calendar days have passed, or after all working days have been used is incidental to the work regardless if a quantity was included in the contract.
 - 3. Includes:** Unit price includes, but is not limited to, all labor, materials, and equipment to install and remove all required protection.

PART 2 - PRODUCTS**2.01 MATERIALS**

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

B. Supplementary Cementitious Materials (SCM):

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

C. Fine Aggregate for Concrete:

1. Meet the requirements of [Iowa DOT Section 4110](#) and [Materials I.M. 409](#), Source Approvals for Aggregates.
2. Comply with the following gradation:

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

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

D. Coarse Aggregate for Concrete:

1. Crushed stone particles with Class 2 durability complying with [Iowa DOT Section 4115](#) and [Materials I.M. 409](#), Source Approvals for Aggregates.
2. Comply with one of the following gradations:

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

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

2.01 MATERIALS (Continued)

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

1. Meet the requirements of [Iowa DOT Section 4112](#) and [Materials I.M. 409](#), Source Approvals for Aggregates.
2. For crushed limestone or dolomite, meet the durability class required for the coarse aggregate. When gravel durability is lower than the coarse aggregate durability requirements, pea gravel is not to exceed 15% of the total aggregate mix.
3. Comply with the following aggregate gradation:

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

4. The Engineer may authorize a change in gradation subject to materials locally available at the time of construction.
- F. Water Requirements:** Comply with [Iowa DOT Section 4102](#). Potable water obtained from a municipal supply, suitable for drinking, may be accepted without testing.
- G. Admixtures:** Meet [Iowa DOT Materials I.M. 403](#) and the requirements for the liquid admixtures shown below. Other admixtures may be used subject to the approval of the Engineer.
1. **Air Entrainment Admixture:** Comply with [Iowa DOT Section 4103](#).
 2. **Retarding and Water Reducing Admixtures:** Comply with [Iowa DOT Section 4103](#).
 3. **Accelerating admixtures (calcium chloride):** Comply with [Iowa DOT Article 2529.02](#).
- H. Bars:** Comply with [Iowa DOT Section 4151](#) for metallic tie bars and dowel bars or [Iowa DOT Section 4156](#) for glass fiber reinforced polymer dowel bars. Meet the tie bar requirements for bar mats. All metallic bars must be epoxy coated.
- I. Expansion Tubes:** Comply with [Iowa DOT Section 4191](#).
- J. Metal Keyways:** Comply with [Iowa DOT Section 4191](#).
- K. Supports for Bars:** Comply with [Iowa DOT Materials I.M. 451.01](#).
- L. Joint Fillers and Sealers:**
1. **Joint Sealers:** Comply with [Iowa DOT Article 4136.02](#).
 2. **Preformed Expansion Joint Fillers and Sealers:** Use the following types of preformed materials for filling expansion joints that comply with [Iowa DOT Article 4136.03](#). When the type is not specified, use a resilient filler.
 - Resilient filler
 - Flexible foam expansion joint filler
 - Tire buffings expansion joint filler
 - Elastomeric joint seals

2.01 MATERIALS (Continued)

M. Liquid Curing Compound: Comply with [Iowa DOT Section 4105](#).

N. Covering:

1. **Burlap:** Comply with [Iowa DOT Section 4104](#).
2. **Plastic Film:** Comply with [Iowa DOT Section 4106](#).
3. **Insulating Cover:** Comply with [Iowa DOT Section 4106](#).

O. Grout Systems: Use polymer grouts that comply with [Iowa DOT Materials I.M. 491.11](#).

2.02 CONCRETE MIXES

A. Mix Design:

1. Comply with Iowa DOT Class C or Class M mix meeting the requirements of [Materials I.M. 529](#). If higher durability mixes are specified, use C-SUD or CV-SUD mixes.
2. Ensure compatibility of all material combinations. If the concrete materials are not producing a workable concrete mixture, a change in the material may be required. Changes will be at no additional cost to the Contracting Authority.

B. Consistency and Workability:

1. Slump:

- a. Use an amount of mixing water that will produce workable concrete of uniform consistency. Unless specifically modified by the Engineer, ensure slump, measured according to [Iowa DOT Materials I.M. 317](#), is no less than 1/2 inch or no more than 2 1/2 inches for machine finish and no less than 1/2 inch and no more than 4 inches for hand finish. When a water reducing admixture is used, the maximum slump may be increased to 5 inches.
- b. If it is not possible to produce concrete having the required consistency without exceeding the maximum allowable water to cement ratio specified, the cement content may be increased or water reducing admixture may be added. Obtain the Engineer's approval. Do not exceed the maximum water to cement ratio. Additional cement or water reducer will be added with no additional cost to the Contracting Authority.
- c. The basic absolute volume of water per unit volume of concrete is based on average conditions. If material characteristics require that the total quantity of water used to secure the required consistency reduces the batch yield (computed on the basis of absolute volumes of the batch quantities used) by more than 2.0%, the Engineer may adjust the proportions to correct the yield. This adjustment will not be a basis for adjustment of the contract unit price.

2. Air Content: Use an approved air entraining agent.

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

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

1. Mix proportions for the various mixes using fly ash and GGBFS are included in [Iowa DOT Materials I.M. 529](#). The maximum allowable fly ash substitution rate is 20%. Do not use a GGBFS substitution rate of more than 35% by weight (mass). The total supplementary cementitious material substitution rate is not to exceed 40%.
2. If C-SUD or CV-SUD mixes are specified, the maximum allowable Class F fly ash substitution rate is 25% and the maximum Class C fly ash substitution rate is 35%. The maximum combination rate is 20% Class C fly ash and 20% GGBFS.
3. When Type IP, IT, or IS cement is used in the concrete mixture, only fly ash substitution will be allowed. Between October 16 and March 15, use of Type IL cement with fly ash and GGBFS or Type IP, IS, or IT cement with fly ash will be allowed only when maturity method is used to determine time of opening. Transport, store, haul, and batch fly ash and GGBFS in such a manner to keep it dry.

PART 3 - EXECUTION**3.01 EQUIPMENT****A. Batching and Mixing Equipment:****1. General:**

- a. **Weighing and Proportioning Equipment:** Comply with [Iowa DOT Article 2001.20](#).
- b. **Mixing Equipment:** Comply with [Iowa DOT Article 2001.21](#).
- c. **Material Bins:** Involves any structure in which materials are stored. Each part of any bin, including foundations and supports, must be adequate to withstand any stress to which it might be subjected to while in use.

2. Batching:

- a. Ensure the batching plant is Iowa DOT calibrated and approved. Provide copy of current calibrations and approvals.
- b. Coordinate the batch plant operation and batch trucks with the paving operation in order to ensure a steady supply of materials.
- c. Operate the batch plant and trucks to minimize dust, noise, or truck nuisances.

3. Mixing:**a. Construction or Stationary Mixer:**

- 1) Ensure the concrete is uniform in composition and consistency. If this condition is not produced because of the size of the batch, the size of the batch may be reduced or the mixing time increased, or both, until this result is obtained. If non-uniform, corrective action must be taken.
- 2) Ensure the methods of delivering and handling the concrete are such that objectionable segregation or damage to the concrete will not occur, and they will facilitate placing with a minimum of handling.

b. Ready Mixed Concrete:

- 1) Ensure the concrete is uniform in composition and consistency. If non-uniform, concrete producers must take corrective action.
- 2) Ready mixed concrete is defined as concrete proportioned in a central plant and mixed in a stationary mixer for transportation in trucks without agitation, proportioned at a central plant, and only partially mixed in a stationary mixer for transportation and finish mixing in a transit mixer, or proportioned at a central plant, and then mixed in a transit mixer prior to or during transit.
- 3) When necessary to add additional mixing water at the site of placement, mix the batch at least an additional 30 revolutions of the drum at mixing speed.
- 4) Ensure each vehicle in which concrete will be delivered is capable of discharging concrete having a slump not over 2 inches at an overall rate for its entire load of not less than 1.25 cubic yards per minute. Ensure the concrete is delivered at a rate sufficient to maintain a sustained rate of progress of not less than 100 feet per hour for the width and depth of pavement to be placed.

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

B. Concrete Delivery Equipment:**1. General:**

- a. In handling concrete from the mixer to the place of deposit, take care to avoid segregation.
- b. When concrete is deposited through a chute, slope the chute to allow concrete to flow slowly without segregation. Place the delivery point of the chute as close as possible to the point of deposit. Keep chutes and spouts clean. Thoroughly flush them with water before and after each run. Discharge the water outside the paving area in an approved concrete washout area.
- c. Provide alternate plan for concrete delivery in event of equipment failure.
- d. Take concrete samples from material placed on the subgrade or subbase.

3.01 EQUIPMENT (Continued)**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.
- 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.

3.01 EQUIPMENT (Continued)

- 3) Will provide consolidation to full width and full depth of concrete placement. Provide intermediate consolidation by using external hand held vibrators.
- 4) Produces a surface reasonably free of voids and tears.
- 5) Provide boom-style screed (drive-in screeds are not allowed) with an auger boom, placement head (water spray mechanism not allowed), guidance equipment, and software to produce 3-dimensional surface.
- 6) Produces pavement smoothness as specified in Section 7010, 3.07, C.

2. Vibrators for Machine Paving:

- a. Consolidate, with a single pass of an approved internal or surface vibrator, the full width and depth of concrete requiring a finishing machine. Operate internal vibrators within a frequency range of 4,000 to 8,000 vibrations per minute. The Engineer may authorize the minimum vibration frequency to be lowered to 3,500 vibrations per minute for particular sections of paving, such as superelevations. Operate surface vibrators within a frequency range of 3,500 to 6,000 vibrations per minute.
 - b. Avoid operating vibrators in a manner to cause a separation of the mix ingredients, either a downward displacement of large aggregate particles or an accumulation of laitance on the surface of the concrete. When forward motion of the paver is reduced, vibrator frequency may need to be reduced to avoid separation of the mix.
 - c. If a vibrator fails to operate within the specifications, repair or change the vibrator before the paving begins:
 - The following day, or
 - The same day if the continuous paving that day is stopped at a header or at the end of a session.
 - d. If two adjacent vibrators fail to operate within the specifications, stop the paving operation and repair or replace the vibrators.
 - e. Stop vibrators whenever forward motion of the paver is stopped.
 - f. Set the internal vibrator penetration depth into the concrete pavement to mid slab or as deep as possible while passing above reinforcing steel. Provide an operating position locking device so that no part of the vibrating unit can be lowered to the extent that it will come in contact with reinforcing steel or tie bars while paving.
 - g. Do not exceed the manufacturer's recommendations for vibrator horizontal spacing. Do not exceed 16 inches from center to center.
 - h. Mount the longitudinal axis of the vibrator body approximately parallel to the direction of paving. Tilt the trailing end of each vibrator downward to a slope of 10 to 30 degrees below horizontal.
 - i. Use vibrators that meet or exceed the following specifications at the manufacturer's design frequency of 10,000 vpm:
 - 1) Amplitude (peak to peak) 0.070 inches.
 - 2) Centrifugal force 1,200 pounds.
- 3. Vibrators for Hand Methods:** Use a vibration rate between 3,500 to 6,000 vibrations per minute, and use an amplitude sufficient to be perceptible on the surface of the concrete more than 12 inches from the vibrating unit.
- 4. Hand Finishing Equipment:** Provide all finishing tools necessary for proper finishing of the concrete including straightedges for checking and correcting finished concrete surfaces.
- 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.

3.01 EQUIPMENT (Continued)

- b. Flexible Forms:** Use steel or wood flexible forms for curves with a radius less than 100 feet.
 - 1) Bracing, support, and staking must prevent deflection or movement of forms.
 - 2) Ensure that forms used to shape back of curbs at returns have height at least equal to design thickness of pavement and curb height.
 - 3) Forms must be free from scale and surface irregularities.
- 6. Curing Equipment:** Use pressure sprayer capable of applying a continuous uniform film of curing compound. Use equipment with a shield if wind conditions do not allow proper coverage
- 7. Concrete Saws:** Use power operated concrete saws capable of cutting hardened concrete neatly.
- 8. Joint Sealing Equipment:** Use equipment capable of cleaning the joint and heating and installing sealant in joints according to manufacturer's recommendations.

3.02 PAVEMENT CONSTRUCTION

A. Removal of Pavement: Comply with [Section 7040, 3.02](#).

B. Final Subgrade/Subbase Preparation:

- 1. General:**
 - a. Meet the requirements of [Section 2010](#) for subgrade construction, subgrade treatment, and subbase construction.
 - b. Trim the subgrade or subbase to the final grade for placement of concrete.
 - c. Unless otherwise ordered by the Engineer, the subgrade or subbase, at time of placing concrete for concrete pavement, must be in a uniformly moist but not muddy condition to a depth of not less than 1 inch.
- 2. Subgrade and Subbase Loading:**
 - a. Travel of concrete delivery trucks on a subgrade or subbase must be approved by the Engineer. In such cases, watering of the subgrade or subbase must be limited to just ahead of the paving machine.
 - b. Enter and exit from side streets to minimize repetitive loading on the subgrade or subbase by concrete trucks.
 - c. Do not allow loads in excess of the legal axle load on the completed subgrade or subbase.
 - d. Partially loaded trucks may be required.
 - e. If subgrade or subbase failure occurs, coordinate the repair with the Engineer.
- 3. Paving Suspended:**
 - a. Suspend the paving operation where subgrade or subbase stability has been lost.
 - b. Do not place concrete on a subgrade or subbase that has become unstable, bears ruts or tire marks of equipment, or that is excessively softened by rain until such subgrade or subbase has been reconsolidated and reshaped to correct the objectionable condition.
 - c. If necessary, scarify to a minimum depth of 6 inches, aerating, and recompact 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.

3.02 PAVEMENT CONSTRUCTION (Continued)**C. Surface Fixture Adjustment:**

1. Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with [Section 6010, 3.04](#) for manhole adjustments and [Section 5020, 3.04](#) for water fixture adjustments.
2. Clean outside of fixture to depth of pavement before concrete placement.
3. Construct boxouts where allowed for later adjustment of fixtures. See [Figure 7010.103](#) for the size and shape of the boxout.

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

1. Ensure forms have sufficient strength to support paving operations being used.
2. Set base of forms at or below subgrade elevation with top of forms at pavement surface elevation. With Engineer approval, extra height forms may be used to shape the back of integral curb and edge of pavement; set base at or below subgrade elevation with top of form at top of curb elevation.
3. Place and secure forms to required grade and alignment. Do not vary the top face of the form from a true plane by more than 1/8 inch in 10 feet, and do not vary the vertical face from a true plane by more than 1/4 inch in 10 feet.
4. If the soil supporting the forms is softened by rain or standing water so that the forms are inadequately supported, or if voids occur under the forms, remove forms. Rework subgrade to proper elevation and density, and reinstall forms.
5. Ensure forms are free of latent concrete and coated with release agent before concrete is placed.

E. Bar and Reinforcement Placement: Ensure bars are clean, straight, free from distortion and rust, and are firmly secured in position as specified in the contract documents. Place all bars in approved storage to prevent damage; do not distribute along the work site except as needed to avoid delay in paving.**1. Tie Bars:**

- a. Place bars prior to vibration. For slip form paving, tie bars may be installed after vibration, provided the concrete is consolidated around the bars. Bars may be supported by approved chairs or may be placed in position by a machine or method approved by the Engineer.
- b. Use approved continuous bolsters with runners to support reinforcement for bridge approach sections. Place the supports transversely across the approach and space them longitudinally no greater than 4 feet. For double reinforced approach sections the top layer of reinforcing may be chaired off the bottom layer of reinforcing using approved continuous high chairs with runners, provided they are positioned directly above the continuous bolsters with runners supporting the bottom layer of reinforcing. Hold epoxy coated reinforcing steel in place with epoxy or plastic coated bar supports and epoxy or plastic coated tie wires.

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.

3.02 PAVEMENT CONSTRUCTION (Continued)

- c. Check the placement of each assembly and the position of the bars within the assembly using a suitable template or other device approved by the Engineer. If the assembly is found to be placed outside of the above tolerances, correct the placement.
- d. Cutting the tie wires of the load transfer assemblies is optional.

3. Bar Mats for Reinforced Pavement:

- a. When reinforced pavement is specified, assemble bar mats accordingly and firmly fastened together at all bar intersections.
- b. Place, secure, latch, and tie bar mats for a continuous mat as specified in the contract documents. Displacement during concrete placement operations is not allowed.
- c. Use chairs to ensure proper placement of bar mats.

4. Tie Bars and Dowel Bars in Existing Pavement:

- a. When anchoring in existing concrete, use a grout system according to the manufacturer's instructions. Obtain the Engineer's approval for the grout system.
- b. For horizontal installations, use either a pressure injection system with mechanical proportioning and mixing, or use encapsulated chemical anchors. Install as follows:
 - 1) Ensure drilled holes to receive the grout match the dimensions and spacing specified in the contract documents. When not specified in the contract documents, the maximum nominal diameter of the hole must be 1/8 inch larger than the outside diameter of the dowel or bar, or as recommended by the manufacturer. Drill holes for tie bars and dowel bars into the face of the existing pavement at midpoint. To ensure proper horizontal alignment, do not allow any hole misalignments to exceed 1/4 inch in the vertical or horizontal plane. Clean the hole with compressed air immediately prior to placing the grout.
 - 2) Use a polymer grout to secure the dowels in the existing pavement. Inject the grout into the rear of the hole with pressure. Use sufficient grout so that when the bar to be grouted is placed in position, excess grout will be forced out the front of the hole. Rotate the bar during the insertion process to ensure complete coating with the grouting material. Hand proportioning and mixing is not allowed.
 - 3) If using grout with approved encapsulated anchors, install according to the manufacturer's recommendations.
 - 4) Use horizontal installation procedures for vertical or angled installations; however, pourable grouts may be used. Pourable grouts must be mechanically mixed.

F. Concrete Pavement Placement:

- 1. Use paving machine for all uniform width pavements 8 1/2 feet or more in width and 250 feet or more in length, unless alternate methods are approved by the Engineer. Screeds and laser guided screeds may be used on short pavement runs up to 250 feet.
- 2. Place, consolidate, and finish the concrete to the full depth and width conforming to the specified crown and cross-section in a single operation.
- 3. 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.

3.02 PAVEMENT CONSTRUCTION (Continued)

8. When placing by hand methods, consolidate the concrete by using vibrating units. Use a definite system or pattern in the operation of the vibrator so the full width of concrete in each linear foot of lane will receive adequate and uniform consolidation. The system and methods of vibrating is subject to approval of the Engineer. Do not use vibrating equipment as a tool for moving concrete laterally.
 9. Stringless Paving:
 - a. Provide an electronic file identifying x, y, and z coordinates for curbs and pavement edges, as well as pavement centerline based on project alignments and elevations.
 - b. Location and elevation of the finished slab should be verified against grade check hubs at 25 foot intervals for the first 100 feet of each days run and at critical locations, such as intakes and through intersections where grades may be flat. The Engineer may waive these requirements if experience has shown compliance with the design elevations.
 - c. Record each verification check and submit to the Engineer.
 - d. At the beginning of paving operations on the project or after each modification to the paving machine, verify the paving equipment is calibrated per the manufacturer's recommendations.
- G. Integral Curbs:** Integral curbs are placed with the pavement in a single paving machine operation; however, hand methods may be allowed for radius, returns, and sections of curb and gutter 100 feet or less in length or in other special sections where mechanical equipment cannot be used.
1. Pave, edge, protect, saw, and cure curb in same manner as pavement.
 2. Finish curb as rapidly as finishing operations on pavement permit. Maximum distance behind paving machine is 100 feet.
 3. Complete final finish on curbs by hand methods, including the use of a 6 foot straightedge.
 4. Check surfaces of curb and gutter with 10 foot straightedge; correct variations greater than 1/8 inch. Ensure top of curb slopes to street when Class A sidewalk will be constructed adjacent to the curb.
 5. For drop curb at driveways and where sidewalks intersect streets, use forms to shape the backs of such curbs.
 6. When using hand methods for building curb, the following additional requirements will apply:
 - a. Remove free water, latency, dust, leaves, or other foreign matter from the slab prior to placing concrete for curb.
 - b. Use freshly mixed concrete; do not store concrete in receptacles at side of pavement for use in curb at a later time; do not use concrete requiring retempering.
 - c. Consolidate curb concrete to obtain adequate bond with the pavement slab and to eliminate honeycomb in the curb. Avoid disturbing the alignment of forms or the gutter flow line.
- H. PCC Railroad Crossing Approach:** Construct according to Section 7010 and [Figure 7010.903](#). Construct asphalt section according to the full depth patch requirements of [Section 7040](#).
- I. Finishing:**
1. **Grade and Crown:** Promptly after concrete has been placed and vibrated, strike off the surface to the true section by the screed. Finish the surface true to crown and grade.

3.02 PAVEMENT CONSTRUCTION (Continued)

2. **Watering the Surface:** The practice of lubricating the pavement surface by sprinkling water by spray, brush, or other methods to afford greater ease in finishing operation is not allowed.
3. **Floats:** Finish surface with wood or magnesium floats; finish from both sides simultaneously if pavement is placed to full width with one pass of paving machine.
4. **Straightedging:**
 - a. After the longitudinal floating has been completed and the excess water has been removed, and while the concrete is still plastic, test the pavement surface for trueness.
 - b. Immediately fill any depressions found with freshly mixed concrete, struck off, consolidated, and refinished.
 - c. Check surface longitudinally while concrete is still plastic; correct any surface deviations greater than 1/8 inch in 10 feet.
5. **Surface Treatment:**
 - a. **Drag Surface Treatment:** Unless otherwise specified, texture the finished surface with an artificial turf or burlap drag treatment.
 - 1) Pull the artificial turf or burlap drag longitudinally over the finished surface to produce a tight, uniform, textured surface, and round the edges in a workmanlike manner.
 - 2) Remove the artificial turf or burlap drag from the pavement surface at regular intervals and clean with water to remove accumulated concrete from the fabric in order to maintain a consistent finished texture.
 - 3) When the desired texture is not attained, the Engineer may require the final finish be a broom finish.
 - b. **Surface Tining:** When surface tining is specified, use a longitudinal tining. Under special circumstances, when specified in the contract documents, transverse tining may be required.
 - 1) **Longitudinal:**
 - a) Complete longitudinal surface tining using a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and uniformly spaced at 3/4 inch intervals. The depth of the grooves must be a minimum of 1/8 inch to a maximum of 3/16 inch in the plastic concrete.
 - b) Use equipment with horizontal and vertical string line controls to ensure straight grooves.
 - c) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.
 - d) At longitudinal joints, leave a 2 to 3 inch wide strip of pavement surface (centered along the joint) that is not grooved for the length of the joint.
 - 2) **Transverse:**
 - a) If transverse surface tining is required or allowed, use a machine with a wire broom or comb. For small or irregular areas, or during equipment breakdown, hand methods may be used. Use a broom or comb with a single row of tines 1/8 inch (+/- 1/64 inch) in width and randomly spaced from 3/8 inch to 1 5/8 inch with no more than 50% of the spacing exceeding 1 inch. The depth of the grooves must be a minimum of 1/8 inch to a maximum of approximately 3/16 inch in the plastic concrete.
 - b) Conduct this operation at such time and in such manner that the desired surface texture will be achieved while minimizing displacement of the larger aggregate particles and before the surface permanently sets.

3.02 PAVEMENT CONSTRUCTION (Continued)

- 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.
- 7. Honeycomb Repair:** When paving without forms, fill any honeycombed area immediately with freshly mixed concrete and work into the slab prior to initial set and the application of curing. Failure to do so may prompt the Engineer to declare the work defective and cause it to be removed and replaced at no additional cost to the Contracting Authority.

J. Surface Curing:

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

K. Construction of Joints:

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

3.02 PAVEMENT CONSTRUCTION (Continued)

- 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.

L. Joint Sealing:**1. Timing:**

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

3.02 PAVEMENT CONSTRUCTION (Continued)**2. Cleaning:**

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

3. Sealing:

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

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

N. Form Removal:**1. Timing:**

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

2. Honeycomb Repair:

- a. When the forms are removed, fill honeycombs with mortar composed of 1 part cement and 2 parts fine aggregate by weight.
- 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°F and rising. At the time of placement, concrete must have a temperature of at least 40°F.
 - 2) Stop mixing and placing when the air temperature is 38°F or less and falling or if the temperature stops rising and does not reach 38°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:

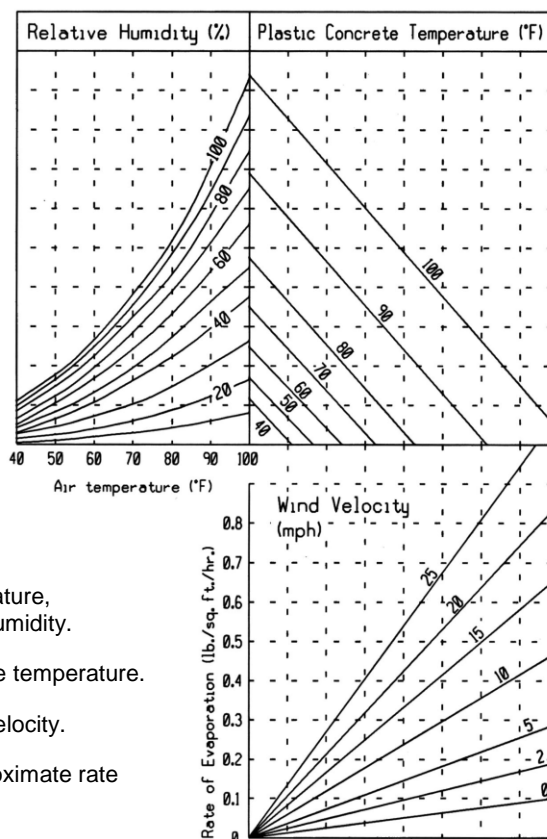
Night Temperature Forecast	Type of Protection ¹
35°F to 32°F	One layer of burlap for concrete.
31°F to 25°F	Two layers of burlap or one layer of plastic on one layer of burlap.
Below 25°F	Four layers of burlap between layers of 4 mil plastic or equivalent commercial insulating material approved by the 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°F for the next 48 hours.
 - d. Forecasted high temperatures exceed 55°F for the next 24 hours and subgrade temperatures are above 40°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.
 - 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°F.

3.04 PAVEMENT PROTECTION (Continued)

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

- 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.

3.04 PAVEMENT PROTECTION (Continued)

- 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. 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 [Iowa 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 Mix	Type of Cement	Minimum Age For Opening ¹	Minimum Compressive Strength (psi)	Minimum Flexural Strength Center Point (psi)
C	Type I	7 Days ²	3,000	500
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. If maturity testing is used to determine opening, minimum flexural strength may be lowered to 350 psi if approved by the Engineer.

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

¹ Refers to the Iowa DOT Materials I.M.s, Iowa DOT Standard Specifications, or SUDAS Standard Specifications.

² Certified plant inspection per [Iowa DOT Materials I.M. 527](#).

³ The Contractor is responsible for developing the maturity curve for the specified mix, taking maturity readings, and delivering a copy of the results to the Engineer.

B. Air Content:

- Air content of the concrete will be evaluated according to [Iowa DOT Materials I.M. 318](#) and [327](#).

