INTRODUCTION

This publication has been prepared to provide a compilation of standard requirements, called Specifications, used by the New York State Department of Transportation for construction contracts. These specifications are written to the Contractor. They define the Contractor’s responsibility in meeting each specification, enumerate the Department’s expectations and how they are going to measure and pay, and explain what the Contractor is expected to provide.

When this publication, entitled Standard Specifications (USC) and dated as shown on the Title Page, is incorporated by reference into the Department’s construction contracts, it is made a part of that contract. The requirements stated herein may be revised or amended from time to time by notes or special specifications or documents of any description that would be furnished as part of a construction contract.
STATE OF NEW YORK

DEPARTMENT OF TRANSPORTATION

ENGINEERING DIVISION

Contained herein are:
General Provisions of Contract;
Contract forms of Proposal, Agreement and Bonds;
General Construction Specifications;
Materials of Construction;
Payment Items

Adopted
by

The Commissioner of Transportation
and Short Titled

"STANDARD SPECIFICATIONS" (USC)

Note: While these specifications may be used for general construction work, they have been compiled in US customary units with particular emphasis placed upon their use for highways, parkways, bridges and similar work. Necessary modifications of the contents hereof will be incorporated in the "Contract Documents" covering dissimilar work.
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Section 200
EARTHWORK

SECTION 201 - CLEARING AND GRUBBING

201-1 DESCRIPTION

201-1.01 General. This work shall consist of clearing, grubbing, removing and disposing of all trees, brush, stumps, fences, debris, and miscellaneous structures not covered under other contract items within the construction area and such other areas as specified or directed. The Contractor shall clear such additional areas within the limits of the right-of-way and easement lines as specified or directed.

201-1.02 No Burning Requirement. Materials generated by the work, including construction and demolition debris, shall not be disposed of by burning on or off the site. Off site burning in a permitted solid waste incinerator or in another lawful manner as refuse derived fuel will be permitted.

201-2 MATERIALS (Not specified)

201-3 CONSTRUCTION DETAILS

201-3.01 Limits of Work Areas. The Engineer will establish the limits of areas to be cleared and grubbed, to be cleared but not grubbed, or areas, objects or features that are designated to remain undisturbed. In general, the work areas shall include the road section, stream channels, ditches, temporary approaches to bridges, detours and other areas as shown in the contract documents or directed by the Engineer. The Engineer will designate fences, structures, debris, trees and brush to be cleared where grubbing is not required. Clearing beyond the areas of construction shall be done only where specified or directed.

201-3.02 Clearing and Grubbing. During the life of the contract the Engineer may order the clearing of any trees within the R.O.W. that the Engineer determines to be hazardous or dead and unsightly.

The Contractor shall carefully prune all branches of trees less than 16 feet above any part of the roadway and all branches which have been broken or injured during construction. The work shall be done as specified under §614-3.01A Equipment and B. Pruning.

Whenever trees are felled or trimmed on/or adjacent to highways, all wood shall be immediately removed from the roadway or any area that would present a hazard to traffic. Grubbed stumps shall be moved immediately at least 30 feet from the edge of pavement. No trees, tree trunks, stumps or other debris shall be felled, sidecast or placed outside the limits of the road section. No grubbing will be required beneath the embankment where the finished grade will be 6 feet or more above the original ground surface unless otherwise specified in the contract documents. Where trees or existing stumps are cleared and grubbing is not required, the tree trunk or existing stump shall be cut off not more than 6
inches above the original ground surface unless otherwise approved. Exposed stumps not required to be removed, but which are within 30 feet of the edge of the pavement or are in a built-up area, shall be chipped out to a depth of not less than 6 inches below the finished grade and the holes backfilled if directed by the Engineer. This work shall be completed within one week after start of work on the tree.

201-3.03 Disposal

A. General. All wood including grubbed stumps shall be removed from the contract site or otherwise disposed of.

B. Methods of Disposal of Wood and Brush.

1. Disposal (No Burning). All wood and brush shall be disposed of within fifteen (15) days after cutting or felling unless otherwise approved. No burning of land clearing materials that result from the clearing and grubbing operations, except in a permitted solid waste incinerator or as refuse derived fuel, will be permitted. The Contractor will have the following options or combination of options for disposal of this material:

   a. The Contractor shall make every effort to salvage marketable timber as specified in paragraph B4 of this subsection.
   b. When permitted by a note in the contract documents, disposable material may be placed at locations approved by the Engineer within the right-of-way but outside of the embankment area.