3.07 QUALITY CONTROL (Continued)

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

Table 7010.03: Concrete Air Content Price Adjustments

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

*Air content deviation below the acceptable limits

** Air content deviation above the acceptable limits

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

1. **Straightedge:** The Engineer will check PCC pavement surfaces with a 10 foot straightedge placed parallel to the centerline. Areas showing high spots of more than 1/4 of an inch in 10 feet will be marked. Complete surface corrections according to the following procedures 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.
 - a. Complete surface corrections by diamond grinding, placing a PCC overlay, or replacement.
 - b. Use grinding and texturing equipment complying with [Iowa DOT Section 2532](#). Use a minimum 36 inch wide cutting head, unless a 24 inch cutting head is necessary due space limitations.
 - c. Perform surface correction parallel to lane lines or edge lines as directed by the Engineer. Make each pass parallel to the previous pass. Ensure the ground surface is of a uniform texture.
 - d. Do not allow adjacent passes to overlap more than 1 inch or have a vertical difference of 1/8 inch as measured from bottom of groove to bottom of groove.
 - e. Begin and end smoothness corrections at lines normal to the pavement lanes lines or edge lines within any one corrected area. Proceed from the centerline or lane line toward the pavement edge to maintain pavement cross slope.

Surface corrections will be completed at the direction of the Engineer with no additional cost to the Contracting Authority.

3.07 QUALITY CONTROL (Continued)**2. Inertial Profilers:**

- a. If specified in the contract documents, comply with [Iowa DOT Section 2317](#) and [Materials I.M. 341, Appendix A](#) to measure pavement smoothness with an inertial profiler and start appropriate corrective measures, if necessary; the engineer will determine the corrective measures to be taken. No incentive for pavement smoothness will be made.
- b. Evaluate according to the smoothness requirements of Table 7010.04 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.
- c. Smoothness measurements will be suspended for structures and through intersections.

Table 7010.04: Smoothness Adjustment/Correction

Segment Speed	Mean Roughness Index (inches per mile)	Pay Factor
Greater than 45 mph	< 200	100%
	200 to 250	-\$15.00/foot/lane or grind ¹
	≥ 250	Grind ¹
Less than or equal to 45 mph	< 250	100%
	250 to 300	-\$15.00/foot/lane or grind ²
	≥ 300	Grind ²

¹ Correct to below 200 inches per mile² Correct to below 250 inches per mile**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 [Iowa 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. If approved by the Engineer, take non-destructive measurements to determine the pavement thickness and the thickness index for each section.
 - a. Use Magnetic Imaging Tomography (MIT) Scan T2 or T3 gauge to perform thickness measurements.
 - b. Use 24 gauge commercial steel as targets that are 11.81 inches in diameter with G90 coating meeting ASTM A 653.
 - c. The Engineer will determine the location of each lot, the random location of each metal target, and the random thickness measuring scheme for each section using an Iowa DOT developed spreadsheet. Immediately prior to paving, the Engineer will place the target or observe the contractor place the target. The program will randomly determine which targets to measure.

3.07 QUALITY CONTROL (Continued)

- 1) For regular or irregular areas, the section will be divided longitudinally into 1,000 square yard lots. One target will be located in each lot based on the spreadsheet selection. Beginning with the first station at +00, place a target from the edge of the pavement halfway between dowel baskets, if applicable. If the +00 station falls on a basket, move the target location ahead halfway between the dowel baskets. A minimum of 10 targets will be tested. If a target location falls on a bridge or in an approach section, it will be eliminated.
- 2) The transverse location of the targets will be randomly determined by the spreadsheet. The random locations will be 4 feet from edge of pavement, left or right. Place targets in the center of the pavement panel to prevent interference by the steel in the joints. For ease of measuring, plates may be placed 18 inches from the edge if there is no tie steel or a work bridge is not available.
- d. Follow the manufacturer's instructions for operating the thickness gauge. It is important to avoid testing close to any steel including vehicles, equipment, steel toed shoes as well as tie bars, dowel bars and baskets, and manhole covers. When wearing steel toed shoes, always keep both toes at least 2 feet from the gauge during the test. Three repeat readings will be taken. The readings should all be within 0.15 inch of each other.
- e. Evaluate each section according to [Iowa DOT Materials I.M. 346](#).
- f. The Engineer will perform quality assurance testing at a minimum of one random test per seven plate locations, using one of the following methods.
 - 1) Probe during paving operations according to [Iowa DOT Materials I.M. 396](#). Plates may be moved to 18 inches from the edge of the pavement to allow easier testing.
 - 2) Survey, to a minimum of 0.005 foot, on the plate prior to paving and on top of the pavement directly over the plate after placement to determine an accurate thickness verification.
 - 3) MIT gauge according to [Iowa DOT Materials I.M. 346](#). Use a different gauge than the one used by the contractor on the project.
- g. Include all MIT Scan measurements and quality assurance measurements for calculation of pavement thickness. The final pavement thickness will be determined by one of the following:
 - 1) If all the quality assurance measurements are within ± 0.25 inch of the MIT Scan measurements, the MIT Scan measurements will be considered validated. The Engineer will determine final thickness based on the average MIT Scan measurements.
 - 2) If at any one location, the quality assurance measurements are greater than ± 0.25 inch difference from the MIT Scan measurements, core at the plate location and 2 feet away from the plate location. If the core at the plate location indicates that it has moved during placement, use the core thickness from the core taken 2 feet away as the pavement thickness. The Engineer will replace the MIT Scan thickness at the location with the core thickness taken 2 feet away along with the average MIT Scan measurements as final pavement thickness.
 - 3) If all of the quality assurance measurements are greater than ± 0.25 inch difference from the MIT Scan measurements, the Engineer will randomly select a minimum of 10 random locations, at 2 feet from the plate location, for coring by the Contractor. The Engineer will use the average core thickness, tested according to [Iowa DOT Materials I.M. 346](#), to determine final pavement thickness.

3.07 QUALITY CONTROL (Continued)

- h. If any measurement is deficient from T by 0.5 inch or more, the measurement should be rechecked to confirm the reading and the equipment. If the repeat measurement is also 0.5 inch or more below T, mark the location directly over the target. Drill a 4.0 inch diameter core at that location. If the core length confirms the pavement is deficient by 0.5 inch or more, drill a core 60 feet in each direction longitudinally at the same transverse location from the deficient core. Drilling will be continued at 60 feet intervals until a core is obtained that is not deficient. Interpolate between this core and the adjacent core to determine the limits of the deficient area. These additional cores are to be used to define the deficient area and will not be used in the thickness index calculation. When an obstruction, such as a bridge, intersection, previous work, etc., prevents drilling a core at the required 60 feet interval in either direction longitudinally, continue the balance of the distance on the other side of the obstruction.
3. 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.
 4. Based on the thickness index determined by the Engineer, the pavement payment will be as shown in Tables 7010.05 and 7010.06.
 5. 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

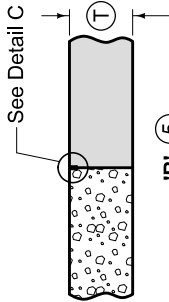
3.07 QUALITY CONTROL (Continued)**Table 7010.06: Pay Factor for PCC Pavement for Design Thickness 9" or Greater**

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

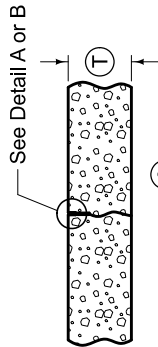
- E. Defects or Deficiencies:** Remove and replace or repair pavement containing excessive cracks, fractures, spalls, or other defects at no additional cost to the Contracting Authority. The method of replacement or repair will be determined by the Engineer.

END OF SECTION

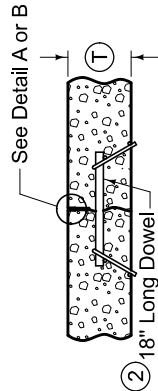
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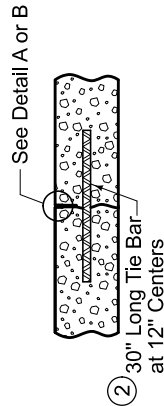
'B' 5
PLAIN JOINT
(Abutting Pavement Slabs)



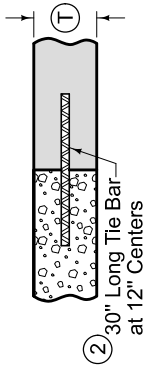
'C' 6
CONTRACTION JOINT



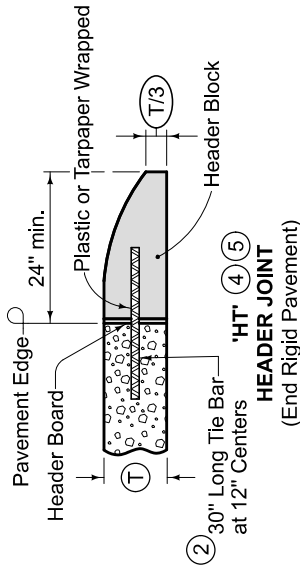
'CD' 1 4 6
DOWELED CONTRACTION JOINT



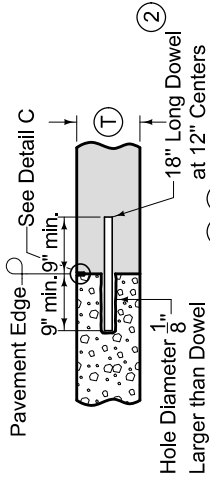
'CT' 4
TIED CONTRACTION JOINT



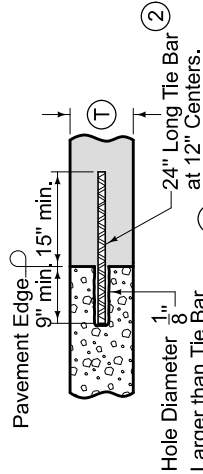
'DW' 3 4 7
DAY'S WORK JOINT (Non-working)



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

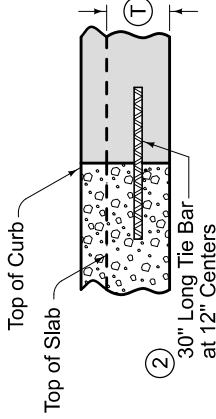


'RD' 4 5
ABUTTING PAVEMENT JOINT



'RT' 4
ABUTTING PAVEMENT JOINT
RIGID TIE

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

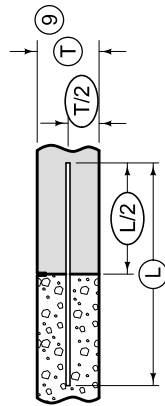


'DW - CG' 3 4
DAY'S WORK JOINT
CURB AND GUTTER UNIT

LEGEND	
	Existing Pavement
	Proposed Pavement

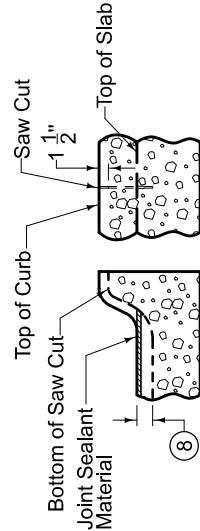
	IOWA DOT	REVISION 12 04-15-25
	FIGURE 7010.101	STANDARD ROAD PLAN
REVISIONS: Added oval dowel bars, Added RT joint		SHEET 1 of 8
SUDAS DIRECTOR		DESIGN METHOD ENGINEER

JOINTS

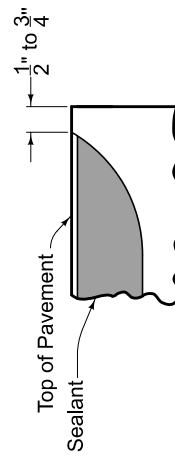


BAR PLACEMENT

(Applies to all joints unless otherwise detailed.)



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

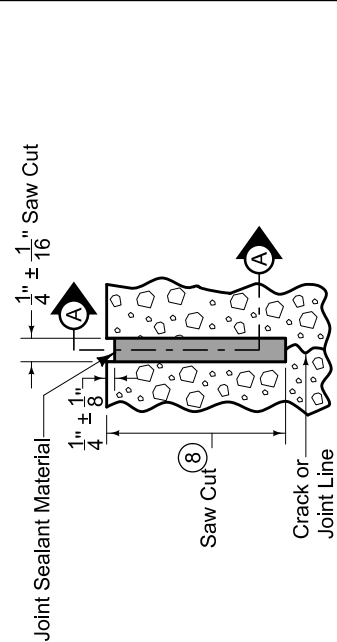


SECTION A-A

(Detail at Edge of Pavement)

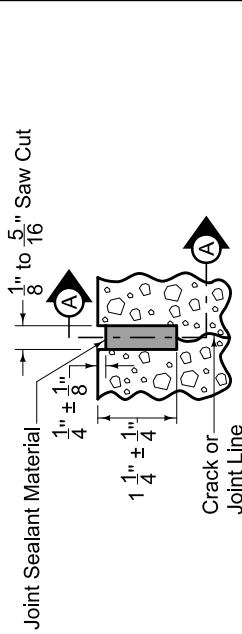
⑧ Saw 'CD' joint to a depth of $T/3 \pm 1/4"$; saw 'C' joint to a depth of $T/4 \pm 1/4"$.

⑨ When tying into old pavement, $\text{\textcircled{T}}$ represents the depth of sound PCC.



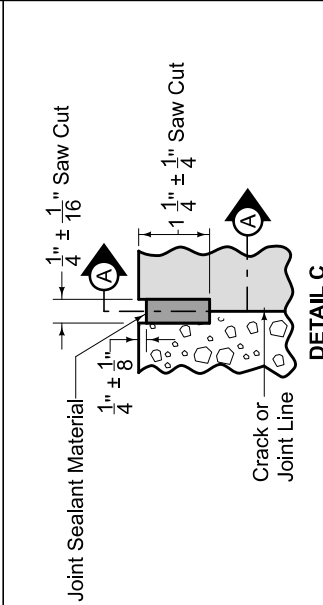
DETAIL A

(Saw cut formed by conventional concrete sawing equipment.)



DETAIL B

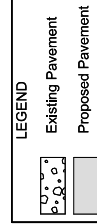
(Saw cut formed by approved early concrete sawing equipment.)



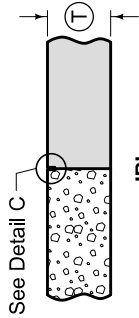
DETAIL C

BAR SIZE TABLE FOR CONTRACTION JOINTS				
	Solid Dowel Diameter	Tubular Dowel Diameter	Elliptical Diameter	Tie Bar Size
⑧	$\frac{3}{4}$ "	$\frac{7}{8}$ "	N/A	#6
⑨	$1\frac{1}{4}$ "	$1\frac{3}{8}$ "	Small	#10
⑩	$1\frac{1}{2}$ "	$1\frac{5}{8}$ "	Medium	#11

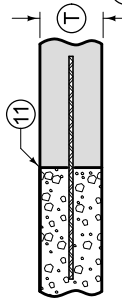
Tubular and Elliptical Dowel Bars will not be allowed for RD joints.



SUDAS IOWA DOT
FIGURE 7010.101 STANDARD ROAD PLAN
 REVISIONS: Added oval dowel bars, Added B/C joint.
 DESIGN DIRECTOR: *[Signature]*
 DESIGN METHODS ENGINEER: *[Signature]*

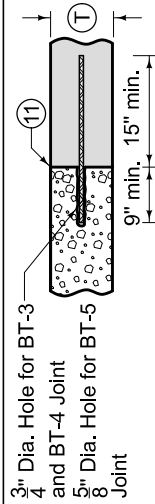


'B'
PLAIN JOINT
(Abutting Pavement Slabs)



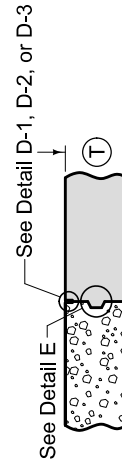
'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE

(T)	Joint	Bars	Bar Length and Spacing
< 8"	'BT-1'	#4	36" Long at 30" Centers
≥ 8"	'BT-2'	#5	30" Long at 30" Centers
	'BT-6'	#5	36" Long at 30" Centers
	'BT-3'	#5	36" Long at 15" Centers

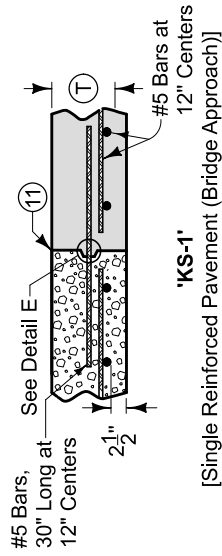


'BT'
ABUTTING PAVEMENT JOINT - RIGID TIE (Drilled)

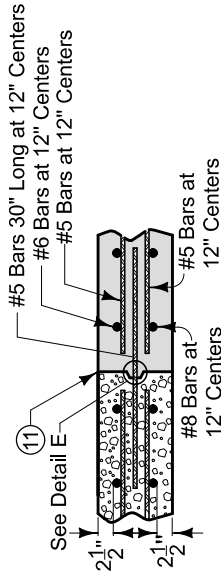
(T)	Joint	Bars	Bar Length and Spacing
< 8"	'BT-5'	#4	24" Long at 30" Centers
≥ 8"	'BT-3'	#5	24" Long at 30" Centers
	'BT-4'		24" Long at 15" Centers



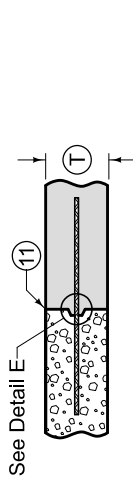
'K'
KEYED JOINT FOR ADJACENT SLABS
(Where T is 8" or more)



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



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



'KT'
ABUTTING PAVEMENT JOINT - KEYWAY TIE

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

LONGITUDINAL CONTRACTION

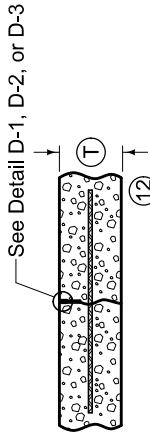
⑩ Bar supports may be necessary for fixed form paving to ensure the bar remains in a horizontal position in the plastic concrete.

⑪ Sawing or sealing of joint not required.

⑫ The following joints are interchangeable, subject to the pouring sequence:

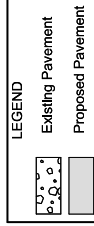
- 'L-1', 'BT-1', and 'KT-1'
- 'L-2', 'BT-2', and 'KT-2'
- 'L-3', 'BT-6', and 'KT-3'

KT joints should not be used when DOT is contracting authority.



'L'
CONTRACTION JOINT

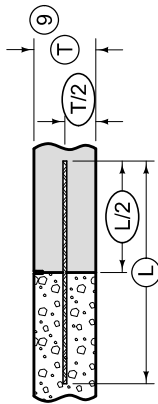
(T)	Joint	Bars	Bar Length and Spacing
< 8"	'L-1'	#4	36" Long at 30" Centers
≥ 8"	'L-2'	#5	36" Long at 30" Centers
	'L-3'		36" Long at 15" Centers



LEGEND
Existing Pavement
Proposed Pavement

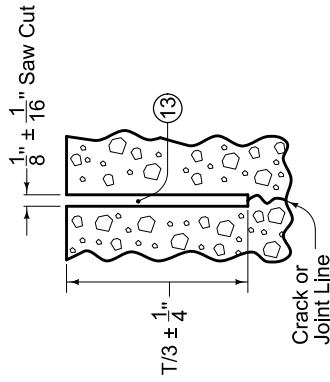
SUDAS IOWA DOT	REVISION 12 04-15-25
	PV-101
FIGURE 7010.101	STANDARD ROAD PLAN
REVISIONS: Added oval dowel bars, Added BT-6 joint	
SUDAS DIRECTOR	
DESIGN METHOD ENGINEER	

JOINTS



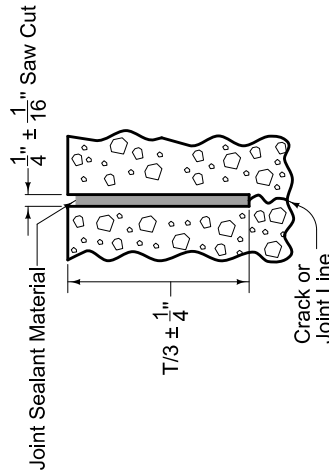
TIE BAR PLACEMENT

(Applies to all joints unless otherwise detailed.)



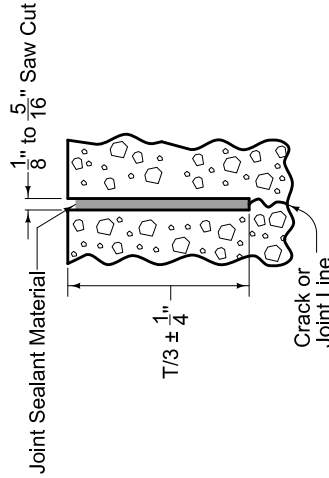
DETAIL D-1

(Required when specified in the contract documents.)



DETAIL D-2

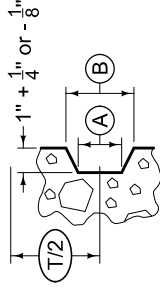
(Required when the Department of Transportation is not the Contracting Authority, or when specified in the contract documents)



DETAIL D-3

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

- ⑨ When tying into old pavement, T represents the depth of sound PCC.
- ⑬ Sealant or cleaning not required.



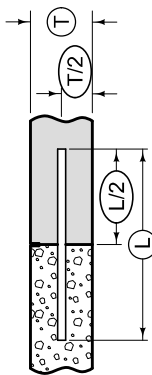
DETAIL E

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

LEGEND

Existing Pavement
 Proposed Pavement

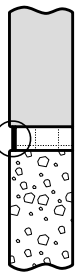
SUDAS FIGURE 7010.101 REVISIONS: Added oval crowl bars, Added Black Joint	IOWA DOT STANDARD ROAD PLAN	REVISION 12 04-15-25 PV-101 SHEET 4 of 8
	DESIGN DIRECTOR: <i>[Signature]</i> DESIGN METHODS ENGINEER: <i>[Signature]</i>	



DOWEL PLACEMENT

(Applies to all joints unless otherwise detailed.)

See Detail H

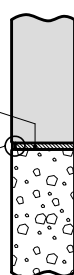


'CF' JOINT

Width (See table below)

TYPE	WIDTH
CF-1	2"
CF-2	2 1/2"
CF-3	3"
CF-4	3 1/2"

See Detail F

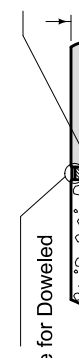


'E' EXPANSION JOINT

1" EXPANSION JOINT

Detail F or Detail G (See Bar Size Table for Doweled Expansion Joints)

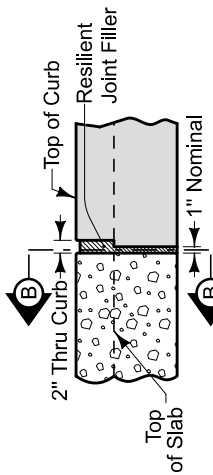
Joint Filler Material (See Bar Size Table for Doweled Expansion Joints)



14 18" Long Dowel at 12" Centers

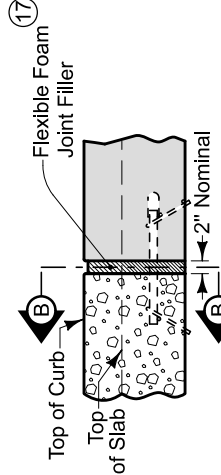
'ED', 'EE', 'EF' (See Doweled Expansion Joints Table)

DOWELED EXPANSION JOINT



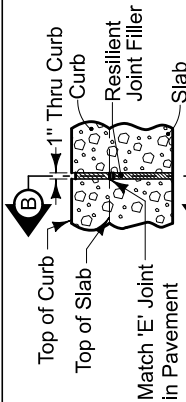
'E' JOINT IN CURB

(View at Back of Curb)



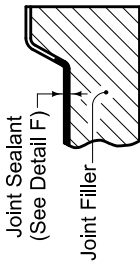
'EE' JOINT IN CURB

(View at Back of Curb)

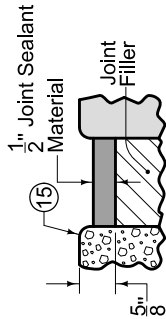


'ES' JOINT IN CURB

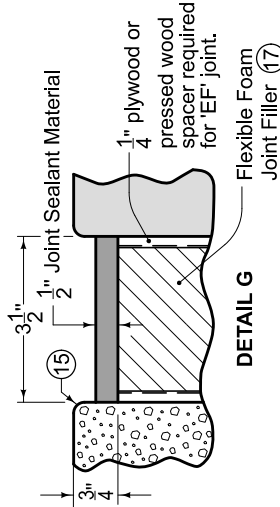
(View at Back of Curb)



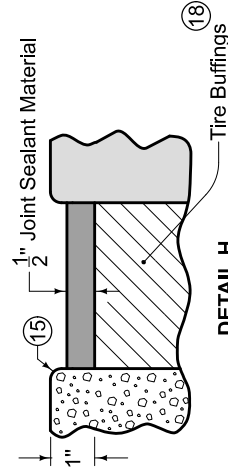
SECTION B-B



DETAIL F



DETAIL G



DETAIL H

EXPANSION

- 14 See Bar Size Table for Doweled Expansion Joints.
- 15 Edge with 1/4 inch tool for length of joint indicated if formed; edging not required when cut with diamond blade saw.
- 16 See Dowel Assemblies for fabrication details and placement limits. Coat the free end of dowel bar to prevent bond with pavement. At intake locations, dowel bars may be cast-in-place.
- 17 Predrill or preform holes in joint material for appropriate dowel size.
- 18 Compact tire buffings by spading with a square-nose shovel.

DOWELED EXPANSION JOINTS	
TYPE	FILLER MATERIAL (17)
ED	1" Resilient (Detail F)
EE	2" Flexible Foam (Detail F)
EF	3 1/2" Flexible Foam (Detail G)

BAR SIZE TABLE FOR DOWELED EXPANSION JOINTS		
(T)	Dowel Diameter	Bar Size
< 8"	3/4"	1 1/4"
≥ 8" but < 10"	1"	1 1/2"

Tubular, GFRP, and Elliptical Dowel Bars will not be allowed for expansion joints.

LEGEND

Existing Pavement

Proposed Pavement

REVISION 12 04-15-25

SUDAS IOWA DOT

FIGURE 7010.101 STANDARD ROAD PLAN

REVISIONS: Added oval dowel bars, Added BT-50 joint

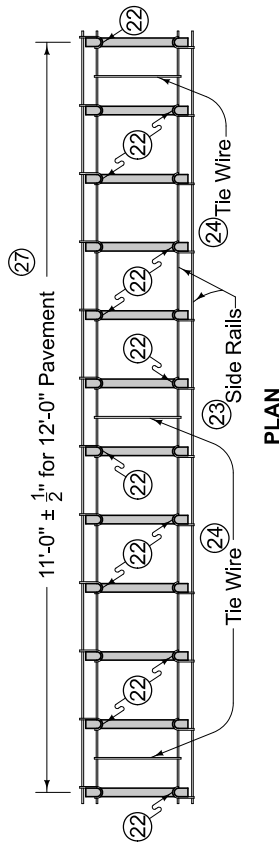
SUDAS DIRECTOR

DESIGN METHODS ENGINEER

SHEET 5 of 8

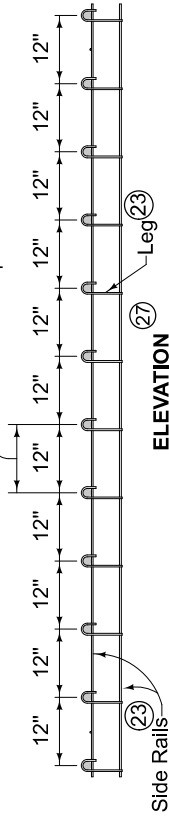
JOINTS

CONTRACTION JOINTS

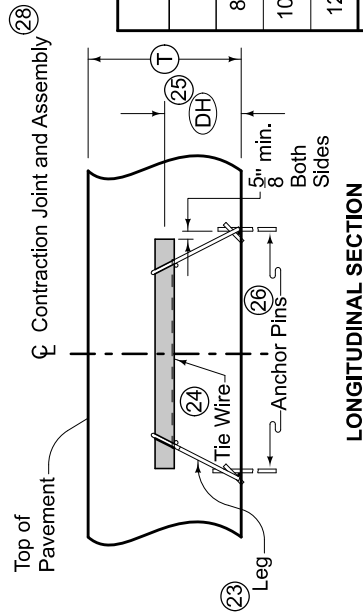


PLAN

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



ELEVATION



LONGITUDINAL SECTION

DOWEL ASSEMBLIES (19) (20) (21)

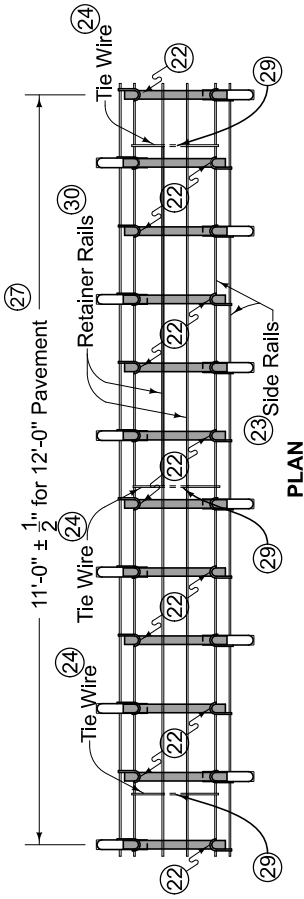
DOWEL HEIGHT AND DIAMETER FOR DOWELED CONTRACTION JOINTS				
(T)	(DH) (25)	Diameter (Solid)	Diameter (Tubular)	Elliptical
8" to 9 $\frac{1}{2}$ "	4 $\frac{1}{4}$ "	1 $\frac{1}{4}$ "	1 $\frac{3}{8}$ "	Small
10" to 11 $\frac{1}{2}$ "	5 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	1 $\frac{5}{8}$ "	Medium
12" to 13"	6 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	1 $\frac{5}{8}$ "	Medium

Tubular, Elliptical Dowel Bars will not be allowed for RD joints.

- (19) Use 18 inch long dowel bars with a tolerance of $\pm 1/8$ inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within $\pm 1/8$ inch.
- (20) Use wires with a minimum tensile strength of 50 ksi.
- (21) Details apply to both transverse contraction and expansion joints.
- (22) Weld alternately throughout.
- (23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.
- (24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.
- (25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.
- (26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.
- (27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.
- (28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.

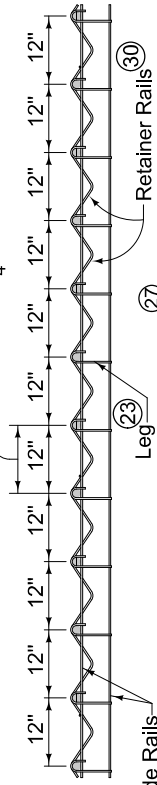
	IOWA DOT	REVISION 12 04-15-25
		FIGURE 7010.101 STANDARD ROAD PLAN SHEET 6 of 8
REVISIONS: Added oval dowel bars, Added B1-C3 joint.		
DESIGN DIRECTOR 		DESIGN METHODS ENGINEER
JOINTS		

EXPANSION JOINTS

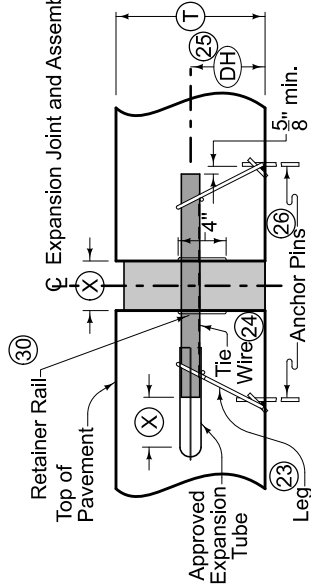


PLAN

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



ELEVATION



SECTION THRU EXPANSION JOINT

JOINT OPENING AND EXPANSION TUBE EXTENSION	
Joint Type	Minimum Tube Length
"ED"	6"
"EE"	7"
"EF"	9"

(T)	(DH)(25)	Diameter
8" to 9 1/2"	4 1/4"	1 1/4"
10" to 11 1/2"	5 1/4"	1 1/2"
12" to 13"	6 1/4"	1 1/2"

Tubular, GFRP, and Elliptical Dowel Bars will not be allowed for expansion joints.

DOWEL ASSEMBLIES

- (19) Use 18 inch long dowel bars with a tolerance of ± 1/8 inch. Ensure the centerlines of individual dowels are parallel to the other dowels in the assembly within ± 1/8 inch.
- (20) Use wires with a minimum tensile strength of 50 ksi.
- (21) Details apply to both transverse contraction and expansion joints.
- (22) Weld alternately throughout.
- (23) 0.306 inch diameter wire. Wire sizes shown are the minimum required.
- (24) Maximum 0.177 inch diameter wire, welded or friction fit to upper side rail, both sides.
- (25) Measured from the centerline of dowel bar to bottom of lower side rail + 1/4 inch.
- (26) Per lane width, install a minimum of 8 anchor pins evenly spaced (4 per side), to prevent movement of assembly during construction. Anchor assemblies placed on pavement or PCC base with devices approved by the Engineer.
- (27) If dowel basket assemblies are required for curbed pavements, the assembly length is based on the jointing layout. See PV-101, sheet 8.
- (28) Ensure dowel basket assembly centerline is within 2 inches of the intended joint location longitudinally and has no more than 1/4 inch horizontal skew from end of basket to end of basket.
- (29) Clip and remove center portion of tie during field assembly.
- (30) 1/4 inch diameter wire.

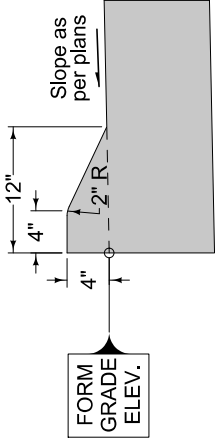
	REVISION 12 04-15-25
	PV-101
FIGURE 7010.101	STANDARD ROAD PLAN
REVISIONS: Added oval dowel bars, Added BT+6 joint	
SUDAS DIRECTOR: <i>[Signature]</i> DESIGN METHOD ENGINEER: <i>[Signature]</i>	
JOINTS	

For joint details, see PV-101.

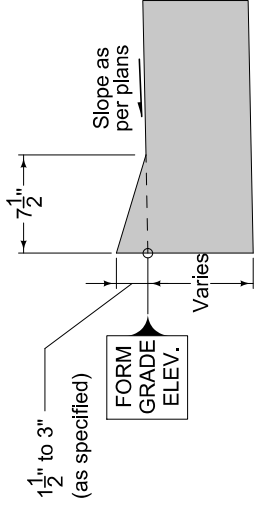
- ① 6 inch Standard Curb, 6 inch Sloped Curb, or 4 inch Sloped Curb as specified.
- ② $\frac{1}{8}$ inch if Proposed Pavement is HMA. No elevation difference if Proposed Pavement is PCC.
- ③ 'BT', 'KT', or 'L' joint if Proposed Pavement is PCC. 'B' joint if Proposed Pavement is HMA.
- ④ 0 to 2 inches for residential entrances, $1\frac{1}{2}$ to 3 inches for industrial or commercial entrances.

		REVISION 5 04-21-20
	FIGURE 7010.102	PV-102
STANDARD ROAD PLAN		SHEET 1 of 2
REVISIONS: Split DRIVEWAY DROP CURB detail into two details. Added new circle note 4 on Sheet 1. Renumbered callouts on Sheet 3.		
R. D. Wiggins SUDAS DIRECTOR DESIGN METHODS ENGINEER		

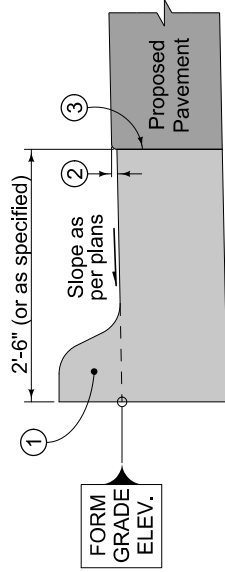
PCC CURB DETAILS



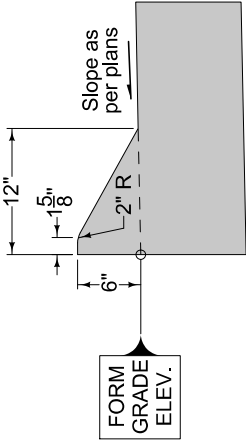
4" SLOPED CURB



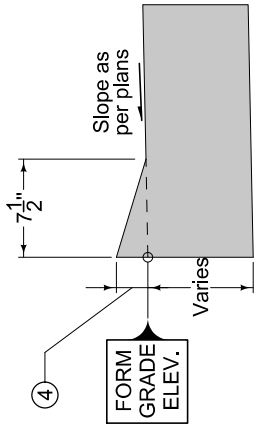
DRIVEWAY DROP CURB
(Iowa Department of Transportation is the Contracting Authority)



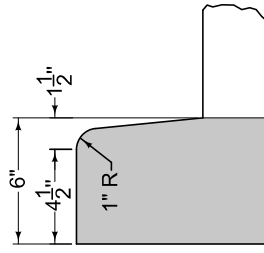
CURB AND GUTTER UNIT



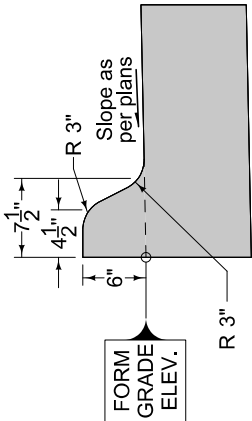
6" SLOPED CURB



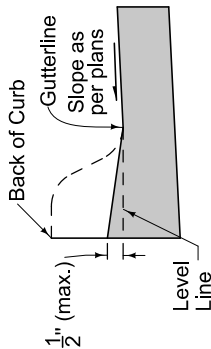
DRIVEWAY DROP CURB
(Iowa Department of Transportation is not the Contracting Authority)



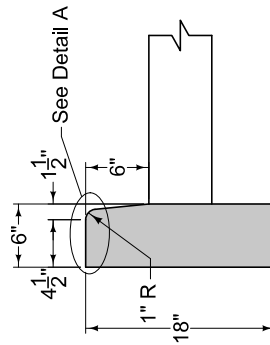
DETAIL A



6" STANDARD CURB



DROP CURB
AT SIDEWALK



BEAM CURB*

*For short replacement sections, match existing curb profile

1.08 MEASUREMENT AND PAYMENT (Continued)

- J. Fixture Adjustment:** Comply with [Section 6010](#) for adjustment of manholes and intakes and [Section 5020](#) for adjustment of water valves and fire hydrants.
- K. Pavement Removal:** Comply with [Section 7040](#).
- L. Subgrade and Subbase:** For excavation and construction of subgrade and subbase, comply with [Section 2010](#).
- M. Asphalt Cold Weather Paving:**
- 1. Measurement:** When cold weather paving is required and authorized by the Engineer, measurement will be in tons of flexible paving mixture in which the warm mix additive is incorporated, regardless of the method of measurement for asphalt pavement.
 - 2. Payment:** Payment will be at the unit price of \$3.00 per ton. Payment will be limited to the use of the warm mix additive incorporated only within the contract period and with prior authorization of the work by the Engineer. No price modifications will be made for quantity underruns or overruns for this item. Warm mix additive necessary after the completion date, after all calendar days have passed, or after all working days have been used is incidental to the work regardless if a quantity was included in the contract.
 - 3. Includes:** Unit price includes, but is not limited to, all additional labor, materials, and equipment to supply and place the flexible pavement under the approved cold weather paving plan.

PART 2 - PRODUCTS**2.01 ASPHALT MATERIALS**

Comply with [Iowa DOT Section 2303](#), with the following exception:

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

2.02 WARM MIX ASPHALT MATERIALS

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

2.03 RECYCLED ASPHALT MATERIALS

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

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

2.04 SUBGRADE AND SUBBASE

Comply with [Section 2010](#).

PART 3 - EXECUTION**3.01 ASPHALT PAVEMENT**

Construct according to [Iowa DOT Section 2303](#) and the following:

- A. Preparation of Pavement Foundation:** Construct subgrade and subbase according to [Section 2010](#).
- B. Compaction:** Compact to a minimum of 94% of laboratory density. Do not exceed 8% average air void level for roadway density specimens.
- C. Tack Coats:** Apply tack coats according to [Iowa DOT Section 2303](#). In addition, if the emulsion is diluted, the dilution must be done by the manufacturer and certified. Provide the Engineer with the new application rate required to achieve the specified undiluted application rate.
- D. Fillets and Runouts:** Rake out coarse aggregate prior to shaping and compaction of fillets and runouts.
- E. Asphalt Railroad Crossing Approach:** Construct according to [Section 7020](#) and [Figure 7020.902](#).
- F. Fixtures in the Pavement Surface:**
 - 1. Adjust manhole frames and other fixtures within area to be paved to conform to finished surface. Comply with [Section 6010, 3.04](#) for manhole adjustments and [Section 5020, 3.04](#) for water fixture adjustments.
 - 2. Clean outside of fixture to depth of pavement before asphalt placement.
 - 3. Construct boxouts where allowed for later adjustment of fixtures. See [Figure 7020.201](#) for the size and shape of the boxout.
- G. Samples and Testing:** Take samples from the compacted material and test according to Section 7020, 3.04. Randomly locate samples in the pavement area. Notify the Jurisdiction the day prior to coring and testing to give the Jurisdiction the opportunity to witness coring and testing.
- H. Cold Weather Paving:** When authorized by the Engineer, comply with the following.
 - 1. **Street Surface Temperatures:** When street surface temperature is below requirements shown in Tables 7020.02 and 7020.03, or when air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40°F, cold weather paving may be considered by the Engineer.

Table 7020.02: Street Surface Temperatures for Base and Intermediate Course Lifts of Asphalt Mixtures

Nominal Thickness (inches)	Street Surface Temperature (°F)
Less than 2	40
2 to 3	35
Over 3	35

3.01 ASPHALT PAVEMENT (Continued)**Table 7020.03: Street Surface Temperatures for Surface Course Lift of Asphalt Mixtures**

Nominal Thickness (inches)	Street Surface Temperature (°F)
1	HMA: 50/WMA: 40
1 1/2	HMA: 45/WMA: 40
2 and Greater	40

2. Cold Weather Paving Plan:

- a. Submit a written cold weather paving plan to the Engineer for approval. Document material, operational, and equipment changes for paving when air temperature approximately 3 feet above grade, in shade, and away from artificial heat sources is less than 40°F.
- b. Include the following:
 - 1) Use an approved mix design that incorporates a warm mix additive. Do not use water injection.
 - 2) Identify warm mix additive and dosage rate.
 - 3) Identify modifications to compaction process and when modifications apply.
- c. If the National Weather Service forecast for the construction area predicts ambient air temperature less than 40°F at the projected time of paving within the next 24 hours, confirm or submit revisions to the cold weather paving plan for Engineer validation. Update plan as required to accommodate conditions anticipated for the next day's operations. Upon validation of the plan, the Engineer will allow paving for the next day. Once in effect, pave conforming to the Engineer-accepted cold weather paving plan for balance of that workday or shift regardless of the temperature at time of paving.
- d. Engineer's written acceptance will be required for the cold weather paving plan. Engineer's acceptance of the plan does not relieve Contractor of responsibility for the quality of pavement placed in cold weather.

3. Restrictions and Limitations:

- a. Do not place flexible paving mixtures over frozen subgrade or base, or where roadbed is unstable.
- b. Engineer may further limit placement if, in the Engineer's judgment, other conditions are detrimental to quality work.

3.02 BASE WIDENING

A. Equipment: Use equipment complying with [Iowa DOT Section 2213](#).

B. Conditions:

- 1. Resurfacing over Concrete Base Widening:** When the existing pavement is asphalt 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. Asphalt 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 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 [Iowa 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 asphalt mixture in the number of lifts required to produce the required thickness. Do not allow the compacted thickness of the top lift to exceed 2 1/2 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 4 1/2 inches.
3. Do not place asphalt 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 asphalt material as soon as the previous lift has been compacted.
7. Obtain the lab density for that day's asphalt paving from an Iowa 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:

1. 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.
2. 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.
3. 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 [Iowa DOT Materials I.M. 204 Appendix F](#). The quality index for density of each lot will be determined by the following formula:

$$\text{Density (Q.I.)} = \frac{(\text{Average } G_{mb})_{\text{Field Lot}} - ((\% \text{ Density})_{\text{Specified}} \times (\text{Average } G_{mb})_{\text{Lab Lot}})}{(\text{Standard Deviation } G_{mb})_{\text{Field Lot}}}$$

where G_{mb} = bulk Specific Gravity of the mixture

3.04 DEFECTS OR DEFICIENCIES (Continued)

- 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 Asphalt Pavement Density

Density Index 7 Samples 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

¹Or 6 samples and 1 outlier. Only one outlier will be allowed.

No incentive payment for pavement density will be made.

C. Thickness Deficiencies:

- The Engineer will measure the cores according to [Iowa DOT Materials I.M. 337](#). All areas of uniform and similar thickness and width for the project will be divided into lots.
- 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:

$$\text{Thickness (Q.I.)} = \frac{\text{Avg. Thickness} - (\text{Design Thickness} - 0.50)}{\text{Max Thickness} - \text{Minimum Thickness}}$$

- 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 Asphalt Pavement Thickness

Thickness Index 7 Samples	Percent Payment (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.

- Do not apply the thickness quality index adjustment to a layer with a designated thickness of "variable" or "nominal", or to a layer designated as a scratch course or leveling course. Do not apply the quality index adjustment to pavement layers designated in the contract documents as grade correction or cross slope correction.

3.05 PAVEMENT SMOOTHNESS

A. Straightedge: The Engineer will check asphalt 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 following procedures 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.

1. Complete surface corrections by diamond grinding, placing an asphalt overlay per [Section 7021](#), replacing the area per [Section 7040](#), or inlaying the area.
2. For diamond grinding, perform the same work and use the same equipment as specified in [Section 7010, 3.07, C](#). After diamond grinding, cover the surface with a slurry seal complying with [Section 7070](#).
3. If the surface is corrected by overlay, replacement, or inlay, begin and end the surface correction with a transverse saw cut normal to the pavement lane lines or edge lines within any one area. Ensure the profile of the surface is smooth with no bumps or dips at the beginning or end of the correction. Correction must be a minimum of the entire lane width.

Surface corrections will be completed at the direction of the Engineer with no additional cost to the Contracting Authority.

B. Inertial Profilers:

1. If specified in the contract documents, comply with [Iowa DOT Section 2317](#) and [Materials I.M. 341, Appendix A](#) to measure pavement smoothness with an inertial profiler and start appropriate corrective measures, if necessary; the engineer will determine the corrective measures to be taken. No incentive for pavement smoothness will be made.
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.
3. Smoothness measurements will be suspended for structures and through intersections.

Table 7020.04: Smoothness Adjustment/Correction

Segment Speed	Mean Roughness Index (inches per mile)	Pay Factor
Greater than 45 mph	< 200	100%
	200 to 250	-\$15.00/foot/lane or correct ¹
	≥ 250	Correct ¹
Less than or equal to 45 mph	< 250	100%
	250 to 300	-\$15.00/foot/lane or correct ²
	≥ 300	Correct ²

¹ Correct to below 200 inches per mile

² Correct to below 250 inches per mile

3.06 QUALITY CONTROL

- A. Provide Quality Management - Asphalt (QM-A) for bid items with asphalt quantities exceeding 1,000 tons. On locally let projects, all testing normally conducted by the Iowa 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 [Iowa 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 [Iowa 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 Iowa 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 [Iowa DOT Section 2521](#) is required.
 - 2) Ensure personnel performing production quality control testing is Iowa DOT certified for the duties performed.
 - 3) Provide easy and safe access to the location in the plant where samples are taken.
 - 4) A "significant mix change" is defined as a single occurrence of an aggregate interchange of greater than 5%, a single occurrence of an asphalt content change greater than 0.2%, or any deletion or introduction of a new material into the mix.
 - b. Sampling and Testing:
 - 1) Sample and test asphalt binder to verify the quality of the binder grade. Take asphalt binder samples at random times as directed and witnessed by the Engineer according to [Iowa DOT Materials I.M. 204](#).
 - 2) Use cold feed or ignition oven gradation for aggregate gradation control to assure materials are being proportioned according to the specifications. Take aggregate samples at random times as directed and witnessed by the Engineer according to [Iowa DOT Materials I.M. 204](#). The Engineer will secure the samples according to [Iowa DOT Materials I.M. 205, Appendix A](#).
 - 3) Sample the hot asphalt mixture at random locations as directed and witnessed by the Engineer according to [Iowa DOT Materials I.M. 322](#). Secure the samples according to [Iowa DOT Materials I.M. 205, Appendix A](#).
 - 4) Assist the Engineer with material sampling for verification testing. When the Engineer provides notification that a sample is to be taken, obtain sample within 15 minutes.
 - 5) Each day's production of a mix design will be considered a lot.
 - a) When the anticipated quantity for the day is 2,000 tons or more, divide that day's production into four sublots, with the first subplot being the first 500 tons produced. The Engineer will divide the remaining anticipated quantity for the day into three equally sized sublots.

3.06 QUALITY CONTROL (Continued)

- b) When the anticipated quantity for the day is less than 2,000 tons, use the first 500 tons produced for the first daily subplot. The Engineer will establish 750 ton daily sublots for mix production exceeding the first 500 tons.
- 6) No more than four paired hot asphalt mixture samples will be required for acceptance of a lot.
- 7) Do not take paired samples from the first 100 tons of mix produced each day or the first 100 tons of mix following a significant mix change. When paving operations are staged so each day of placement is less than 100 tons for the entire production of a bid item, establish a sampling plan with the Engineer that includes a minimum of one sample per 2,500 tons.
- 8) Test the quality control sample of each production paired sample as follows:
 - a) Prepare and compact two gyratory specimens according to [Iowa DOT Materials I.M. 325G](#).
 - b) Determine the density for each specimen according to [Iowa DOT Materials I.M. 321](#). Average the results to determine sample density.
 - c) Use the field quality control laboratory compaction for field density control. The laboratory density for field control will be the bulk specific gravity of compacted mixture (Gmb) at Ndesign. Bulk specific gravity at Ndesign will be determined by compacting specimens to Nmax and back calculating the bulk specific gravity at Ndesign.
 - d) Determine the Theoretical Maximum Specific Gravity of the uncompacted mixture according to [Iowa DOT Materials I.M. 350](#) or other test methods recognized by AASHTO or ASTM.
 - e) Determine laboratory air voids for each sample according to [Iowa DOT Materials I.M. 501](#).
- 9) When liquid anti-strip additives are used, satisfy one of the following methods to regulate the quantity of additive:
 - a) Present certification that the equipment used to measure and blend the liquid anti-strip additive:
 - Meets the anti-strip supplier's recommended practice,
 - Is directly tied to the asphalt binder supply system, and
 - Has been calibrated to the equipment manufacturer's guidelines.
 - b) Test the binder to measure the quantity of liquid anti-strip additive in the binder for every 5,000 tons of asphalt production. Obtain the Engineer's approval for the supplier's test method prior to use of the test.
 - c) Run the test method in [Iowa DOT Materials I.M. 319](#) during production. If unable to certify or test for the presence and quality, run the test method in [Iowa DOT Materials I.M. 319](#) each 10,000 tons of production to measure the effectiveness of the additive. Ensure test results satisfy the minimum requirements of [Iowa DOT Article 2303.02, E](#).
- c. Production Control:
 - 1) After the JMF is established, the combined aggregate furnished for the project, the quantity of asphalt binder, and the laboratory air voids should consistently comply with the JMF, as target values. Control them within the production tolerance given in Table 7020.05.

3.06 QUALITY CONTROL (Continued)**Table 7020.05 Production Tolerances**

Measured Characteristic	Target Value (%)	Specifications Tolerance (%) ¹
Cold feed gradation No. 4 (4.75 mm) and larger sieves	by JMF	± 7.0
Cold feed gradation No. 8 (2.36 mm)	by JMF	± 5.0
Cold feed gradation No. 30 (600 µm)	by JMF	± 4.0
Cold feed gradation No. 200 (75 µm)	by JMF	± 2.0 ²
Daily asphalt binder content	by JMF	± 0.3
Field laboratory air voids - absolute deviation from target	0.0 ³	<1.0 ⁴

¹ Based on single test unless otherwise specified.

² Maintain the filler/bitumen ratio of the plant produced mixture between 0.6 and 1.4.

³ Unless otherwise specified.

⁴ Based on the moving average of four test values.

- 2) Control plant production so that the plant produced asphalt mixture will meet mixture design criteria (within the test tolerances given in Table 7020.05) for Air Voids at Ndesign gyrations of the gyratory compactor. Monitor the slope of the gyratory compaction curve of plant produced material. Slope variations in excess of ±0.40 of the mixture design gyratory compaction curve slope may indicate potential problems with uniformity of the mixture.
- 3) The gyratory mix design gradation control points for the size mixture designated in the project plans will not apply to plant production control.
- 4) Strive for the target value of the percent air void and asphalt binder by adjusting gradation and asphalt binder content.
- 5) Produce a uniform composition mixture complying with the JMF.
- 6) Adjustments to the JMF target gradation and asphalt binder content values may be made.
 - a) Determine from quality control testing that adjustments are necessary to achieve the specified properties.
 - b) Consult with the Engineer regarding adjustments to the JMF.
 - c) The Contractor's adjustment recommendations prevail, provided all specifications and established mix criteria are being met for plant production.
- 7) Measure estimated film thickness and voids in the mineral aggregate (VMA) for specifications compliance every day of asphalt production.
- 8) Prepare quality control charts according to [Iowa DOT Materials I.M. 511](#). Keep the charts current and available showing both individual sample results and moving average values. Base moving average values on four consecutive sample results. Moving averages may restart only in the event of a mandatory plant shutdown for failure to maintain the average within the production tolerance. Include the target value and specifications tolerances on control charts.
- 9) Calculate laboratory voids for individual samples according to [Iowa DOT Materials I.M. 501](#). Use the individual density and individual maximum specific gravity determined for each sample. To determine the moving average of laboratory voids, use the average of the last four individual sample laboratory voids.
- 10) Monitor the test results and make mix adjustments, when appropriate, to keep the mixture near the target values. Notify the Engineer whenever the process approaches a specification tolerance limit. Cease operations when the moving average point for laboratory air voids is outside the specification tolerance limit. Assume responsibility to cease operations, including not incorporating material which has not been placed. Do not start the process again until notifying the Engineer of the corrective action proposed.

3.06 QUALITY CONTROL (Continued)

- B. Provide quality control for bid items with asphalt quantities of 1,000 tons or less as follows:
1. **Mix Design:** Prepare the job mix formula. Prior to asphalt production, obtain the Engineer's approval for the job mix formula. Comply with [Iowa DOT Article 2303.02](#) and [Iowa DOT Materials I.M. 510](#). Submit for approval.
 2. **Plant Production:** Use a current calibration of the asphalt production plant for the job mix formula no more than 12 months old. Maintain an asphalt binder log to track when the binder was delivered. Identify the job mix formula on the asphalt delivery ticket. Use certified asphalt binder and approved aggregate sources meeting the job mix formula. Monitor the quality control test results and make adjustments to keep the mixture near the target job mix formula values.
 3. **Construction:** Take density measurements of the compacted mixture. Use the field quality control laboratory compaction for field density control as specified in Section 7020, 3.04. The Engineer may accept the density of the compacted layer based on cores or density gauge. The Engineer may waive density measurement provided the compaction has been thorough and effective. Take density measurements of the compacted mixture no later than the next working day following placement and compaction. For small quantities, a lot is the entire quantity of each asphalt mixture bid item. The quality index for density will not apply to small quantities.
 4. **Sampling and Testing:** Material sampling and testing is for production quality control only. Acceptance of mixture is based on Contractor certification. Perform a minimum of one aggregate cold-feed and one loose asphalt test per lot. Sampling and testing of loose asphalt is only required for mechanically placed mixture. All sampling and testing procedures will follow the Iowa DOT Specifications and Materials I.M.s using certified technicians and qualified testing equipment. The Engineer may approve alternative sampling procedures, or may approve sampling of uncompacted mix and gradation if Contractor can provide plant reports for other recent projects(s) demonstrating the job mix formula has been produced according to the specifications. Take the sample between the first 100 to 200 tons of production. No split samples for agency correlation testing are required. Asphalt binder will be accepted based on the asphalt supplier's shipment certification. No binder sampling or testing is required. No material sampling or testing is required for daily asphalt production of less than 100 tons on any project.
 5. **Certification:** Provide a certification for the production of any mixture in which the requirements in this section for small quantities are applied. Place the test results and certification statement on the Iowa DOT Daily Plant Report. The Daily Plant Report for certified asphalt may be submitted at the end of the project for all certified asphalt quantities, or submitted at intervals for portions of the certified quantity. Use the following certification statement:

"The certified asphalt was produced in compliance with the provisions of Section 7020, of the SUDAS Standard Specifications. The certified asphalt was produced with certified asphalt binder and approved aggregates as specified in the approved mix design."

3.07 REMOVAL OF PAVEMENT

Comply with [Section 7040](#).

END OF SECTION

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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 Iowa 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.

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 or automated flagger assistance devices (AFAD). 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.

2.02 SIGNS

A. Material: Sheet aluminum, galvanized steel, plywood, or flexible roll-up material complying with [Iowa DOT Article 4186.02](#).

B. Size and Type:

1. **Regulatory Signs:** As indicated in the contract documents or recommended in the MUTCD.
2. **Sidewalk Signs:** Minimum size 12 inch by 24 inch.
3. **Warning Signs:** Comply with Table 8030.01.

Table 8030.01: Warning Signs

Speed Limit (mph)	Minimum Sign Size	Minimum Uppercase Letter Size	Minimum Plaque Size
< 25	30" x 30"	4"	18" x 18"
25 - 35	36" x 36"	5"	18" x 24"
>35	48" x 48"	7"	24" x 30"

C. Retroreflective Sheeting: Comply with [Iowa DOT Article 4186.03](#).

D. Posts:

1. **Wood Posts:** Comply with [Iowa DOT Section 4164](#).
2. **U-Shaped Rail Steel Posts:** 3.0 pounds per foot.
3. **Perforated Square Steel Tube Posts:** 2 1/4 or 2 1/2 inch square 12 gage perforated steel tubing.

E. Portable Sign Stands: Crashworthy per the test and evaluation criteria of National Cooperative Highway Research Program (NCHRP) Report 350 or Manual on Assessing Safety Hardware (MASH). Must be stable in windy conditions.

2.03 CHANNELIZING DEVICES

Channelizing devices include cones, channelizers, tubular markers, vertical panels, drums, and barricades. Crashworthy per the test and evaluation criteria of NCHRP 350 or MASH-16.

A. Retroreflective Sheeting: Comply with [Iowa DOT Article 4186.03](#).

B. Cones: Minimum height of 18 inches for daytime and speed less than or equal to 35 mph. Minimum height of 28 inches with retroreflective bands for nighttime or speed greater than 35 mph.

C. Channelizers: 42 inch height with retroreflective bands and 16 pound base.

D. Tubular Markers: Minimum diameter 2 inches with retroreflective bands. Minimum height 18 inches for daytime and speed less than or equal to 35 mph. Minimum height 28 inches for nighttime or speed greater than 35 mph.

2.03 CHANNELIZING DEVICES (Continued)

- E. Vertical Panels:** Minimum height 36 inches with 8 to 12 inch panel width and 24 inch minimum panel height.
- F. Drums:** Minimum width 18 inches. Minimum height 36 inches.
- G. Barricades:** Minimum rail length 2 feet for Type I or Type II barricades. Minimum rail length 4 feet for Type III barricades. Minimum height of top rail for Type I and Type II equals 3 feet and minimum height to top rail of a Type III is 5 feet.

2.04 MISCELLANEOUS PRODUCTS

- A. Orange Mesh Safety Fence:** Comply with [Iowa DOT Article 4188.03](#).
- B. Temporary Barrier Rail:** Unless otherwise specified, use precast concrete units. Comply with [Iowa DOT Standard Road Plan BA-401](#).

2.05 EQUIPMENT

- A. Warning Lights:**
 - 1. For nighttime installation, provide Type A warning lights visible to both directions of traffic.
 - 2. For 24 hour installations, provide Type B warning lights.
- B. Arrow Boards:** When required, provide Type A, B, or C arrow boards operating in sequential chevron mode.
- C. Portable Dynamic Message Signs:** Comply with [Iowa DOT Article 4188.07](#).
- D. Pilot Cars:** Pickup trucks or automobiles with G20-4 signs reading: PILOT CAR - FOLLOW ME. Mount two signs on each vehicle, visible from both directions of traffic. Mount signs with bottom of signs at least 1 foot above the top of the vehicle's roof.
- E. Vehicle Warning Lights:** Supply amber, high-intensity rotating, flashing, oscillating, or strobe light.

2.06 FLAGGERS

- A. General:** Comply with the current [Iowa DOT Flagger's Handbook](#) for flagger operations, equipment, and apparel.
- B. Lighting:** Provide auxiliary lighting at flagger stations when nighttime flagging is required.
- C. Training:** For other than short time, emergency, or relief assignment of flaggers, provide flagger training to include the following:
 - 1. Issuing a copy of the current [Iowa DOT Flagger's Handbook](#) to and review by each flagger.
 - 2. Presentation of the current Iowa Professional Flagging Video to each flagger.
 - 3. Issuing a flagger training card to each flagger, to be carried at all times and shown upon request. Include the following information on training card:
 - a. Employee name
 - b. Date of training
 - c. Name of instructor
 - d. Expiration date of December 31 of the year following the training date

2.06 FLAGGERS (Continued)**D. Automated Flagger Assistance Device (AFAD):**

1. AFADs may be used for flagging operations.
2. Ensure all AFADs meet the current requirements of the MUTCD Section 6E.04 and 6E.06.
 - a. Use RED/YELLOW lens type AFADs as per MUTCD Section 6E.06
 - b. Comply with crashworthiness requirements of Iowa DOT Article 4188.01, B.
 - c. If using AFADs on primary roadways, comply with Iowa DOT Article 4188.11 for remote communication capabilities.
3. Ensure AFAD is operated by trained flaggers who have been instructed how to use the project-specific AFAD. Ensure trained flaggers are available to step in as manual flaggers in case of an AFAD malfunction.
4. Place AFADs where flagger stations are shown on the project plans. Ensure AFADs are clearly visible to approaching traffic, and if used at night, illuminated as flagger stations.
5. Ensure flagger operating an AFAD has direct line of sight to the AFAD location and an unobstructed view of approaching traffic. The use of a camera to monitor the AFAD and/or the approaching traffic is not allowed in lieu of a manual flagger.
6. Ensure flaggers do not perform other duties while operating AFADs and do not leave AFADs unattended at any time while they are in use. Ensure pilot car drivers do not operate AFADs.
7. A single flagger is allowed to operate two AFADs if the following requirements are met:
 - a. The flagger has unobstructed view of both AFADs,
 - b. The flagger has unobstructed view of both directions of approaching traffic, and/or
 - c. The distance between AFAD locations is not greater than 1,000 feet.
8. Immediately replace AFADs with manual flaggers in the event of malfunction.

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 [Iowa 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.
 - 1. Review all traffic control operations for compliance with the contract documents.
 - 2. Monitor traffic operations and submit proposed traffic control plan changes to the Engineer for approval.
 - 3. Coordinate all changes to the traffic control plan.
 - 4. 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.

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SEEDING**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Certification of Products
- B. Acceptance and Warranty
- C. Seed Types and Mixes
- D. Equipment
- E. Application of Seed

1.02 DESCRIPTION OF WORK

Includes the requirements for seedbed preparation; furnishing, applying, and covering the seed; and compaction of the seedbed.

1.03 SUBMITTALS

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

- A. Submit certification of products to the Engineer prior to seed placement:
 - 1. Seed: Submit a laboratory analysis for all seeds, specifying the purity and germination. Provide a lot number on all submittals and labeling. Ensure lot number is the same on all records pertaining to a particular seed. Provide 48 hours notice prior to mixing the seed and give the Engineer an opportunity to witness the seed mixing. Submit a mechanically printed seed tag from a seed conditioner or grower approved by the Iowa Crop Improvement Association or other state's equivalent association/agency.
 - 2. Fertilizer: Submit certification of the fertilizer analysis with scale weight and statement of guaranteed analysis. Submit from a certified fertilizer dealer, a mechanically printed commercial fertilizer label, or bill of lading. Comply with the inspection and acceptance requirements of [Iowa DOT Materials I.M. 469.03](#).
 - 3. Wood Cellulose Fiber Mulch: Submit certification of the degradable wood cellulose fiber mulch ingredients with applicable use and rate, and the water retention capacity by manufacturer or supplier.
 - 4. Wood Excelsior Mulch: Bale wood excelsior and determine the mass (weight). Use the mass of the material, furnished by the manufacturer, to determine the rate of application.
 - 5. Straw Mulch: Certify weight. Furnish a list of the number of bales and a corresponding ticket from an approved scale for the mulch material to be used on the project.
 - 6. Compost: Submit certification of composted organics analysis with U.S. Compost Council's Seal of Testing Assurance (STA), recommended rates of application, and manufacturer's estimated cubic yards per ton.
 - 7. Inoculant: Furnish information from inoculant packaging.
 - 8. Tackifier: Submit certification of the tackifier ingredients, recommended rates of application, and expiration date.
- B. Submit written instructions recommending procedures for maintenance of seeded areas.

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. Deliver packaged materials in original, unopened, and undamaged containers. Do not mix or blend materials except in the presence of the Engineer.
- B. Deliver, handle, and store all materials according to product recommendations, and protect from loss, damage, and deterioration.
- C. Materials not meeting these requirements will be rejected.

1.06 SCHEDULING AND CONFLICTS

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

- A. Coordinate the seeding schedule with all other work on the project. Notify the Engineer at least three calendar days prior to the start of seeding operations.
- B. After all land-disturbing activities are complete and the seedbed has been approved by the Engineer, perform seeding operations.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Conventional Seeding:****1. Seeding:**

- a. **Measurement:** Measurement will be in acres for each type of seed.
- b. **Payment:** Payment will be in unit price per acre for each type of seed.
- c. **Includes:** Unit price includes, but is not limited to, removal of rock and other debris from the area; repairing rills and washes; preparing the seedbed; furnishing and placing seed, including any treatment required; furnishing and placing fertilizer and mulch; and furnishing water and other care during the care period, unless these items are bid separately.

2. Fertilizing:

- a. **Measurement:** Measurement will be in acres of fertilizer.
- b. **Payment:** Payment will be at unit price per acre of fertilizer.
- c. **Includes:** Unit price includes, but is not limited to, furnishing, applying, and incorporating fertilizer to the area to be seeded.

3. Mulching:

- a. **Measurement:** Measurement will be in acres of mulch.
- b. **Payment:** Payment will be in unit price per acre of mulch.
- c. **Includes:** Unit price includes, but is not limited to, furnishing, applying, and incorporating mulch to the area to be seeded.

SODDING**PART 1 - GENERAL****1.01 SECTION INCLUDES**

Sod Installation

1.02 DESCRIPTION OF WORK

This section includes preparation of the sodbed, furnishing and installing sod, fertilizing, watering, and maintenance for completed sodded areas.

1.03 SUBMITTALS

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

- A. Sod grower's certification of grass species and location of sources.
- B. Certification of the fertilizer analysis.
- C. Written instructions recommending procedures for maintenance of sodded lawns, prior to final acceptance of sod.

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. Harvest, deliver, and transplant sod within a period of 24 hours unless a suitable preservation method is approved by the Engineer prior to delivery.
- B. Do not harvest or transport sod when moisture content may adversely affect sod survival.
- C. Protect sod that cannot be placed immediately on delivery from sun, wind, dehydration, and rain prior to installation.
- D. Sod showing visible signs of heating or dehydration will be rejected.
- E. Do not tear, stretch, or drop sod during handling and installation.
- F. Deliver fertilizer to the site in original, unopened, and non-damaged containers, each bearing the manufacturer's guaranteed analysis.
- G. Store packaged materials off the ground and protect from moisture and deterioration.

1.06 SCHEDULING AND CONFLICTS

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

- A. Notify the Engineer at least 3 calendar days prior to start of sodding operations.
- B. Perform sod installation after planting and other work affecting ground surface has been completed, or as approved by Engineer.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT**A. Sod:**

1. **Measurement:** Measurement will be in square yards of sod placed.
2. **Payment:** Payment will be at the unit price per square yard of sod placed.
3. **Includes:** Unit price includes, but is not limited to, preparation of sod and sodbed, stakes, fertilizing, watering, maintenance, and clean up. Also includes any necessary sod replacements during maintenance period.

EROSION AND SEDIMENT CONTROL**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. NPDES General Permit No. 2
- B. Stormwater Pollution Prevention Plan (SWPPP)
- C. Erosion Control Measures
- D. Velocity and Flow Control Measures
- E. Sediment Control Measures
- F. Application/Installation of Measures
- G. Removal/Replacement of Measures

1.02 DESCRIPTION OF WORK

- A. Furnish all materials; install, construct, maintain, and remove specified erosion control devices; at locations specified in the contract documents, or where specified by the Engineer.
- B. Complete the required construction work on this project, while minimizing soil erosion and controlling water pollution. Maintain these features as specified, from initial construction stages to final completion of the project.

1.03 SUBMITTALS

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

- A. Upon request, provide copies of all records and documentation related to compliance with the Iowa DNR NPDES Permit.
- B. For grid-tied concrete block mat, submit all manufacturer details, recommendations, and installation instructions for approval.
- C. For manufactured track-out devices, submit a copy of shop drawings and installation instructions per the manufacturer.

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. Implement erosion and sediment control measures at the appropriate time(s).
- B. Coordinate construction to minimize damage to erosion and sediment control devices.

1.07 SPECIAL REQUIREMENTS**A. Permit:**

1. When applicable, comply with the requirements of the Iowa Department of Natural Resources, *NPDES (National Pollutant Discharge Elimination System) General Permit No. 2 for Stormwater Discharge Associated with Industrial Activity for Construction Activities*, and the Stormwater Pollution Prevention Plan.
2. For projects covered under the Iowa DNR General Permit No. 2, sign on as a co-permittee with the owner and any other contractors or subcontractors.
3. When applicable, comply with the local jurisdiction's permitting requirements.

B. Protection of Property: Prevent accumulation of soil, sediment, or debris from project site onto adjoining public or private property. Remove any accumulation of soil or debris immediately, and take remedial actions for prevention.

C. Permit Compliance: When applicable, conduct all operations in compliance with the Iowa DNR NPDES General Permit No. 2. Labor, equipment, or materials not included as a bid item, but necessary to prevent stormwater contamination from construction related sources, are considered incidental. Incidental work related to compliance with the permit may include, but is not limited to: hazardous materials protection, fuel containment, waste disposal, and providing employee sanitary facilities.

D. Project Staging: Replacing erosion and sediment control practices that are damaged or removed by the contractor in a manner that is inconsistent with the current project staging or SWPPP is the Contractor's responsibility and will be at the Contractor's expense.

1.08 MEASUREMENT AND PAYMENT**A. Stormwater Pollution Prevention Plan (SWPPP):****1. Preparation:**

- a. **Measurement:** Lump sum item; no measurement will be made.
- b. **Payment:** Payment will be at the lump sum price for SWPPP preparation.
- c. **Includes:** Lump sum price includes, but is not limited to, development of a SWPPP by the Contractor meeting local and state agency requirements, filing the required public notices, filing a Notice of Intent for coverage of the project under the Iowa DNR NPDES General Permit No. 2, and payment of associated NPDES permit fees.
- d. **Other:** Item will be paid for upon approval of the SWPPP by the Engineer, and after the Notice of Intent has been filed by the Contractor.

2. Management:

- a. **Measurement:** Lump sum item; no measurement will be made.
- b. **Payment:** Payment will be at the lump sum price for SWPPP management.
- c. **Includes:** Lump sum price includes all work required to comply with the administrative provisions of the Iowa DNR NPDES General Permit No. 2; including record keeping, documentation, updating the SWPPP, filing the Notice of Discontinuation, etc. Item also includes weekly inspections required to satisfy the provisions of General Permit No. 2, unless otherwise specified in the contract documents.
- d. **Does Not Include:** Unit price does not include installation or maintenance of erosion and sediment control practices.
- e. **Other:** The Engineer may make partial payments based on estimates of the project completion. Final payment will be made when the site reaches final stabilization and the Notice of Discontinuation is filed.

1.08 MEASUREMENT AND PAYMENT (Continued)**B. Compost Blankets:**

1. **Measurement:** Measurement will be in square feet for each thickness of compost blanket.
2. **Payment:** Payment will be at the unit price per square foot for each thickness of compost blanket.
3. **Includes:** Unit price includes, but is not limited to, furnishing and spreading compost over the designated area.

C. Filter Berms:

1. **Measurement:** Measurement will be in linear feet for each size of filter berm, measured longitudinally along the top of the berm.
2. **Payment:** Payment will be at the unit price per linear foot for each size of berm.
3. **Includes:** Unit price include, but is not limited to, furnishing material and constructing the filter berm, including vegetation if specified.

D. Filter Socks:

1. **Installation:**
 - a. **Measurement:** Measurement will be in linear feet for each size of filter sock.
 - b. **Payment:** Payment will be at the unit price per linear foot for each size of filter sock.
 - c. **Includes:** Unit price includes, but is not limited to, anchoring stakes.
2. **Removal:**
 - a. **Measurement:** Measurement will be in linear feet of filter sock removed.
 - b. **Payment:** Payment will be at the unit price per linear foot of filter sock removed.
 - c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of filter socks and accumulated sediment.

E. Temporary Rolled Erosion Control Products (RECP):

1. **Measurement:** Measurement will be in square yards, based on the width specified in the contract documents and actual measured length, for each type of temporary RECP.
 - a. Areas of RECP buried in trenches or covered by overlaps along seams will not be measured.
 - b. For each blanket check installed, the Engineer will add 4 feet of length to the measured quantity.
2. **Payment:** Payment will be at the unit price per square yard for each type of temporary RECP.
3. **Includes:** Unit price includes, but is not limited to, excavation, staples, anchoring devices, and material for anchoring slots.

F. Wattles:

1. **Installation:**
 - a. **Measurement:** Measurement will be in linear feet for each type and size of wattle.
 - b. **Payment:** Payment will be at the unit price per linear foot for each type and size of wattle.
 - c. **Includes:** Unit price includes, but is not limited to, anchoring stakes.

1.08 MEASUREMENT AND PAYMENT (Continued)**2. Removal:**

- a. **Measurement:** Measurement will be in linear feet of wattle removed.
- b. **Payment:** Payment will be at the unit price per linear foot of wattle removed.
- c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of wattle and accumulated sediment.

G. Check Dams:**1. Rock Check Dams:**

- a. **Measurement:** Measurement will be in ton of stone installed.
- b. **Payment:** Payment will be at the unit price per ton of stone installed.
- c. **Includes:** Unit price includes, but is not limited to, engineering fabric.

2. Manufactured Check Dams:**a. Installation:**

- 1) **Measurement:** Measurement will be in linear feet for each type and size of manufactured check dam.
- 2) **Payment:** Payment will be at the unit price per linear foot for each type and size of manufactured check dam.
- 3) **Includes:** Unit price includes, but is not limited to, anchoring stakes.

b. Removal:

- 1) **Measurement:** Measurement will be in linear feet for each type of manufactured check dam removed.
- 2) **Payment:** Payment will be at the unit price per linear foot for each type of manufactured check dam removed.
- 3) **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of manufactured check dam and accumulated sediment.

3. **Fiber Logs:** Filter sock and wattles utilized for check dams will be measured and paid for according to 9040, 1.08, D and 9040, 1.08 F respectively.

H. Temporary Earth Diversion Berms:

1. **Measurement:** Measurement will be in linear feet for each type and size of temporary earth diversion berm.
2. **Payment:** Payment will be at the unit price per linear foot of temporary earth diversion berm.
3. **Includes:** Unit price includes, but is not limited to, removal of the berm upon completion of the project.

I. Level Spreaders:

1. **Measurement:** Measurement will be in linear feet of level spreaders.
2. **Payment:** Payment will be at the unit price per linear foot of level spreader.
3. **Includes:** Unit price includes, but is not limited to, maintaining the spreader during the period of construction and removal upon completion of the project, unless otherwise specified in the contract documents.

1.08 MEASUREMENT AND PAYMENT (Continued)**J. Rip Rap:**

1. **Measurement:** Measurement will be in tons for each type of rip rap.
2. **Payment:** Payment will be at the unit price per ton of rip rap.
3. **Includes:** Unit price includes, but is not limited to, engineering fabric.

K. Temporary Pipe Slope Drains:

1. **Measurement:** Measurement will be in linear feet for each type and size of temporary pipe slope drain, measured from end of apron to end of apron.
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, excavation, furnishing and installing pipe and pipe aprons, grading, and removal of the slope drain upon completion of the project.

L. Temporary Sediment Basin:

1. **Outlet Structure:**
 - a. **Measurement:** Each size of temporary sediment basin outlet structure will be counted.
 - b. **Payment:** Payment will be at the unit price for each temporary sediment basin outlet structure.
 - c. **Includes:** Unit price includes, but is not limited to, concrete base, dewatering device, anti-vortex device, outlet pipe, and anti-seep collars (if specified).
 - d. **Does Not Include:** Unit price does not include earthwork required for construction of the temporary sediment basin.
2. **Removal of Sediment:**
 - a. **Measurement:** Each occurrence of sediment removal will be counted.
 - b. **Payment:** Payment will be at the unit price for each occurrence of sediment removal.
 - c. **Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.
3. **Removal of Outlet Structure:**
 - a. **Measurement:** Each temporary sediment basin outlet structure removed will be counted.
 - b. **Payment:** Payment will be at the unit price for each temporary sediment basin outlet structure removed.
 - c. **Includes:** Unit price includes, but is not limited to, dewatering and off-site disposal of the outlet structure, concrete base, emergency spillway, and accumulated sediment.
 - d. **Does Not Include:** Unit price does not include earthwork required to remove the temporary sediment basin and restoration of the area to finished grade.

M. Sediment Trap Outlet:

1. **Installation:**
 - a. **Measurement:** Measurement will be in tons of crushed stone placed.
 - b. **Payment:** Payment will be at the unit price per ton of crushed stone.
 - c. **Includes:** Unit price includes, but is not limited to, engineering fabric.
 - d. **Does Not Include:** Unit price does not include earthwork required for construction of the sediment trap.

1.08 MEASUREMENT AND PAYMENT (Continued)**2. Removal of Sediment:**

- a. **Measurement:** Each occurrence of sediment removal will be counted.
- b. **Payment:** Payment will be at the unit price for each occurrence of sediment removal.
- c. **Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.

3. Removal of Device:

- a. **Measurement:** Each sediment trap outlet removed will be counted.
- b. **Payment:** Payment will be at the unit price for each sediment trap outlet removed.
- c. **Includes:** Unit price includes, but is not limited to, dewatering and off-site disposal of sediment trap outlet and accumulated sediment.
- d. **Does Not Include:** Unit price does not include earthwork required to remove the sediment trap outlet and restoration of the area to finished grade.

N. Silt Fence or Silt Fence Ditch Check:**1. Installation:**

- a. **Measurement:** Measurement will be in linear feet of silt fence or silt fence ditch check.
- b. **Payment:** Payment will be at the unit price per linear foot of silt fence or silt fence ditch check.
- c. **Includes:** Unit price includes, but is not limited to, anchoring posts.

2. Removal of Sediment:

- a. **Measurement:** Each occurrence of sediment removal will be counted.
- b. **Payment:** Payment will be at the unit price for each occurrence of sediment removal.
- c. **Includes:** Unit price includes, but is not limited to, dewatering and removal and off-site disposal of accumulated sediment.

3. Removal of Device:

- a. **Measurement:** Measurement will be in linear feet of silt fence removed.
- b. **Payment:** Payment will be at the unit price per linear foot of silt fence removed.
- c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of fence, posts, and accumulated sediment.

O. Stabilized Construction Exit:**1. Track-out Control by Square Yard:**

- a. **Measurement:** Measurement will be in square yards of material or manufactured track-out pad placed.
- b. **Payment:** Payment will be at the unit price per square yard of material or manufactured track-out pad placed.
- c. **Includes:** Unit price includes, but is not limited to, subgrade stabilization fabric, removal and disposal of accumulated sediment, and removal and disposal of track-out control stone and manufactured pad.

2. Track-out Control by Ton:

- a. **Measurement:** Measurement will be in tons of material placed.
- b. **Payment:** Payment will be at the unit price per ton of material placed.
- c. **Includes:** Unit price includes, but is not limited to, subgrade stabilization fabric.

1.08 MEASUREMENT AND PAYMENT (Continued)**P. Dust Control:****1. Water for Dust Control:**

- a. Measurement:** Measurement will be by metering of water applied to haul roads and other areas to control dust. If metering is not available, measurement will be by counting the loads from a transporting tank of known volume and gauging the contents of the transporting truck for partial loads.
- b. Payment:** Payment will be at the unit price per 1,000 gallons of water used.
- c. Includes:** Unit price includes, but is not limited to, furnishing, transporting, and distributing water to the haul road.

2. Dust Control Product:

- a. Measurement:** Measurement will be in square yards of the treated area.
- b. Payment:** Payment will be at the unit price per square yard of product applied.
- c. Includes:** Unit price include, but is not limited to, furnishing and incorporating the dust control product.

Q. Erosion Control Mulching:**1. Conventional Mulching:**

- a. Measurement:** Measurement will be in acres of conventional mulch.
- b. Payment:** Payment will be at the unit price per acre of conventional mulch.
- c. Includes:** Unit price includes, but is not limited to, furnishing and incorporating mulch in the area designated in the contract documents.

2. Hydromulching:

- a. Measurement:** Measurement will be in acres for each type of hydromulch.
- b. Payment:** Payment will be at the unit price per acre for each type of hydromulch.
- c. Includes:** Unit price includes, but is not limited to, furnishing mulch and tackifier (if applicable), providing equipment specific to hydromulching, and applying the mulch to the specified area.

R. Turf Reinforcement Mats (TRM):

- 1. Measurement:** Measurement will be in square yards for each type of turf reinforcement mat.
- 2. Payment:** Payment will be at the unit price per square yard for each type of turf reinforcement mat.
- 3. Includes:** Unit price includes, but is not limited to, excavation, staples, anchoring devices, and material for anchoring slots.

S. *Intentionally left blank***T. Inlet Protection Device:****1. Installation:**

- a. Measurement:** Each type of inlet protection device will be counted.
- b. Payment:** Payment will be at the unit price for each inlet protection device.
- c. Includes:** Unit price includes, but is not limited to, removal of the device upon completion of the project.

1.08 MEASUREMENT AND PAYMENT (Continued)**2. Maintenance:**

- a. **Measurement:** Each inlet protection device maintenance occurrence will be counted.
- b. **Payment:** Payment will be at the unit price for each inlet protection device maintenance occurrence.
- c. **Includes:** Unit price includes, but is not limited to, removal and off-site disposal of accumulated sediment.

U. Flow Transition Mat:

1. **Measurement:** Measurement will be in square feet of flow transition mat.
2. **Payment:** Payment will be at the unit price per square foot of flow transition mat.
3. **Includes:** Unit price includes, but is not limited to, anchoring devices.

V. End of Season Temporary Erosion Control:

1. **Measurement:** Measurement will be in acres of end of season temporary erosion control applied.
2. **Payment:** Payment will be at the unit price per acre for end of season temporary erosion control.
3. **Includes:** Unit price includes, but is not limited to, furnishing, placing, and maintaining the end of season temporary erosion control throughout the winter season.

W. Linear Erosion Control:

When linear erosion control is specified, select an appropriate erosion control practice for use as perimeter control, inlet protection, slope length reduction, or flow diversion. Allowable linear erosion control practices include filter socks, wattles, or silt fence as described in Section 9040.

1. Installation:

- a. **Measurement:** Measurement will be in linear feet of linear erosion control installed. No distinction will be made between practices.
- b. **Payment:** Payment will be at the unit price per linear foot for linear erosion control.
- c. **Includes:** Unit price includes, but is not limited to, anchoring posts and anchoring stakes.

2. Removal:

- a. **Measurement:** Measurement will be in linear feet of linear erosion control removed. No distinction will be made between practices.
- b. **Payment:** Payment will be at the unit price per linear foot of linear erosion control removed.
- c. **Includes:** Unit price includes, but is not limited to, restoration of the area to finished grade and off-site disposal of fence, filter socks, wattles, anchoring posts, anchoring stakes, and accumulated sediment.

1.08 MEASUREMENT AND PAYMENT (Continued)**X. Grid-Tied Concrete Block Mat (GTCBM):****1. Grid Tied Concrete Block Mat:**

- a. Measurement:** Measurement will be the plan quantity in square yards of the finished surface of GTCBM. Areas of GTCBM placed in edge trenches, anchor trenches, or overlapped at mat seams will not be measured.
- b. Payment:** Payment will be at the unit price per square yard of grid-tied concrete block mat installed.
- c. Includes:** Unit price includes, but is not limited to, concrete anchor trenches, underlayments, ground anchors, ties, and splicing.

2. GTCBM Concrete Anchor Trench:

- a. Measurement:** Measurement will be in linear feet of GTCBM concrete anchor trench.
- b. Payment:** Payment will be at the unit price per linear foot of GTCBM concrete anchor trench.
- c. Includes:** Unit price includes, but is not limited to, excavation, concrete, and installation.

PART 2 - PRODUCTS**2.01 COMPOST BLANKETS**

Comply with [Section 9010, 2.07, C](#) for compost material requirements for compost blankets.

2.02 COMPOST BLANKET TACKIFIER

- A. Use a biodegradable, organic binding agent or polyacrylamide that can be mixed with, or injected into, compost as it is placed, which is not detrimental to the establishment of vegetation.
- B. Use in compost blankets when specified in the contract documents.
- C. Apply at the rate recommended by the manufacturer.

2.03 FILTER MATERIAL

Material for use in filter socks and other areas, as specified in the contract documents.

- A. Use material derived from wood, bark, or other, non-toxic vegetative feedstocks.
- B. Use material with no visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
- C. Use material meeting the following particle sizes:

Table 9040.01: Filter Material Size

Sieve Size	Percent Passing ¹
2"	100
1"	90-100
3/8"	0-30

¹ The target flow rate of in-place material is 10 gal/min/lf. The Engineer may approve use of alternate materials meeting the target flow rate.

2.04 SLASH MULCH

Material for use in filter berms, and other areas as specified in the contract documents, to slow, filter, and divert stormwater runoff.

- A. Raw wood slash from hard or soft timber harvested during clearing and grubbing operations within the project area.
- B. Product of a mechanical chipper, hammermill, or tub grinder.
- C. Maximum length of individual pieces shall not exceed 20 inches.
- D. Maximum width of individual pieces shall not exceed 2 inches.

2.05 FILTER SOCK

- A. For slope and sediment control applications, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 5 mil thickness, photodegradable HDPE.
- B. For inlet protection, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 500 denier polypropylene.
- C. Use 1 inch by 2 inch (minimum) hardwood stakes or stakes of equivalent strength.

2.06 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP)

Use temporary rolled erosion control products that are classified and have material properties according to the Erosion Control Technology Council's (ECTC) guidelines as follows:

A. Material Classification:

1. **RECP Type 1 (Ultra Short-term):** Functional longevity of 3 months and classified as follows:
 - a. **RECP Type 1.A:** Mulch control netting or open weave textile consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
 - b. **RECP Type 1.B:** Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.
 - c. **RECP Type 1.C:** Single-net erosion control blankets consisting of processed degradable natural and/or polymer fibers, mechanically bound together by a single rapidly-degrading, synthetic or natural fiber netting.
 - d. **RECP Type 1.D:** Double-net erosion control blankets, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two rapidly-degrading, synthetic or natural fiber nettings.
2. **RECP Type 2 (Short-term):** Functional longevity of 12 months and classified as follows:
 - a. **RECP Type 2.A:** Netting or open weave textile consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
 - b. **RECP Type 2.B:** Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.
 - c. **RECP Type 2.C:** Single-net erosion control blankets and open weave textiles, consisting of an erosion control blanket composed of processed degradable natural or polymer fibers, mechanically bound together by a single degradable synthetic or natural fiber netting.
 - d. **RECP Type 2.D:** Double-net erosion control blanket, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two degradable synthetic or natural fiber nettings.
3. **RECP Type 3 (Extended Term):** Functional longevity of 24 months and classified as follows:
 - a. **RECP Type 3.A:** Open weave textiles consisting of a slow-degrading synthetic mesh or woven natural fiber netting.
 - b. **RECP Type 3.B:** Erosion control blankets consisting of processed slow-degrading natural or polymer fibers, mechanically bound together between two slow-degrading synthetic or natural fiber nettings to form a continuous matrix.

2.06 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)

- 4. RECP Type 4 (Long Term):** Functional longevity of 36 months and classified as follows:
- RECP Type 4.A:** Open weave textiles consisting of processed slow-degrading natural or polymer yarns or twines woven into a continuous matrix.
 - RECP Type 4.B:** Erosion control blankets consisting of processed slow degrading natural or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix.

B. Properties and Performance:

- Testing performed according to the ECTC's Testing Procedures for Rolled Erosion Control Products. Verify manufacturer's test results by independent testing.
- Material properties meeting the ECTC Standard Specifications for Rolled Erosion Control Products are summarized as follows:

Table 9040.02: Rolled Erosion Control Products

Type	Shear Stress ² (lbs/ft ²)	Max. Slope ³ (H:V)	Material Thickness (in)	C Factor ⁴	Tensile Strength	
					MD ⁵ (lbs/ft)	TD ⁵ (lbs/ft)
1.A ¹	≥ 1.0	5:1	≥ 0.03	≤ 0.10	≥ 125	≥ 10
1.B	≥ 1.0	3:1	≥ 0.30	≤ 0.10	≥ 125	≥ 10
1.C	≥ 1.5	3:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 60	≥ 20
1.D	≥ 1.75	2:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 75	≥ 40
2.A ^a	≥ 1.0	5:1	≥ 0.03	≤ 0.10	≥ 125	≥ 10
2.B	≥ 1.0	3:1	≥ 0.30	≤ 0.10	≥ 125	≥ 10
2.C	≥ 1.5	3:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 60	≥ 20
2.D	≥ 1.75	2:1	≥ 0.25 - ≤ 0.50	≤ 0.10	≥ 75	≥ 40
3.A	≥ 2.0	2:1	≥ 0.20 - ≤ 0.40	≤ 0.05	≥ 100	≥ 40
3.B	≥ 2.0	1.5:1	≥ 0.25 - ≤ 0.50	≤ 0.05	≥ 100	≥ 40
4.A	≥ 2.25	1:1	≥ 0.20 - ≤ 0.40	≤ 0.05	≥ 100	≥ 40
4.B	≥ 2.25	1:1	≥ 0.25 - ≤ 0.50	≤ 0.05	≥ 100	≥ 40

¹ C Factor and permissible shear stress for Types 1.A and 2.A mulch control netting must be obtained with netting used in conjunction with pre-applied mulch material.

² Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (≥ 0.5 in soil loss) during a 30 minute flow event in large-scale performance testing, ASTM D 6460 or equivalent test acceptable to the Engineer.

³ This value represents the maximum gradient on which the product should be utilized for rainfall/slope application.

⁴ Maximum C Factor from standardized large-scale rainfall performance testing, ASTM D 6459 or equivalent test acceptable to the Engineer.

⁵ Machine direction and transverse direction (cross-machine direction).

- C. RECP Anchors:** Stakes or staples as recommended by manufacturer, with a minimum length of 6 inches.

2.07 WATTLES

- Netting:** Open weave, degradable netting. Nominal diameter of 9 inches, or as specified.
- Fill Material:** Straw, wood excelsior, coir, or other natural materials approved by the Engineer.
- Stakes:** 1 inch by 1 inch (minimum) wooden stakes, or stakes of equivalent strength.

2.08 CHECK DAMS (DITCH CHECK)**A. Synthetic Permeable Check Dam (HDPE):**

- 1. Ditch Berm:**
 - a. Installed height of 9 to 10 inches.
 - b. Manufactured check dam constructed from sheets of perforated, UV-stabilized HDPE.
 - c. Perforations of 30 to 40% open area.
- 2. RECP for Permeable Check Dam (when specified):** RECP Type 4, 4 feet wide.
- 3. Anchors:** As recommended by the manufacturer.

B. Triangular Foam Check Dam: Triangular-shaped device with a height of 8 to 10 inches and a base of 16 to 20 inches.

- 1. Inner Support Material:** Urethane foam.
- 2. Outer Cover:** Woven geotextile material shaped to fit around the inner support material, extending 2 to 3 feet beyond the bottom edge of the triangular-shaped inner support.
- 3. RECP for Triangular Foam Check Dam:** RECP Type 4, 4 feet wide.

C. Rock Check Dam:

- 1. Aggregate:** Erosion stone complying with [Iowa DOT Article 4130.04](#).
- 2. Engineering Fabric:** Comply with Section 9040, 2.22.

D. Fiber Log: Provide filter sock complying with 9040, 2.05 or wattle complying with 9040, 2.07.**E. RECP Blanket Pillow Check:** Utilize standard RECP specified for ditch or swale lining to form RECP blanket pillow check.**F. Rock/Sand Bags:**

- 1. Bags:**
 - a. Woven polypropylene fabric sewn together with double stitching.
 - b. Overall size of at least 14 inches by 26 inches.
 - c. Minimum grab strength of 90 pounds per ASTM D 4632.
 - d. UV stability of 70% per ASTM D4355
- 2. Aggregate:** Clean 1 inch nominal crushed stone or gravel.

2.09 LEVEL SPREADERS

- A.** Provide 2 inch by 8 inch (minimum) pressure-treated timber of the length specified.
- B.** Use timbers that are relatively straight and have a minimum length of 5 feet each.

2.10 RIP RAP

- A. **Class A Revetment:** Comply with [Iowa DOT Section 4130](#).
- B. **Class B Revetment:** Comply with [Iowa DOT Section 4130](#).
- C. **Class D and E Revetment:** Comply with [Iowa DOT Section 4130](#).
- D. **Erosion Stone:** Comply with [Iowa DOT Section 4130](#).

2.11 TEMPORARY PIPE SLOPE DRAINS

- A. PVC, HDPE, and metal pipes as specified in [Section 4020, 2.01](#).
- B. HDPE, Type C (corrugated interior).
- C. All pipes listed are allowed for use within the right-of-way.

2.12 TEMPORARY SEDIMENT BASIN OUTLET STRUCTURES

- A. **Base:** Class C concrete unless otherwise specified in the contract documents.
- B. **Riser:** CMP complying with [Section 4020](#); diameter as specified in the contract documents.
- C. **Dewatering Device:**
 - 1. Drill holes in the riser of the number, diameter, and at the elevation specified in the contract documents.
 - 2. 1/4 inch by 1/4 inch or 1/2 inch by 1/2 inch wire mesh for hardware cloth.
- D. **Barrel:** CMP complying with [Section 4020](#); diameter as specified in the contract documents.
- E. **Anti-Vortex Device:** CMP complying with [Section 4020](#); diameter according to [Figure 9040.116](#) and riser diameter as specified in the contract documents.
- F. **Anti-Seep Collar:**
 - 1. Manufactured anti-seep collar constructed of Corrugated metal, HDPE, or gum rubber.
 - 2. Size according to manufacturer's recommendations. Ensure overall collar width and height is at least 3 feet larger than outlet pipe's nominal diameter.
- G. **Sediment Baffle:** Provide silt fence complying with Section 9040, 2.14.

2.13 SEDIMENT TRAPS

- A. **Erosion Stone:** Comply with Section 9040, 2.10.
- B. **Engineering Fabric:** Comply with Section 9040, 2.22.

2.14 SILT FENCE

- A. Fabric:** Comply with [Iowa DOT Article 4196.01](#).
- B. Posts:** 4 foot minimum steel (T-section) weighing at least 1.25 pounds per foot, exclusive of anchor plate. Painted posts are not required.
- C. Fastener:** Wire or plastic ties with a minimum tensile strength of 50 pounds.

2.15 STABILIZED CONSTRUCTION EXIT

- A. Stone Exit:** Comply with [Iowa DOT Section 4122](#), Gradation 13, Macadam crushed stone.
- B. Subgrade Stabilization Material:** Use woven, UV-stabilized geotextile with a minimum tensile strength of 135 lb/ft.
- C. Manufactured Track-out Pad:**
 - 1. Must be approved by the Engineer.
 - 2. Provide a manufactured device intended to reduce track-out of sediment by flexing and vibrating tires as vehicles pass across the surface.
 - 3. Capable of supporting anticipated construction vehicle and equipment loads per manufacturer's recommendations.

2.16 DUST CONTROL

- A. Water:** Use potable water or water from a source approved by the engineer.
- B. Calcium Chloride:** Comply with [Iowa DOT Article 4194.01](#).
- C. Lignosulfonate (Tree Sap):** Use a commercially-available product with known lignin content.
- D. Soapstock (Soybean Oil):**
 - 1. Use a commercially-available, undiluted, soybean oil soapstock emulsion.
 - 2. Comply with manufacturer's recommendations for storage, transportation, temperature, and application equipment requirements.

2.17 EROSION CONTROL MULCH

- A. Conventional Mulch:**
 - 1. Use dry cereal straw (oats, wheat, barley, or rye) or native grass straw.
 - 2. Use material that is free of noxious weeds, seed-bearing stalks, or roots, and will be inspected and approved by the Engineer prior to use.
 - 3. Other materials, subject to the approval of the Engineer, may be used.

2.17 EROSION CONTROL MULCH (Continued)**B. Hydromulch:**

1. **Wood Cellulose Mulch:** Comply with [Section 9010, 2.07](#).
2. **Bonded Fiber Matrix (BFM):** Comply with [Section 9010, 2.07](#).
3. **Mechanically Bonded Fiber Matrix (MBFM):** See [Section 9010, 2.07](#).

2.18 TURF REINFORCEMENT MATS (TRM)**A. Material Classification:**

1. **Type 5.A, 5.B, 5.C, 5.D, and 5.E Turf Reinforcement Mat:** Composed of UV-stabilized non-degradable synthetic fibers, filaments, nets, wire mesh and/or other elements processed into a permanent, three dimensional matrix that may be supplemented with degradable components.
2. **Type 5.F High Performance Turf Reinforcement Mat:** A product composed of UV-stabilized, non-degradable, synthetic fibers, filaments, nets, wire mesh and/or other elements, processed into a permanent, three dimensional matrix.

- B. Properties and Performance:** Meet the minimum material and performance requirements contained in the following table:

Table 9040.03: Turf Reinforcement Mats

Property		Test Method	Type					
			5.A	5.B	5.C	5.D	5.E	5.F
Material	Tensile Strength (MD)	ASTM D 6818	≥ 150 lbs/ft ²	≥ 175 lbs/ft ²	≥ 200 lbs/ft ²	≥ 325 lbs/ft ²	≥ 1,500 lbs/ft ²	≥ 3,000 lbs/ft ²
	Tensile Strength (TD)	ASTM D 6818	≥ 150 lbs/ft ²	≥ 175 lbs/ft ²	≥ 200 lbs/ft ²	≥ 225 lbs/ft ²	≥ 1,500 lbs/ft ²	≥ 3,000 lbs/ft ²
	Material Mass / Unit Area	ASTM D 6566	≥ 8.0 oz./yd ²	≥ 8.0 oz./yd ²	≥ 8.0 oz./yd ²	≥ 8.0 oz./yd ²	≥ 8.0 oz./yd ²	≥ 8.0 oz./yd ²
	Thickness	ASTM D 6525	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in	≥ 0.25 in
	UV Stability	ASTM D 4355	80% @ 500 hrs	80% @ 500 hrs	80% @ 1,000 hrs	80% @ 1,000 hrs	90% @ 1,000 hrs	80% @ 3,000 hrs
Performance	Slope Application Max. Gradient (H:V)	N/A	1:1	1:1	0.5:1	0.5:1	0.5:1	0.5:1
	Unvegetated Shear Stress ⁴	ASTM D 6460	≥ 2.0 lb/ft ²	≥ 2.0 lb/ft ²	≥ 2.0 lb/ft ²	≥ 2.0 lb/ft ²	≥ 2.0 lb/ft ²	≥ 2.0 lb/ft ²
	Vegetated Shear Stress	ASTM D 6460	≥ 6.0 lb/ft ²	≥ 8.0 lb/ft ²	≥ 10.0 lb/ft ²	≥ 12.0 lb/ft ²	≥ 12.0 lb/ft ²	≥ 14.0 lb/ft ²
	Seedling Emergence	ASTM D 7322	≥ 250%	≥ 250%	≥ 250%	≥ 250%	≥ 250%	≥ 250%

Refer to the ECTC Specifications for details of testing requirements and assumptions.

2.19 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:

1. 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.
2. Do not allow the device to completely block or plug the intake, preventing inflow.

2.20 FLOW TRANSITION MATS

Comply with the following and [Iowa DOT Materials I.M. 469.10](#).

- A. Mat:** Constructed of 85% minimum UV resistant material with a maximum ground cover of 80%. Meet the requirements of Table 9040.04.

Table 9040.04: Flow Transition Mats

Property	Test Method	Value
Mass/Unit Area (max.)	ASTM D 6566	3 lbs/SF
Minimum Thickness	ASTM D 6525	0.4 inch
Maximum Thickness	ASTM D 6525	1 inch
Wide Width Tensile Strength	ASTM D 6818	2,500 lbs/ft
Minimum Percent Open Area	ASTM D 6567 Calculated	20%
UV Stability	ASTM D 4355	85%
Manning's n	Calculated	0.039

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.

2.21 Grid Tied Concrete Block Mat

Grid tied concrete block mat is manufactured from individual concrete blocks that are cast integrally with a geogrid to form an erosion control mat. The resulting mat is supplied and transported in a rolled form.

A. Blocks:

1. Manufacture blocks with concrete complying with the cement requirements of ASTM C 150 and the aggregate requirements of ASTM C 33.
2. Minimum compressive strength of 5,000 psi at 28 days.
3. Furnish blocks that have a minimum weight of 3 pounds per block. Do not allow completed mat weight to exceed 10 pounds per square foot.
4. Ensure blocks have a flat-top pyramid shape with a nominal base of 6.5 inches by 6.5 inches and a height between 2.25 and 2.5 inches.
5. Place blocks no further than 1.5 inches apart.
6. Ensure missing concrete due to chipping or cracking does not exceed 15% of the average concrete unit weight.

B. Grid:

1. Open-knitted fabric composed of high tenacity, multifilament polypropylene yarns knitted and coated tension to form a stable grid structure. Comply with the material requirements of Table 9040.05.
2. Embed the grid within the base of each of the concrete blocks.
3. When mats will be installed adjacent to each other:
 - a. Extend the geogrid 12 inches beyond one long edge of the mat to allow for overlap with the adjacent mat.
 - b. Extend the geogrid 12 inches beyond one end of the roll to allow for overlap with an abutting mat.

Table 9040.05: Grid Tied Concrete Block Mat Grid Properties

Property ¹	Test Method	Value
Aperture Size	Measured Length	1.4 to 1.9 inches
Ultimate Tensile Strength	ASTM D 6637	2,055 lb/ft
Elongation at Break	ASTM D 6637	6% (max.)
Tensile Strength @ 2%	ASTM D 6637	822 lb/ft (min.)
Tensile Strength @ 5%	ASTM D 6637	1,640 lb/ft (min.)
Tensile Modulus @ 2%	ASTM D 6637	41,000 lb/ft (min.)
Tensile Modulus @5%	ASTM D 6637	32,800 lb/ft (min.)

¹ All values apply to both the machine direction and cross machine direction.

2.21 Grid Tied Concrete Block Mat (Continued)**C. Underlayment Materials:**

1. Use a Type 2D or 3B RECP base layer composed of curled wood excelsior.
2. If required by the manufacturer, provide five-pick leno weave polypropylene netting top layer to add strength and support to the underlying RECP.
3. Depending on the site conditions, additional or alternative underlayment materials may be specified in the contract documents.
4. The underlayments may be attached to the GTCBM during manufacture.
5. When GTCBM will be installed adjacent to each other:
 - a. Extend the RECP underlayment 6 inches beyond one long edge of the mat to allow for overlap with the adjacent mat.
 - b. Extend the RECP underlayment 6 inches beyond one end of the roll to allow for overlap with an abutting mat.

D. Anchors and Ties:

1. **U-Anchors:** Provide No. 3 deformed bars shaped in a "U" with 18 inch long legs.
2. **Ties:** Provide 20 inch long, type 304 stainless steel zip ties with a minimum tensile strength of 250 pounds.

- E. Performance:** Comply with the minimum requirements of Table 9040.07 when tested with a backing material on a non-vegetated surface. Verify performance with full-scale laboratory testing performed by an independent third-party testing facility.

Table 9040.07: Grid Tied Concrete Block Mat Performance

Property	Test Method	Bed Slope	Value
Shear Stress	ASTM D 6460	10% & 20%	18 lb/ft ²
Velocity	ASTM D 6460	10% & 20%	30 ft/sec

2.22 ENGINEERING FABRIC

Comply with [Iowa DOT Article 4196.01, B, 3.](#)

PART 3 - EXECUTION**3.01 SWPPP PREPARATION**

- A. Prepare a SWPPP according to the requirements of the Iowa 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 Iowa 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 Iowa DNR NPDES General Permit No. 2.
- B. Schedule necessary maintenance or improvements for items included in the contract documents.
- C. Notify the Engineer immediately of situations requiring attention beyond that provided for in the contract documents.
- 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 of the slope and perpendicular to sheet flow as specified in the contract documents, or as directed by the Engineer.
- B. Turn the beginning and ends of the filter berm installation uphill to create a “J” shape at each end to prevent runoff from flowing around the end of the berm.
- C. For slopes that receive runoff from above, place a filter berm at the top of the slope to control the velocity and spread flow.
- D. Ditch Checks:
 - 1. When filter berms are allowed for ditch checks, extend the berm up the side slopes of the ditch to prevent flow from bypassing around the edges of the berm.
 - 2. Ensure the bottom of the berm on the slope is higher in elevation than the top of the berm in the middle of the ditch.
 - 3. Construct standard filter berm with a base of 5 to 7 feet and minimum height of 24 inches.
 - 4. Construct compact filter berm with a base of 3 to 5 feet and minimum height of 18 inches.
- E. 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.

3.07 FILTER SOCKS (Continued)

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.

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. Anchor Trenches, Seams, and Terminal Ends:

1. Upslope Anchor Trenches:

- a. Excavate a 6 inch by 6 inch trench along the top of the slope.
- b. Extend the upslope terminal end of the RECP 3 feet past the anchor trench.
- c. Use staples at 1 foot centers to fasten the RECP to the bottom of the trench.
- d. Backfill and compact the trench.
- e. Apply seed and fertilizer to the trench surface if seeding is specified.
- f. Fold top end of RECP over compacted trench and secure upslope terminal end with a single row of staples on 1 foot centers.

2. Adjacent Seams:

- a. Overlap edges of adjacent RECPs by 2 to 4 inches.
- b. Install a sufficient number of staples to prevent seam or abutted rolls from separating.

3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)**3. Consecutive Rolls (End Lap):**

- a. Shingle and overlap consecutive rolls 2 to 6 inches in the direction of flow.
- b. Secure staples through seam at 1 foot intervals.

4. Intermediate Anchor Trench:

- a. Excavate a 6 inch by 6 inch trench.
- b. Use staples at 1 foot centers to fasten the RECP to the bottom of the trench.
- c. Fold the RECP over upslope material and backfill and compact the trench.
- d. Apply seed and fertilizer to the trench surface if seeding is specified.
- f. Continue rolling material downslope over the trench.

5. Staple Check: Install two rows of staggered stakes or staples 4 inches on center and 4 inches apart.**6. RECP Blanket Check:**

- a. For use in conjunction with an RECP blanket lined channel.
- b. During RECP blanket installation, gather a 4 foot section of the blanket.
- c. Fold the blanket back upon itself, with the overlap pointing in the downhill direction, shingle style, to form a shallow, 2 foot long, check dam.
- d. Secure blanket check with long staples or wood stakes spaced at 12 inch intervals.

7. Terminal End Anchor Trench:

- a. Excavate a 6-inch by 6-inch trench.
- b. Extend the terminal end of the RECP 3 feet past the anchor trench.
- c. Use staples at 1-foot centers to fasten the RECP to the bottom of the trench.
- d. Backfill and compact the trench.
- e. Apply seed and fertilizer to the trench surface if seeding is specified.
- f. Fold the remaining end of the RECP over the compacted trench and secure the terminal end of the RECP with staples on 1 foot centers.

B. 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.
4. Unroll the RECP down or horizontally across the slope.
5. Securely fasten RECP to the soil with staples according to the density and pattern recommended by the manufacturer with a minimum rate of 1.3 staples per square yard within the body of the blanket.
6. Place consecutive blankets down the slope end-over-end, shingle style.
7. Overlap ends of consecutive rolls and secure with staples.
8. Overlap edges of adjacent rolls and secure with staples.
9. Anchor the terminal end of the RECP with an anchor trench or staple check slot.

3.08 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP) (Continued)**C. Channel/Ditch Application:**

1. When specified, prepare seedbed and place seed and fertilizer according to [Section 9010](#), prior to placing RECP.
2. Construct an anchor trench at the beginning of the channel across its entire width.
3. Position adjacent rolls in the anchor slot and overlap.
4. Unroll RECP downstream.
5. Follow the manufacturer's recommendations for the installation of intermediate anchor trenches or staple checks at intervals along the channel.
6. Construct consecutive roll lap at end of roll and beginning of new roll.
7. Terminate installation at downstream end with an anchor trench or staple check.
8. Install anchors in a regular pattern over entire area covered according to manufacturer's published recommendations (minimum 1.7 anchors per square yard). Significantly higher anchor rates and longer staples may be necessary in sandy, loose, or wet soils and in severe applications.

3.09 WATTLES ([Figure 9040.105](#))**A. Installation:**

1. Construct a shallow trench, 2 to 4 inches deep, matching the width and contour of the wattle.
2. Install wattle along contour of slope.
3. Turn ends of wattle uphill to prevent water from flowing around ends.
4. Place and compact excavated soil against the wattle, on the uphill side.
5. 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.
6. 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.

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.

3.09 WATTLES (Continued)**C. Replacement:**

1. 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.
2. 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 in the contract documents, provide an RECP under the check dam, installed according to the manufacturer's recommendations.

B. Triangular Foam Check Dam:

1. Install according to the manufacturer's recommendations.
2. When specified in the contract documents, provide an RECP under the check dam, installed according to the manufacturer's recommendations.

C. Rock Check Dam: Construct according to [Figure 9040.107](#).**D. Fiber Log:**

1. When specified in the contract documents, install fiber log check dam over RECP blanket.
2. Install fiber log across ditch or swale perpendicular to flow in a crescent shape with the ends facing upstream.
3. Install fiber log so the center section is one log diameter lower than the ends.
4. Space stakes at 1 foot intervals. Place two stakes at a 45 degree angle to the surface in a crisscross pattern with the fiber log in-between.

F. Rock/Sand Bag:

1. Fill bags only three-fourths full of rock to reduce gaps in the check dam.
2. Stack bags forming a check dam with a height of 1.5 to 2 feet and side slopes 2:1.
3. Tightly abut and overlap rock bags to prevent flow between bag joints.
4. Extend bags up the side slopes of the ditch to prevent flow from bypassing around the edges of the check dam.

3.10 CHECK DAMS (Continued)

G. 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.

1. Remove the check dam and dispose of materials, or salvage to the contractor.
2. Remove the accumulated sediment or spread to match finished grade; ensure proper drainage.
3. Stabilize the area disturbed by removal operations.

3.11 TEMPORARY EARTH DIVERSION BERMS ([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 TEMPORARY SEDIMENT BASIN ([Figures 9040.113](#) and [9040.114](#))**A. Basin Construction:**

1. Construct the storage area to the size and elevations specified in the contract documents.
2. Stabilize the side slopes and internal surfaces of the temporary sediment basin.
3. When specified in the contract documents, install internal baffles to enhance sediment capture. Refer to [Figure 9040.117](#).

B. Outlet Structure:

1. **Concrete Base:** Construct the concrete base and anchor riser section, as shown on [Figure 9040.115](#).
2. **Dewatering Device:**
 - a. Drill holes in the riser section. The number, diameter, and configuration will be specified in the contract documents.
 - b. Wrap the perforated section of the riser pipe with metal hardware cloth.
3. **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](#).

C. Anti-Seep Collar:

1. Provide anti-seep collars at locations shown in the contract documents.
2. Install according to the collar manufacturer's recommendations.
3. Place backfill material and compact over-excavation areas to a minimum of 95% Standard Proctor Density per [Section 3010](#).

3.16 SEDIMENT TRAPS ([Figure 9040.118](#))

- A. Construct the storage area to the size and elevations specified in the contract documents.
- B. Stabilize the side slopes and internal surfaces of the sediment trap.
- C. When specified in the contract documents, install internal baffles to enhance sediment capture. Refer to [Figure 9040.117](#).

3.17 SILT FENCES ([Figure 9040.119](#))**A. Installation:**

1. Install material along the contour of the ground, as specified in the contract documents, or as directed by the Engineer.
2. Install silt fence with a mechanical soil slicing machine that creates a slit in the ground while simultaneously installing the fabric. The trenching method may be used when situations will not allow soil slicing, as determined by the Engineer.
3. Construct a "J-hook" at each end of a continuous run of silt fence, by turning the end of the silt fence uphill, as necessary to prevent runoff from flowing around ends when water behind the fence ponds to a level even with the top of the fence.

3.17 SILT FENCES (Continued)

4. Insert 12 inches of fabric to a minimum depth of 6 inches (fabric may be folded below the ground line).
5. Compact installation by driving along each side of the silt fence, or by other means, as necessary to adequately secure the fabric in the ground, to prevent pullout and water flow under the fence.
6. Drive steel posts into the ground alongside the silt fence, to a minimum depth of 20 inches, unless otherwise specified by the Engineer. Space posts as shown on [Figure 9040.119](#) or as required to adequately support silt fence.

B. Maintenance: Repair or replace non-functioning silt fence that allows water to flow under the fence, is torn, or is otherwise damaged, due to inadequate installation, at no additional cost to the Contracting Authority.

C. Removal:

1. Remove the silt fence upon final stabilization of the project area, or according to the staging indicated in the SWPPP.
2. Remove and dispose of silt fence and posts.
3. Remove sediment or spread to match finished grade; ensure proper drainage.
4. Stabilize the area disturbed by removal operations.

D. Replacement:

1. When accumulated sediment reaches a level one-half the height of the fence, remove the silt fence as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing silt fence and accumulated sediment may be left in place, and a new silt fence installed up-slope from the existing silt fence.
3. When allowed by the Engineer, the existing silt fence may be left in place and the accumulated sediment removed to the original ground line and within 6 inches of the silt fence. Carefully inspect the existing silt fence for structural integrity and signs of undermining. Make any necessary repairs.

3.18 STABILIZED CONSTRUCTION EXIT ([Figure 9040.120](#))

- A. Install a stabilized construction exit at all locations where construction traffic leaving the site presents the potential for sediment track-out.
- B. Remove vegetation and excavate soft soils from entrance area. Thoroughly compact subgrade prior to placing stone or manufactured pad.
- C. Install culvert under entrance if necessary to maintain drainage.
- D. Grade entrance to prevent runoff from flowing onto street. Direct all runoff from entrance to a sediment retention device.
- E. When specified, install subgrade stabilization fabric prior to placing crushed stone or manufactured track-out pad.

3.18 STABILIZED CONSTRUCTION EXIT (Continued)

- F. For stone track-out control, install a layer of crushed stone to the thickness (6 inches minimum) and dimensions specified in the contract documents.
- G. For manufactured track-out pad, install according to manufacturer's recommendations and [Figure 9040.120](#). If soil conditions are poor, provide aggregate base, geotextile, or geogrid as recommended by the manufacturer.
- H. Remove the accumulated sediment and install new stone or clean manufactured device, as required to prevent track-out.

3.19 DUST CONTROL

- A. Water:** Apply frequent light watering to ground surface, as required to control dust.
- B. Calcium Chloride:** Apply according to [Iowa DOT Section 2314](#).
- C. Lignosulfonate (Tree Sap):**
 - 1. Loosen the top 1 to 2 inches of the roadway surface.
 - 2. Apply solution with a 50% residual concentration, at a rate of 0.50 gal/yd², to deliver a 25% residual. For diluted solutions, increase the application rate, as required, to deliver an equivalent 25% residual.
 - 3. Allow product to penetrate through the loosened material.
 - 4. Tight-blade road surface.
- D. Soapstock (Soybean Oil):**
 - 1. Loosen the top 1 to 2 inches of the roadway surface.
 - 2. Apply undiluted soapstock at a rate of 0.70 gal/yd².
 - 3. Allow product to penetrate through the loosened material.
 - 4. Tight-blade road surface.

3.20 EROSION CONTROL MULCHING

- A. Conventional Mulching:**
 - 1. Use conventional mulching when the surface cannot be stabilized by seeding, due to season or ground conditions.
 - 2. Uniformly distribute mulch over the required areas, at a rate of 2 tons/acre for dry cereal straw, or 2.5 tons/acre for prairie hay.
 - 3. Work the mulch into the soil with a mulch tucker, designed to anchor the mulch into the soil, by means of dull blades or disks.

3.20 EROSION CONTROL MULCHING (Continued)**B. Hydromulching:**

1. Place mulch and tackifier (if applicable) in equipment specifically manufactured for hydraulic mulching.
2. Mix materials with fresh, potable water using a combination of re-circulation through the equipment's pump and mechanical agitation to form a homogeneous slurry.
3. If necessary, dampen any dry, dusty soil as required to prevent balling of the material during application.
4. Apply hydromulch in multiple layers from opposing directions, where possible.
5. Apply the slurry evenly over all specified areas, at the minimum component material rates specified:
 - a. Wood Cellulose Mulch:
 - 1) Mulch: Minimum 3,000 lb/acre dry weight.
 - 2) Tackifier: Minimum 50 lb/acre.
 - b. Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
 - c. Mechanically Bonded Fiber Matrix: Minimum 3,000 lb/acre dry weight.
6. Retain and count empty bags of mulch to ensure final application rate.

3.21 TURF REINFORCEMENT MATS

Install according to the manufacturer's published installation literature for the product specified and application (slope or channel).

3.22 INLET PROTECTION

- A. Install inlet protection devices according to the manufacturer's recommendations.
- B. Remove the accumulated sediment, as required to maintain the inlet protection device in working order. Remove any accumulated sediment from streets open to traffic if it encroaches into the traveled roadway.

3.23 FLOW TRANSITION MATS

Install according to the manufacturer's published recommendations.

3.24 GRID TIED CONCRETE BLOCK MAT

Install according to the GTCBM supplier's recommendations, details, and the following:

A. Installation Practices:

1. **Standard Anchor Trench:** Excavate an 18 inch deep vertical trench. Bury 18 inches, or three blocks, of the mat in the trench, backfill, and compact.
2. **Edge Trench:** Excavate a 12 inch trench at a 45 degree angle to the surface. Bury 12 inches, or two blocks, of the mat in the trench, backfill, and compact.

3.24 GRID TIED CONCRETE BLOCK MAT (Continued)**3. Leading and Ending Anchor Trench:**

- a. Excavate an 18 inch deep vertical trench. Bury 18 inches, or three blocks, of the mat in the trench, backfill, and compact.
- b. Install U-anchors at 2 foot increments perpendicular to flow directly behind the first exposed block.

4. Seams: Supply GTCBM in lengths and widths that minimize seams to the extent possible. Where required, construct seams as follows:**a. Standard Seams:** Seams in channels parallel with the direction of flow and all seams on slopes that are not exposed to concentrated flow:

- 1) Extend geogrid 12 inches and RECP 6 inches under the adjacent mat.
- 2) Secure seam with U-anchors at 2 foot increments directly behind the first row of blocks on the adjacent mat. Alternatively, secure adjacent mats with zip ties at 1 foot intervals. Encompass at least 3 cords of each mat with zip ties.

b. Overlap Seams: Where seams are perpendicular to flow in a channel:

- 1) Install upstream mat and flip trailing edge back 24 inches.
- 2) Excavate 2.25 inches of soil 18 inches from the trailing end of the upstream mat.
- 3) Place the leading edge of the downstream mat into the shallow trench. Backfill and tamp soil into the mat filling voids between blocks. Place seed over the soil.
- 4) Flip the end of the upstream mat over the soil-covered and seeded area.
- 5) Secure overlap with U-anchors at 2 foot increments directly behind the first block of the up-channel mat. Alternatively, secure overlap with zip ties at 1 foot intervals. Encompass at least 3 cords of each mat with zip ties.

5. Concrete GTCBM Trench: Where GTCBM is installed at a culvert or storm pipe outlet, construct a concrete GTCBM trench to secure the end of the mat and prevent undermining of the outlet.

- a. Excavate an 18 inch wide by 18 inch deep trench at the end of the pipe apron.
- b. Install 36 inches of GTCBM in trench with 18 inches flat along the bottom of the trench and 18 inches extending vertically up the wall of the trench to the top of the surface of the channel.
- c. Backfill channel with Class C concrete.
- d. If a concrete footing is specified for the apron, and a cast-in-place footing is provided, the concrete GTCBM trench may be combined with the footing by extending 36 inches of GTCBM into the footing in lieu of constructing a separate trench.

B. General Site Preparation:

1. Complete final grading and restore topsoil if previously stripped.
2. Ensure ground surface is smooth and free of rocks, clods, roots, or debris.
3. Perform seedbed preparation and apply seed according to [Section 9010](#) prior to placement of the GTCBM.

C. Slopes:

1. Construct an anchor trench at the top and bottom of the slope.
2. Begin the installation at the top of the slope.
3. Unroll GTCBM down the slope to the bottom anchor trench.

3.24 GRID TIED CONCRETE BLOCK MAT (Continued)

4. If slope length exceeds the allowable length of GTCBM roll, install subsequent mats end to end with a standard seam.
5. Install adjacent rolls and splice with a standard seam.

D. Channels:**1. GTCBM Perpendicular to Flow:**

- a. Place mats continuously across the width of the channel, including side slopes, without any seams parallel to the direction of flow.
- b. Begin installation downstream and move up the channel.
- c. Place the first mat across the channel.
- d. Install an ending anchor trench at the terminal end of the downstream mat.
- e. Install subsequent mats upstream, splicing each abutting mat with a standard seam.
- f. Construct a leading anchor trench at the upstream end of the installation or a concrete GTCBM trench if specified.

2. GTCBM Parallel to Flow:

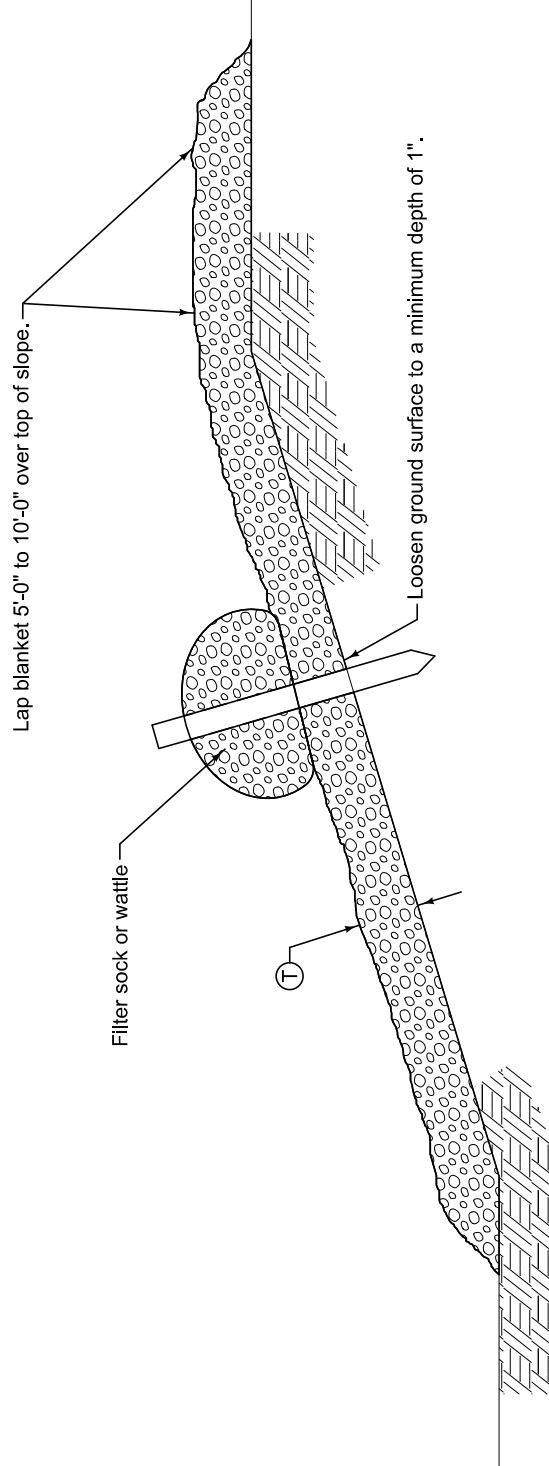
- a. Begin at the upstream end of the installation, utilizing multiple mats as necessary to achieve the width specified in the contract documents.
- b. Construct a leading anchor trench at the upstream end of the installation or a concrete GTCBM trench if specified.
- c. Unroll mats downstream, securing parallel edges with standard seams.
- d. If installation length requires multiple rolls of GTCBM, join ends of subsequent mats together with an overlap seam.
- e. Install an ending anchor trench at the terminal end of the downstream mat.

3.25 TEMPORARY EROSION CONTROL SEEDING

Comply with [Section 9010](#).

END OF SECTION

Compost blanket may be vegetated or unvegetated as specified in the contract documents.



COMPOST BLANKET DETAIL

MINIMUM COMPOST BLANKET THICKNESS

SLOPE	BLANKET THICKNESS
3:1	3"
≤ 4:1	2"


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SUDAS Standard Specifications

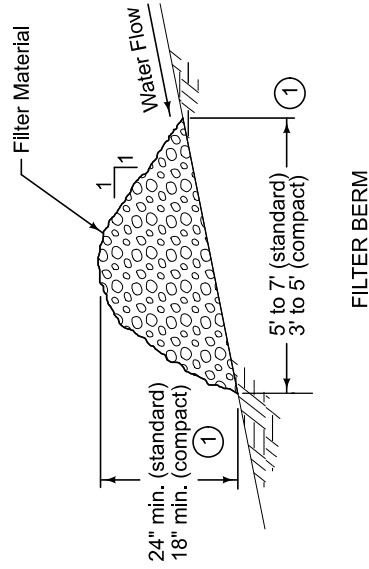
COMPOST BLANKET

Berm shown is typical for slopes flatter than 3:1. For steeper slopes, increase berm size as directed by the Engineer.

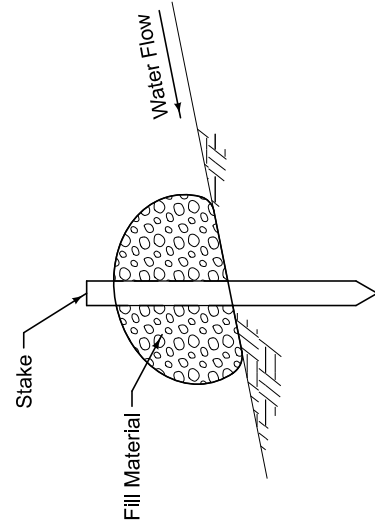
Place berm in uncompacted windrow perpendicular to the slope at locations specified in the contract documents.

Filter sock diameter as specified in the contract documents.

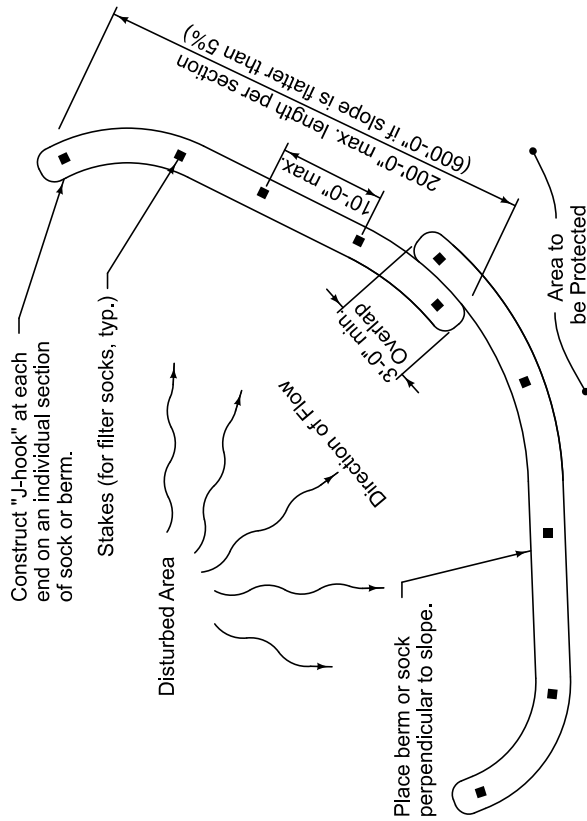
- ① Filter berm size (standard or compact) as specified in the contract documents.



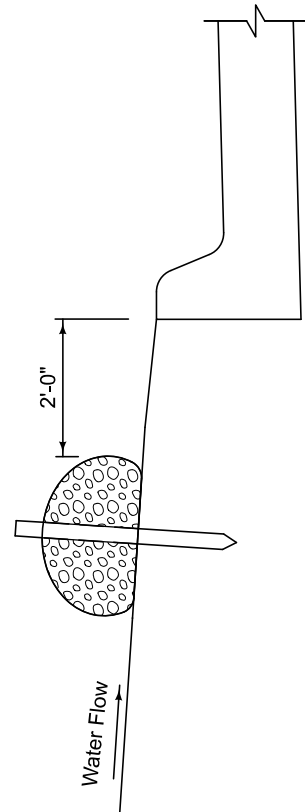
FILTER BERM



FILTER SOCK



PLAN VIEW OF SLOPE
(for sediment and slope control)



SECTION VIEW AT STREET
(for perimeter control along street)

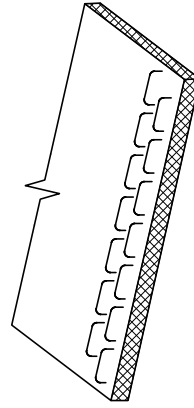
TYPICAL PLACEMENT OF BERM OR SOCK

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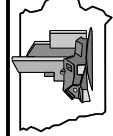
SUDAS Standard Specifications

FILTER BERM AND FILTER SOCK

- ① Secure blanket to ground according to manufacturer's recommended anchoring pattern and anchor density (minimum 1.3 anchors per square yard).
- ② Install staples at 1 foot on center.



STAPLE CHECK
(Two rows of staples at 4" on center and staggered 4" apart)



SUDAS

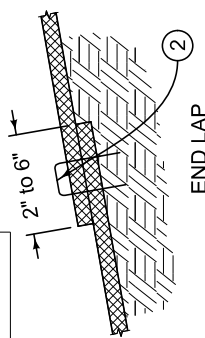
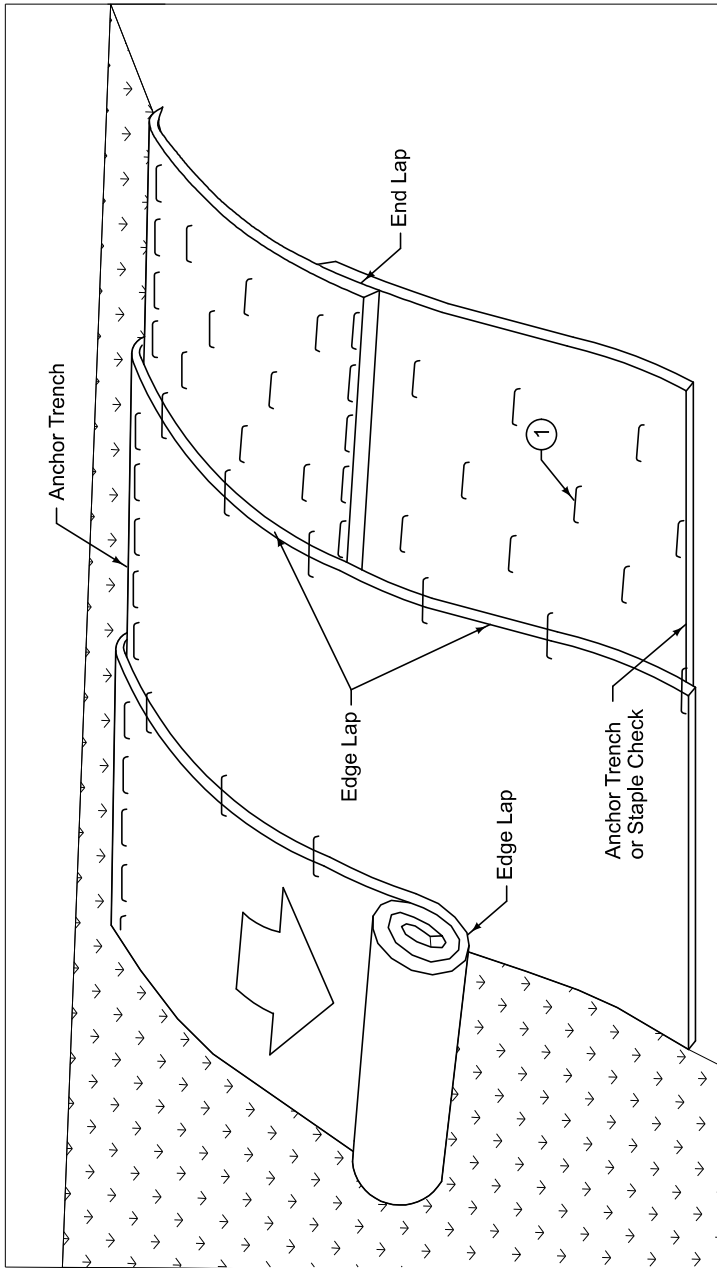
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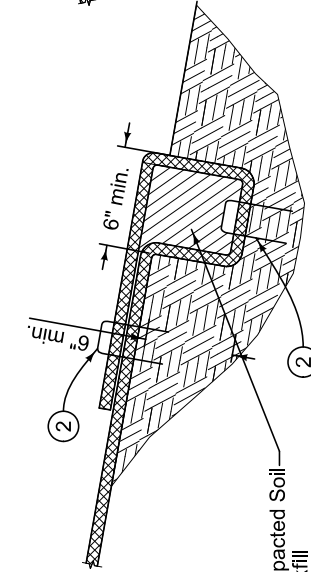
SHEET 1 of 1

SUDAS Standard Specifications

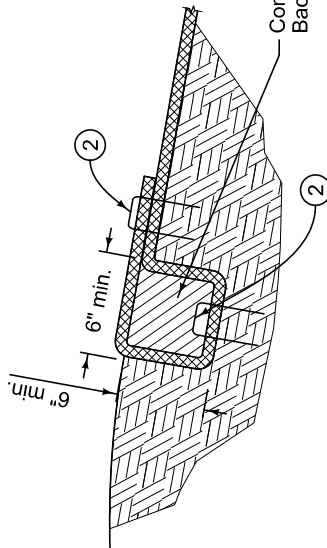
**ROLLED EROSION CONTROL
PRODUCT (RECP)
INSTALLATION ON SLOPES**



END LAP



UPSLOPE AND TERMINAL END ANCHOR TRENCH



EDGE LAP
(4'-0" min. anchor spacing)

- ① Secure blanket to ground according to manufacturer's recommended anchoring pattern and anchor density (minimum 1.7 anchors per square yard).
- ② Install staples at 1 foot on center.
- ③ Install staple checks at 100 foot intervals for channel slopes less than 2.5%.
- ④ Install blanket checks for the following slopes:
 2.5% - 3% 100 ft. intervals
 3% - 5% 50 ft. intervals
 5% - 7% 25 ft. intervals

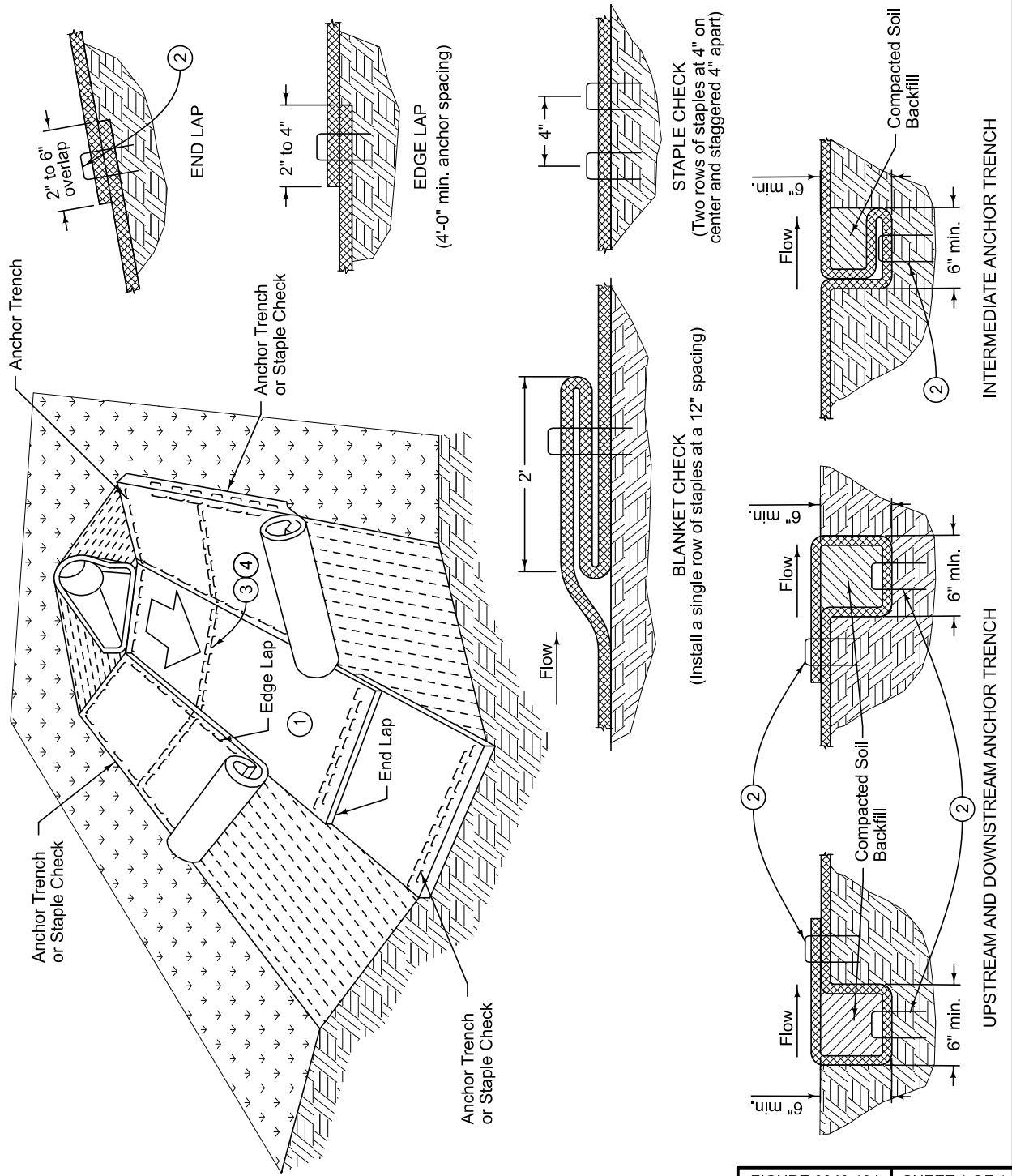
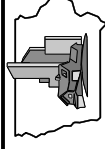
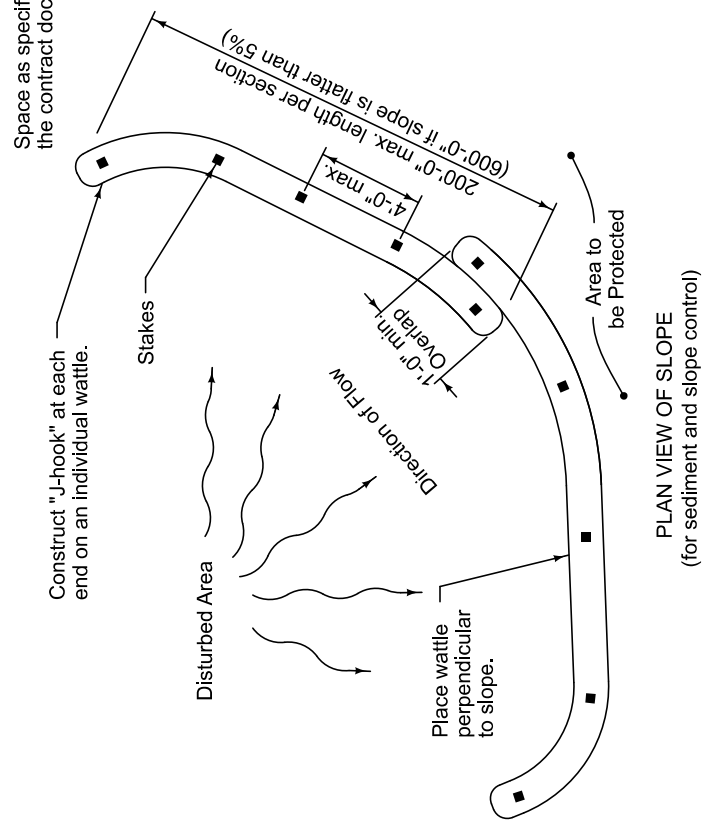
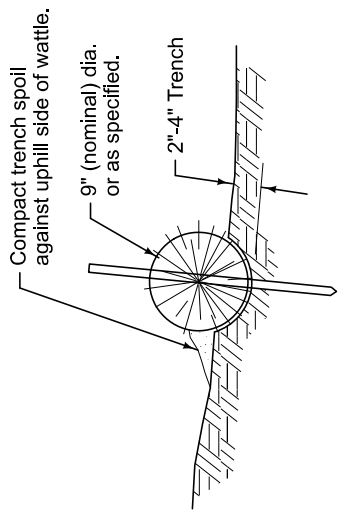
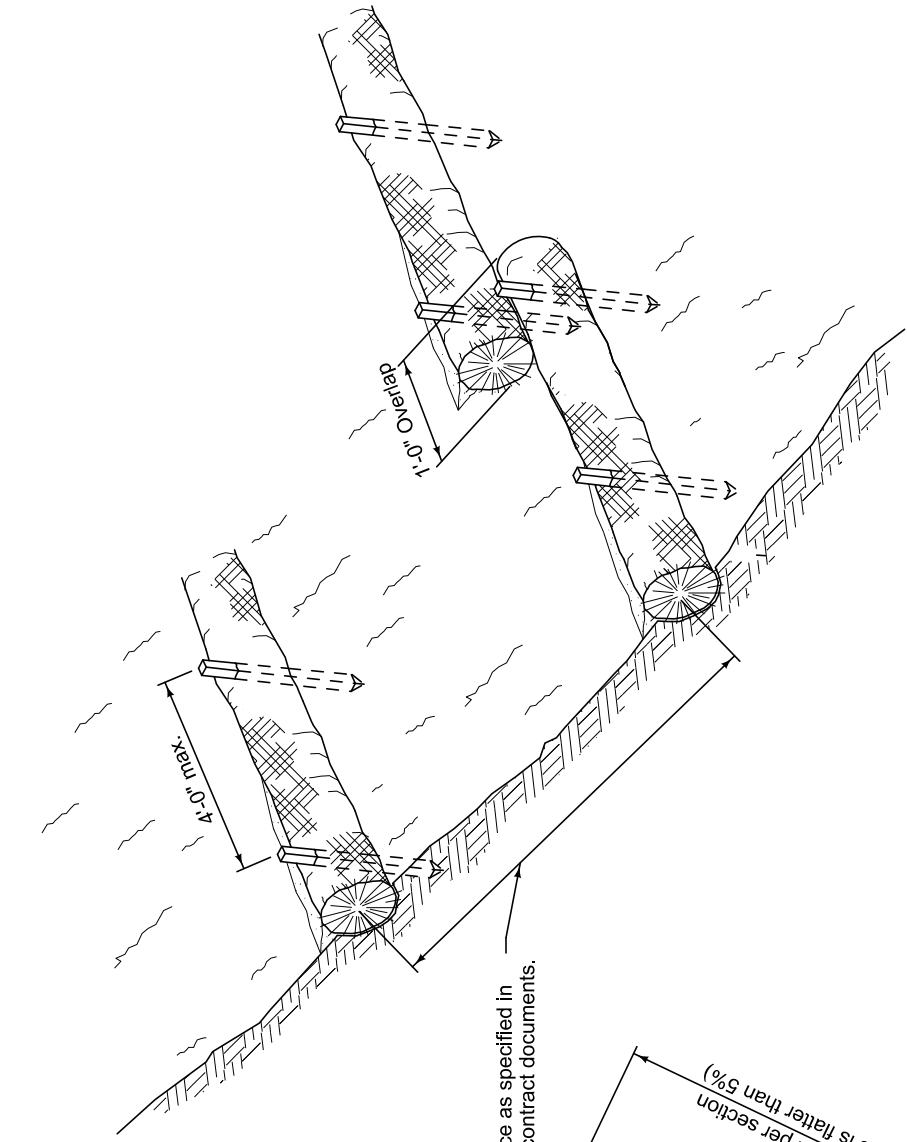


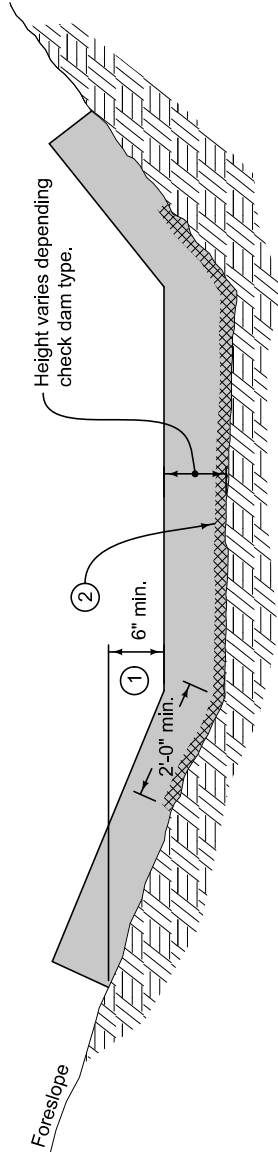
FIGURE 9040.104 SHEET 1 OF 1

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SUDAS Standard Specifications	
WATTLE	

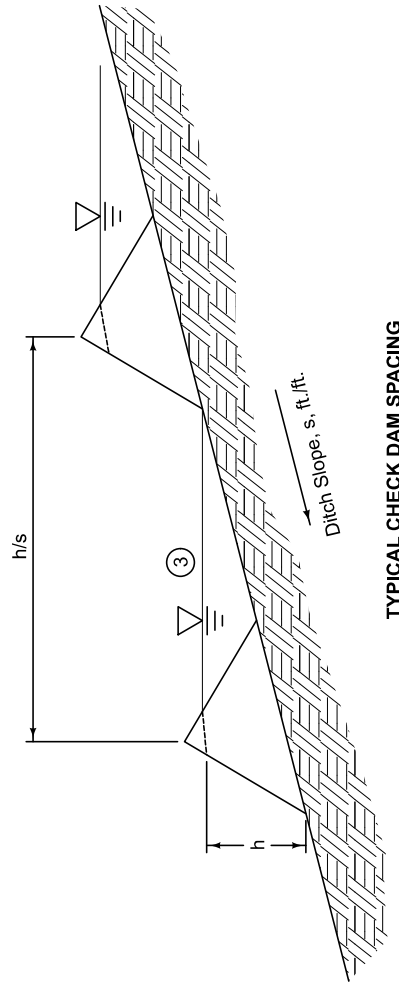


PLAN VIEW OF SLOPE
(for sediment and slope control)

- ① Extend check dam up sides of slope so the bottom of the check dam is at least 6 inches higher than the check dam crest.
- ② When specified, install an 8 foot wide strip of RECP under the check dam. Extend RECP up the slopes a minimum of 2 feet from the toe of the channel.
- ③ Space check dams so crest of downstream check dam is level with the base of the upstream check dam.



TYPICAL CHECK DAM SECTION
 (Applies to silt fence, fiber log, and manufactured check dam devices)



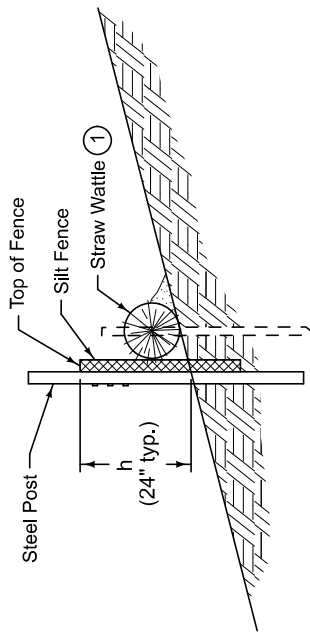
TYPICAL CHECK DAM SPACING

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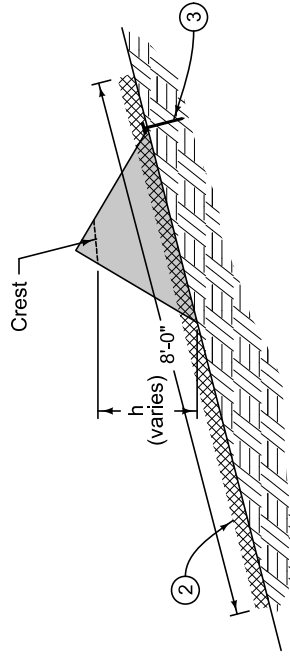
SHEET 1 of 2

SUDAS Standard Specifications

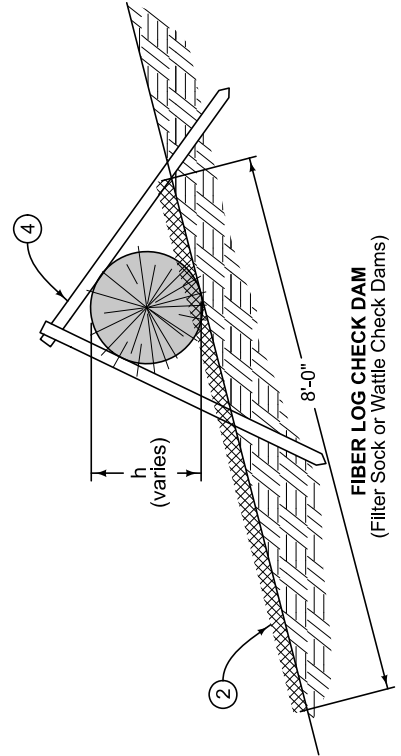
CHECK DAMS



SILT FENCE CHECK DAM
 (See Figure 9040.119 for installation of Silt Fence Check Dams)



MANUFACTURED CHECK DAM
 (Synthetic Permeable and Triangular Foam Check Dams)



FIBER LOG CHECK DAM
 (Filter Sock or Wattle Check Dams)

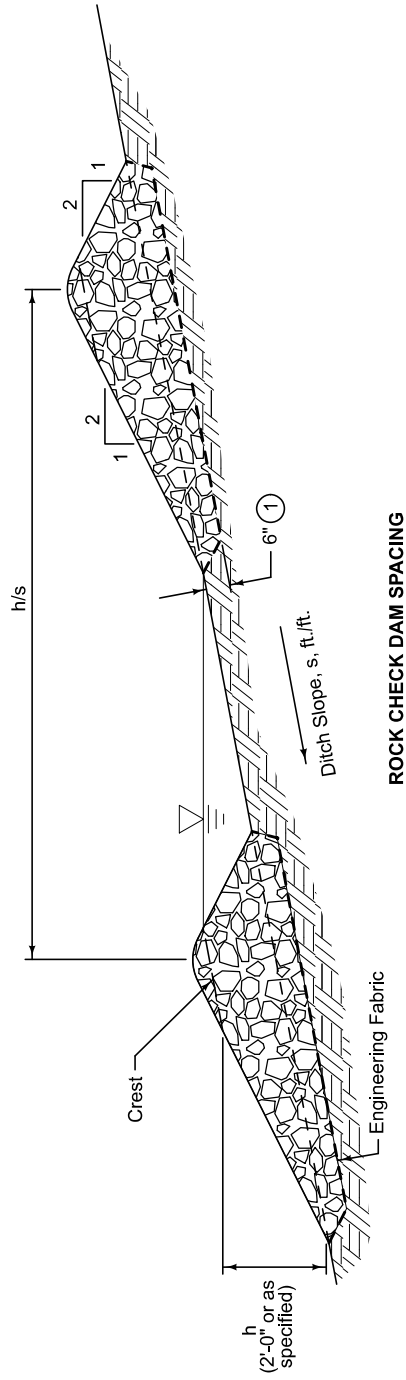
- ① When specified, place a straw wattle against the upstream face of silt fence check dams. Secure wattle in place with wood stakes.
- ② When specified, install an 8 foot wide strip of RECP under the check dam. Extend RECP up the slopes a minimum of 2 feet from the toe of the channel.
- ③ Anchor manufactured check dam according to the manufacturer's recommendations.
- ④ Install two stakes at a 45 degree angle to the surface. Space stakes at 1 foot intervals.

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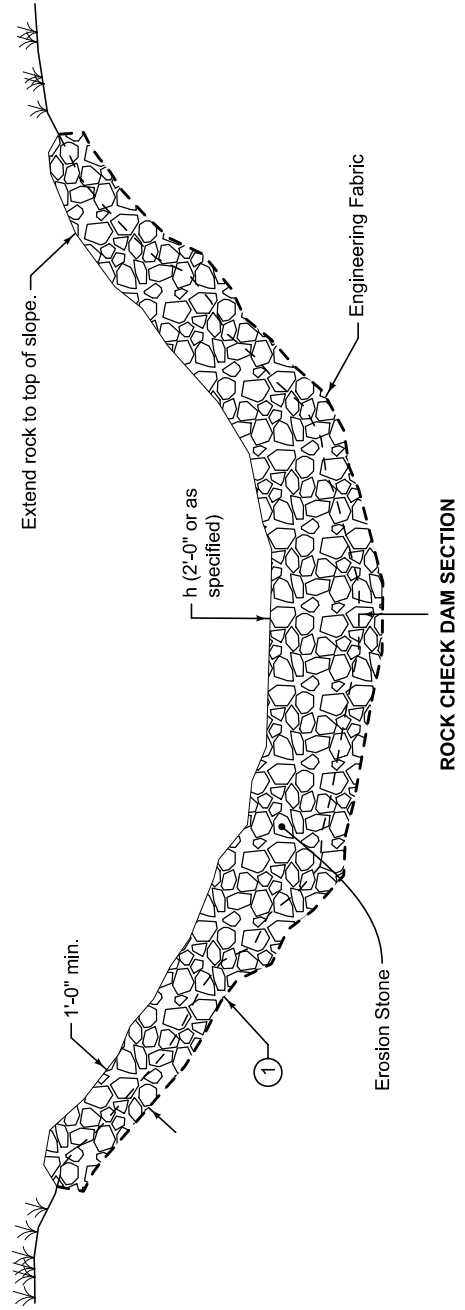
SUDAS Standard Specifications

CHECK DAMS

- ① Key rock check dam into bottom and sides of the channel a minimum of 6 inches.



ROCK CHECK DAM SPACING



ROCK CHECK DAM SECTION

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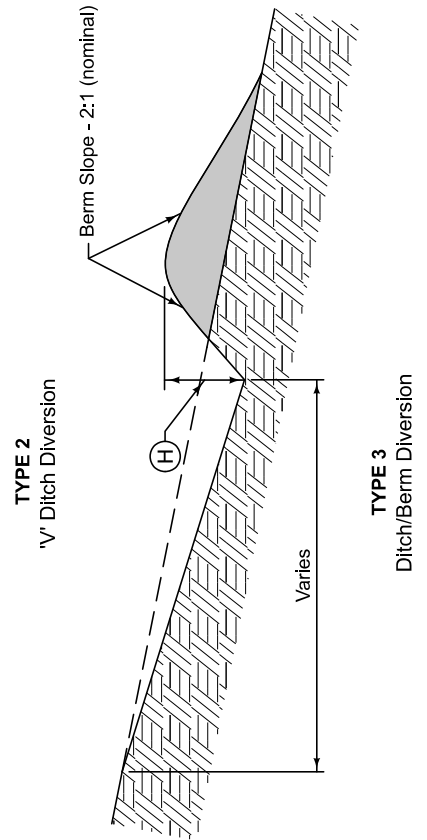
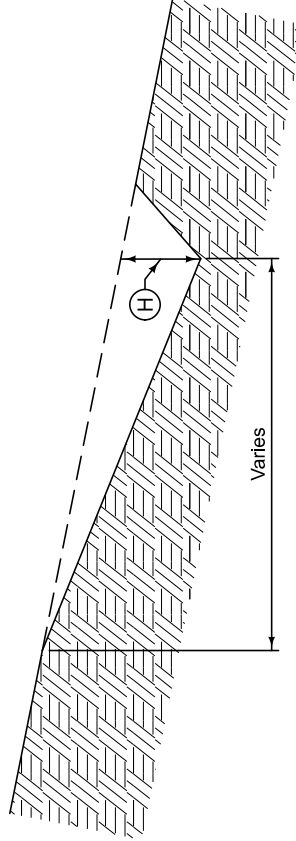
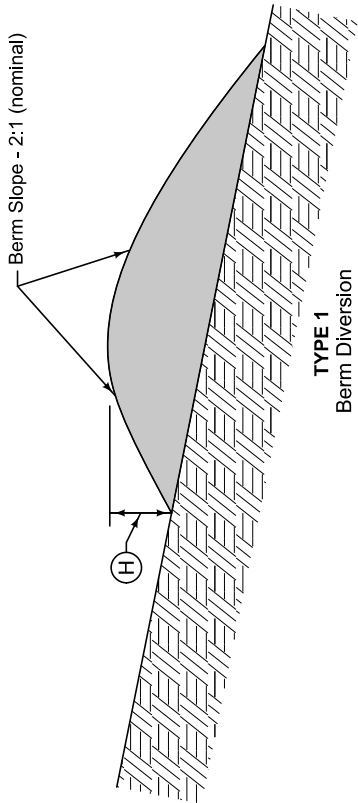
SUDAS Standard Specifications

ROCK CHECK DAM

Diversion Types 1, 2, and 3 may be used interchangeably unless otherwise specified in the contract documents.

Alternate configurations may be used upon approval from the Engineer.

(H) Total height of diversion (swale and berm): 18 inch minimum or as specified.



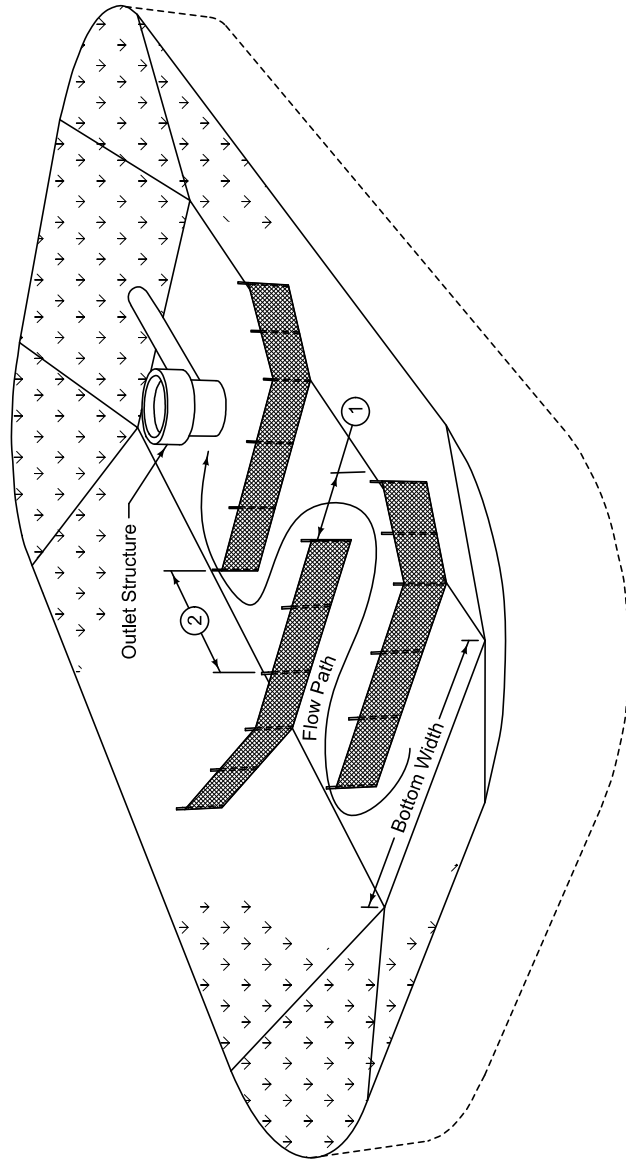
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SUDAS Standard Specifications

**TEMPORARY EARTH
DIVERSION BERMS**

Sediment baffles improve sediment capture by increasing the length that flow must travel through a sediment basin or sediment trap.

- ① Construct sediment baffle by installing rows of silt fence across the bottom of the sediment basin or sediment trap leaving an opening equal to 25% of the bottom width on alternating sides.
- ② Install the number of baffles specified in the contract documents. Space baffles evenly between the inlet and outlet of the basin or trap.

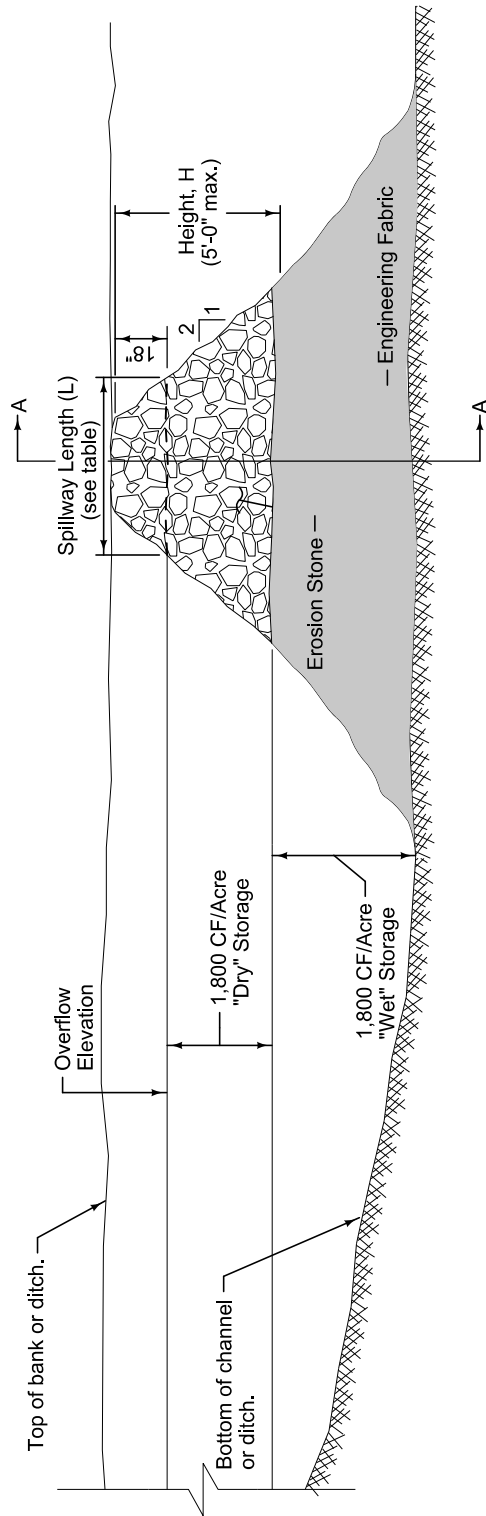


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SUDAS Standard Specifications

SEDIMENT BAFFLE

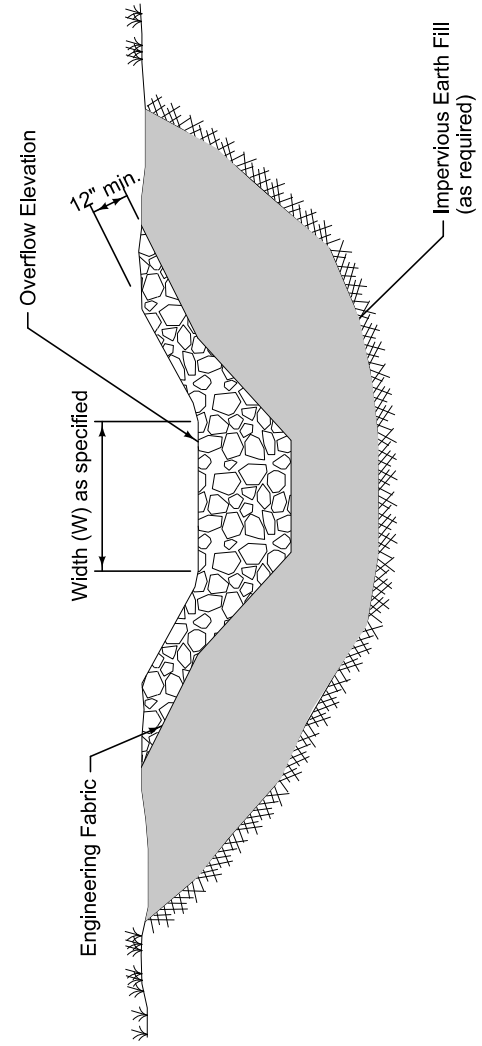
Remove accumulated sediment when level reaches one-half the height of the wet storage.



Spillway Length

H (ft.)	L (ft.)
1.5	2.0
2.0	2.0
2.5	2.5
3.0	2.5
3.5	3.0
4.0	3.0
4.5	4.0
5.0	4.5

PROFILE



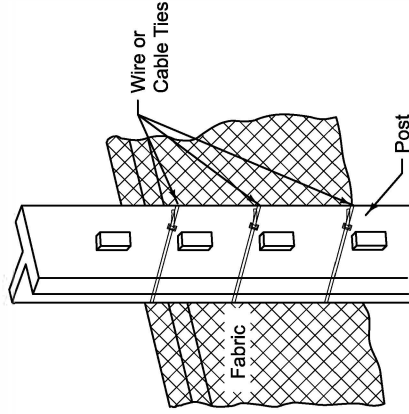
SECTION A-A

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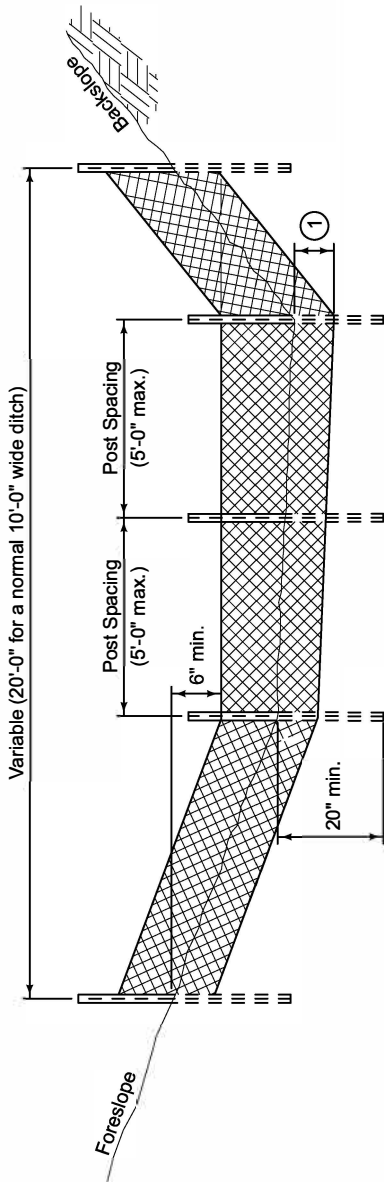
SUDAS Standard Specifications

SEDIMENT TRAP

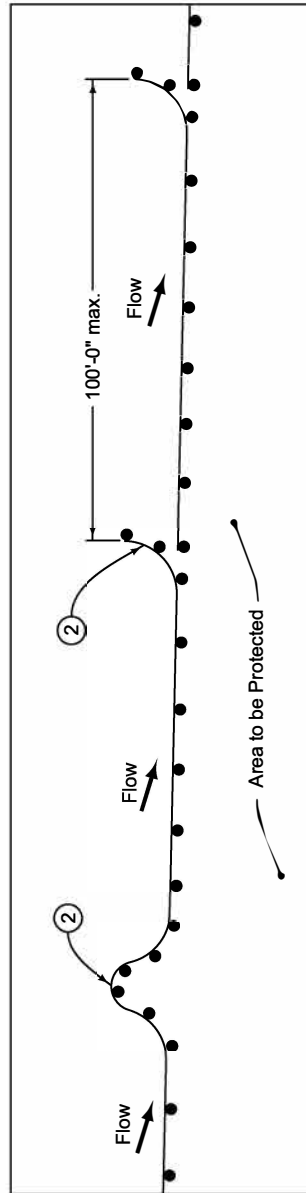
- ① Insert 12 inches of fabric a minimum of 6 inches deep (fabric may be folded below the ground line).
- ② Install silt fence for perimeter control with a maximum run length of 100 feet. At the downstream end of each run, turn the silt fence up the slope for 20 feet as shown to construct a 'J-Hook' to contain runoff. At the contractor's option, the silt fence may terminate and restart at the J-hook or may be installed continuously through the J-hook.



ATTACHMENT TO POST



TYPICAL SILT FENCE DITCH CHECK

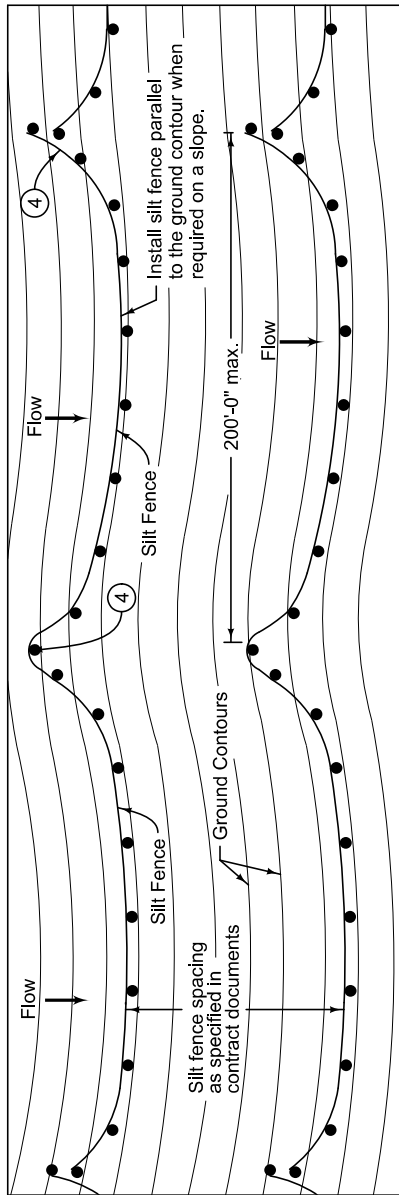


TYPICAL SILT FENCE INSTALLATION FOR PERIMETER CONTROL

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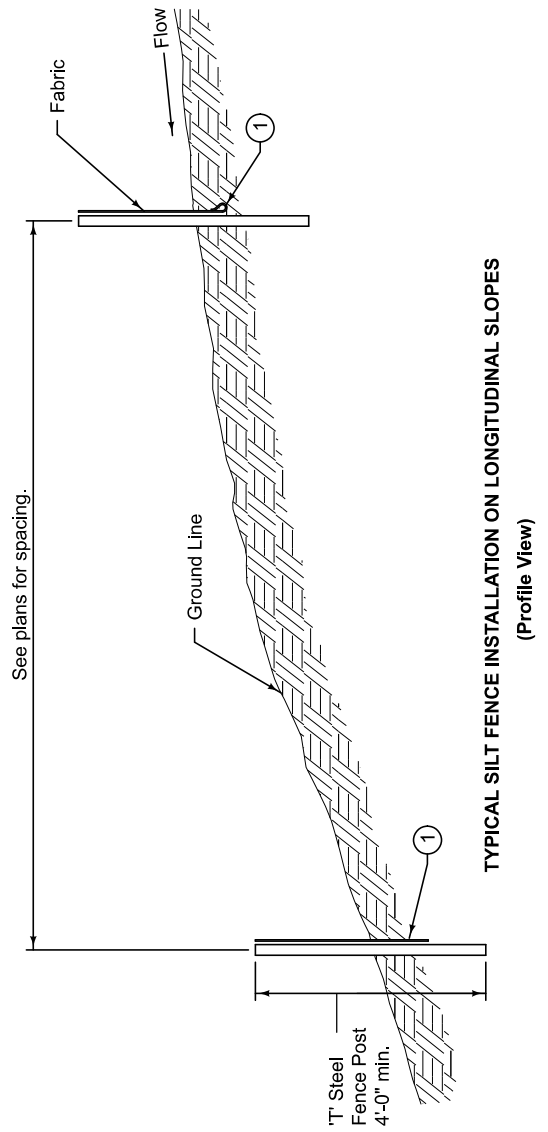
SUDAS Standard Specifications

SILT FENCE

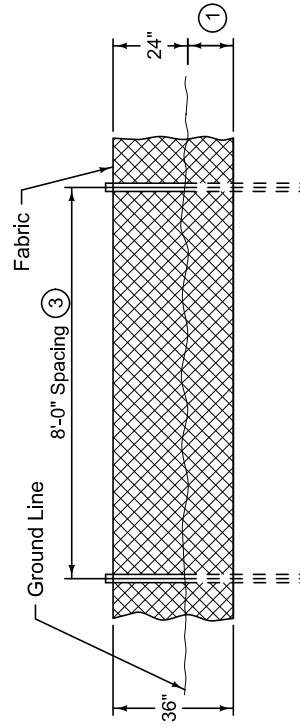


TYPICAL SILT FENCE INSTALLATION ON LONGITUDINAL SLOPES
(Plan View)

- ① Insert 12 inches of fabric a minimum of 6 inches deep (fabric may be folded below the ground line).
- ③ Reduce post spacing to 5 feet at water concentration areas, or as required to adequately support fence.
- ④ Place silt fence continuously along a constant elevation for a maximum run of 200 feet. At the end of each run, construct a 'J-hook' to contain runoff by turning the silt fence up the slope for a length of 20 feet as shown. At the contractor's option, the silt fence may terminate and restart at the J-hook or may be installed continuously through the J-hook.



TYPICAL SILT FENCE INSTALLATION ON LONGITUDINAL SLOPES
(Profile View)



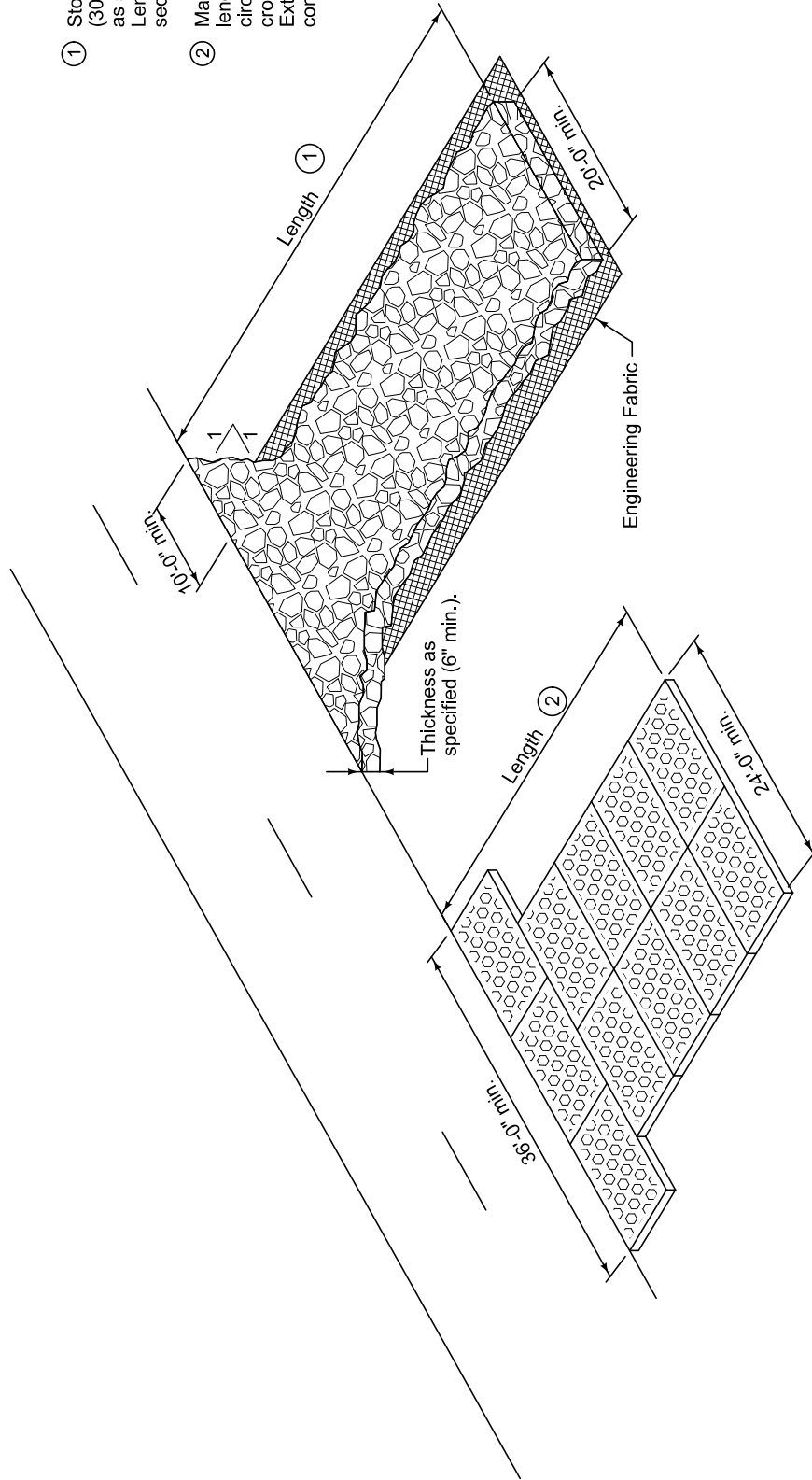
DETAILS OF SILT FENCE ON LONGITUDINAL SLOPES

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SUDAS Standard Specifications

SILT FENCE

- ① Stone Exit: 50 foot minimum length (30 foot for single family residential), or as specified in the contract documents. Length of exit may be increased if sediment track-out occurs.
- ② Manufactured Track-Out Pad: Minimum length of 35 feet or 3 times the circumference of the largest tire that will cross its path (whichever is larger). Extend length if adequate track out control is not achieved.



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SUDAS Standard Specifications

**STABILIZED
CONSTRUCTION EXIT**

2.03 FITTINGS

- A. Comply with ASTM F 626.
- B. Provide attachments to connect braces to posts by fittings that will hold both post and brace rigidly.
- C. Provide 3/8 inch diameter round steel diagonal tension rods with an appropriate commercial means for tightening. Provide a locknut or other device to hold the tightening device in place.
- D. Provide a suitable sleeve or coupling device, recommended by the manufacturer, to connect sections of top rail and provide for expansion and contraction.
- E. Use stretcher (tension) bars of the size specified in ASTM F 626 with suitable bands for attaching fabric to corner, end, or gate posts.

2.04 TIE WIRE AND TENSION WIRE

- A. **Tie Wire:** Provide tie wires for chain link fence that are the size and type the manufacturer recommends, but no smaller than No. 9 diameter for post ties or No. 12 diameter for rail and brace ties. Comply with ASTM F 626.
- B. **Tension Wire:** Comply with ASTM A 824, with Type I or Type II (Class 3) coating per ASTM A 817.

2.05 BARBED WIRE SUPPORTING ARMS

- A. Comply with ASTM F 626 for type of arm configuration specified in the contract documents, as listed below:
 - 1. Type I: Single slanted arm for three barbed wire strands.
 - 2. Type II: Single vertical arm for three barbed wire strands.
 - 3. Type III: V-shaped arm for six barbed wire strands.
 - 4. Type IV: A-shaped arm for five barbed wire strands.
- B. Anchor arms to line, end, corner, and pull posts

2.06 BARBED WIRE

Comply with ASTM A 121, design number 12-4-5-14R, Type A or Type Z (Class 3) coating.

2.07 GATES

- A. Provide the type, height, and width of gates as specified in the contract documents.
- B. Comply with ASTM F 900.
- C. Provide coating on gate, gate posts, and fabric as required for adjacent fence.

2.08 CONCRETE

Provide concrete materials complying with [Section 6010](#).

2.09 ELECTRICAL GROUND

- A. **Ground Rod:** 5/8 inch diameter, 8 foot long copper-clad rod.
- B. **Ground Wire:** No. 6 AWG bare copper wire.

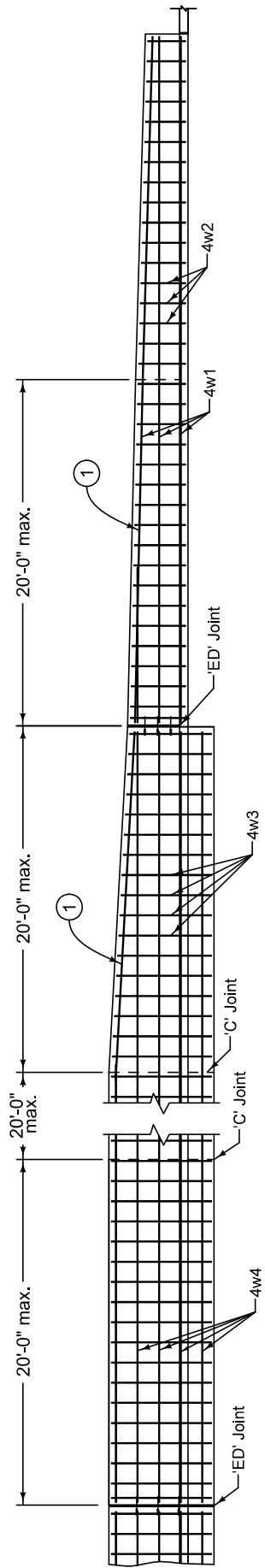
PART 3 - EXECUTION**3.01 CHAIN LINK FENCE INSTALLATION**

- A. General:** Comply with ASTM F 567, except as modified herein. Construct fence at the location and height specified in the contract documents.
- B. Posts:**
- 1. Post Location:**
 - a. Place posts in the line of the fence with equal spacing not to exceed 10 feet on center.
 - b. Set terminal (end, corner, and gate) posts at the beginning and end of each continuous length of fence and at abrupt changes in vertical and horizontal alignments. Place pull posts so that no more than 300 linear feet of fence is constructed with only line posts.
 - 2. Post Setting:**
 - a. Dig or drill post holes to the dimensions specified in the contract documents.
 - b. Set posts in concrete. Ensure all posts are set plumb in a vertical position.
 - c. Form top of concrete footing so it extends 1 inch above grade and is sloped to direct water away from the post. To prevent frost heave, ensure footing is a uniform size to full depth without flare at the top of grade.
 - d. Install posts no less than 24 hours prior to installation of fabric.
 - e. Set terminal, corner, angle, pull, and gate posts with the required brace-post assembly as specified in the contract documents.
- C. Rails:**
- 1. Top Rail:** Pass the top rail through the base of the line post caps to form a continuous brace from end to end of each stretch of fence. Join rail sections with sleeve, swedge end, or coupling device to allow for expansion and contraction. Securely fasten the top rail to the terminal posts with pressed steel connectors.
 - 2. Intermediate Rail:** Securely fasten the intermediate rail between all line posts and terminal posts with pressed steel fasteners. Intermediate rail is required only on fences 8 feet tall and taller.
- D. Braces:**
1. Securely fasten braces to the post by means of malleable iron or pressed steel connections; then truss from the line post back to the end, gate, or corner post.
 2. Tighten the diagonal tension rod (truss rod) to produce proper tension.
- E. Fabric:**
1. Install fabric on the outside of the posts from the area being fenced or on the roadway side of the posts.
 2. Secure one end of the fabric by a stretcher bar inserted in the final link of the fabric. Pull fabric taut with bottom selvedge, 2 inches above grade, before making attachment elsewhere.
 3. Tighten and secure each end of each run of chain link fabric by a stretcher bar inserted in the final link of the fabric. Secure stretcher bar to the end post by tension bands equally spaced no more than 15 inches apart.
 4. Attach fence fabric securely to the braces, top rail, tension wire, and all intermediate posts with wire ties or bands at intervals of no more than 12 inches.

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Provide a minimum concrete cover to near reinforcement of 1 1/2 inches. Provide 3 inches minimum cover at the ends of bars.

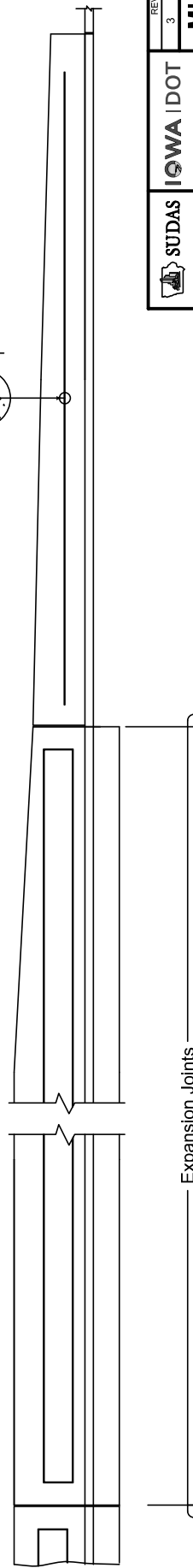
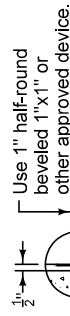
- ① Top bar parallel to top of wall. Lap 6 inch minimum as necessary. Tie securely.



TYPE B WALL

TYPE A WALL

TYPICAL LONGITUDINAL SECTION OF RETAINING WALL



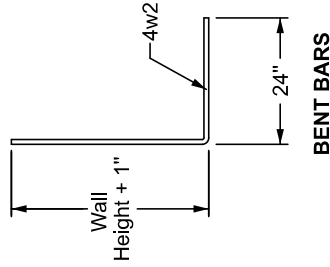
Expansion Joints

TYPICAL RUSTICATION DETAIL

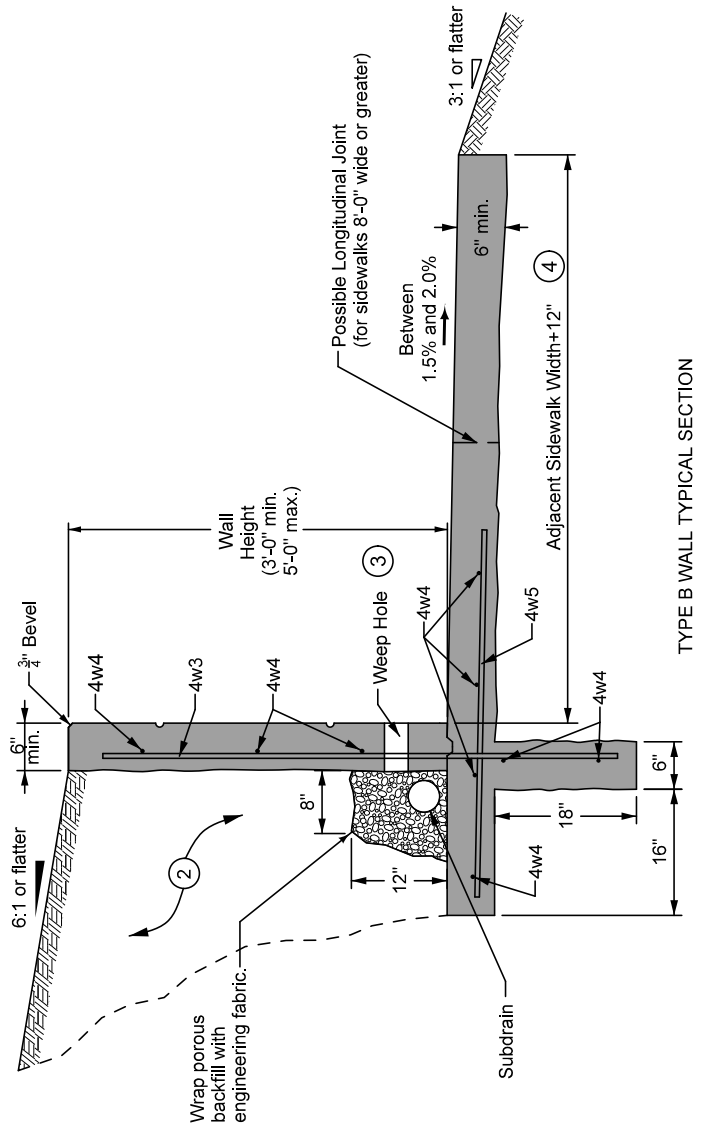
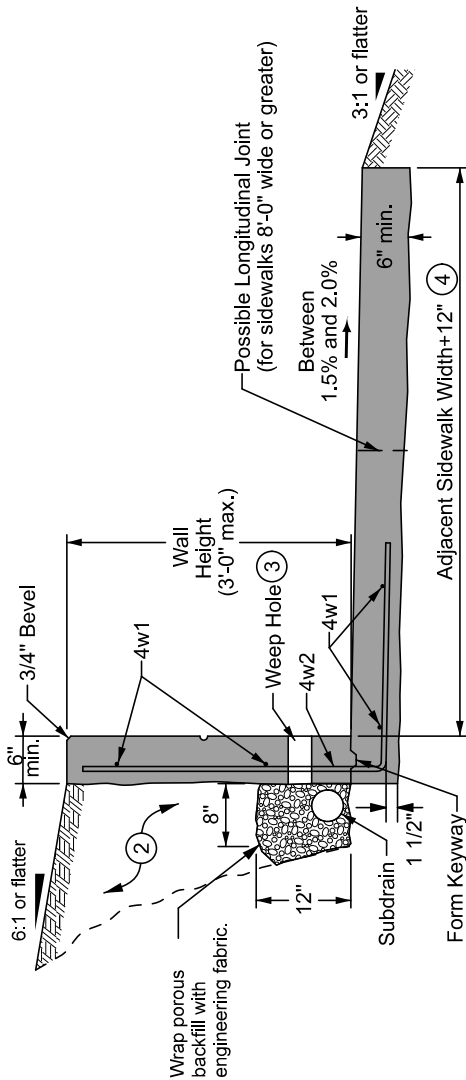
		REVISION 3 04-15-25
	FIGURE 9072.221	MI-221
STANDARD ROAD PLAN		SHEET 1 of 2
REVISIONS: Added 1.5 inch clearance dimension on type "A" wall, "1" bar.		
SUDAS DIRECTOR: <i>[Signature]</i>		
DESIGN METHOD/DESIGN ENGINEER: <i>[Signature]</i>		
COMBINED RETAINING WALL - SIDEWALK		

Provide a minimum concrete cover to near reinforcement of 1 1/2 inches. Provide 3 inches minimum cover at the ends of bars.

- ② Excavate and place backfill material as necessary.
- ③ Provide 3 inch diameter weep holes at 8 foot intervals. Install rodent guards in weep holes. Align bottom of weep hole with top of subdrain.
- ④ Additional 12 inch width is adjacent to wall.



REINFORCING BAR LIST					
Wall Type	Mark	Size	Shape	Length	Spacing
Type A	4w1	4	—	Variable	15"
	4w2	4	L	Variable	14"
Type B	4w3	4	—	Wall Height + 18"	14"
	4w4	4	—	Variable	15"
	4w5	4	—	3'-10"	14"



 SUDAS	IOWA DOT	REVISION 3 04-15-25
		MI-221
FIGURE 9072.221	STANDARD ROAD PLAN	SHEET 1 of 2
REVISIONS: Added 1.5 inch clearance dimension on type "A" wall. "L" bar.		
DESIGN DIRECTOR <i>[Signature]</i>		
DESIGN METHOD <i>[Signature]</i>		
COMBINED RETAINING WALL - SIDEWALK		