      When permitted by a note in the contract documents, disposable material may be placed in the embankment side slope area. The contract documents will define the embankment side slope area and the procedures for the concurrent construction of the embankment and disposal section. This type of disposal will require certain preparatory work. Preparation for direct burial of woody materials shall consist of cutting main trunks and limbs and chipping smaller limbs, branches, foliage and brush. Under conditions when disposal space and earth cover are limited in size and quantity, stumps will have to be ranked in size and placed in layers so as to make best use of the space available and the quantity of materials to be buried.
   c. The Contractor may bury disposable material off the right-of-way at locations obtained by the Contractor at no expense to the State. Such locations are to be approved in writing by the Engineer. The disposal work will require the same preparatory work as stated in option b. above except that the Engineer may waive such requirements for miscellaneous work which may be accommodated in a satisfactory manner by other methods. The disposal area is to be covered with earth as hereinafter specified.
   d. The Contractor may reduce all woody materials to chips and dispose of the chips as specified in paragraph B2 of this subsection.
   e. The material may be sent to a refuse derived fuel processing facility or to other processing facility for eventual beneficial re-use as fuel or for other lawful re-use.

      Under no circumstances is disposal to be made in swamp or wet lands. When the disposal area is within the embankment section or is formed by flattening the embankment slopes, the elevation of the normal embankment construction shall always equal or exceed that of the disposal area. There is to be absolutely no end dumping of disposable material over the sides of the embankment. All disposal areas are to be finally covered with a minimum of 2 feet of earth and graded to drain properly.
2. **Chipping.** Wood may be reduced to chips by the use of an approved chipping machine or stump grinder. Chips shall be 1/2 inch maximum thickness or of other approved thicknesses. Chips resulting therefrom may be disposed of by being stockpiled and used as mulch for planting, by distribution on the ground surface in wooded areas within the right-of-way as approved by the Engineer, or by disposal at a location off the contract site satisfactory to the Engineer.

3. **Burying.** No tree trunks, stumps or other debris shall be buried inside the right-of-way limits without the written approval of the Engineer. Disposal areas outside the right-of-way limits shall be approved in writing by the Engineer and shall be acquired by the Contractor at no expense to the State.

4. **Salvage of Marketable Timber.** In the interest of conservation, the Contractor shall make every effort possible to salvage marketable timber produced as a result of clearing operations, provided the amount of timber is great enough to make the hauling practical. In general, marketable timber is construed to mean logs 8 to 16 feet in length, plus appropriate trimming allowance, having a diameter inside the bark, at the small end, of approximately 10 inches. In the event that the Contractor is not successful in salvaging marketable timber, the Contractor shall advise the Engineer, in writing, of the efforts to salvage and indicate the reason why the timber could not be salvaged.

   Any wood that is cut up in firewood lengths or other marketable lengths may be neatly piled adjacent to the right-of-way in an area provided by the Contractor for periods in excess of one week but shall be removed prior to completion of the contract.

### 201-4 METHOD OF MEASUREMENT

201-4.01 **Per Acre.** Payment for Clearing and Grubbing will be made at the unit price bid per acre computed to the nearest one tenth acre.

201-4.02 **Per Lump Sum.** Payment for Clearing and Grubbing will be made on a lump sum basis for work satisfactorily completed. Monthly payments will be made in proportion to the amount of work done as determined by the Engineer.

201-4.03 **Borrow Areas.** Borrow pits or other pit areas from which material is secured shall not be included for measurement of clearing and grubbing.

### 201-5 BASIS OF PAYMENT

201-5.01 **Clearing and Grubbing.** Payment will be made at the contract price to furnish all materials, labor and equipment necessary to satisfactorily complete the work as specified. No separate payment will be made for any excavation, backfill or earth cover necessary to complete the work of disposal outside the embankment area nor for the work in handling, storing, rehandling and hauling of disposable material within or outside the right-of-way.

*Payment will be made under:*

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### SECTION 202 - DEMOLITION OF BUILDINGS AND STRUCTURES

*(Last Revised September, 2016)*
202-1 DESCRIPTION. This work shall consist of the demolition, removal and disposal of existing buildings; and the demolition, removal and disposal of existing bridge structures, removal and disposal of steel supported and concrete superstructure supported structural slabs (with and without shear connectors), in accordance with the contract documents, or as directed by the Engineer.

202-2 MATERIALS. Not specified.

202-3 CONSTRUCTION DETAILS

202-3.01 General. The Contractor shall conduct all demolition and removal operations in accordance with the contract documents and local building codes. The Contractor shall repair or replace in kind sidewalks, curbs, roadway and other materials designated to remain in place which are damaged as a result of the work at no additional cost to the State.

Where a falling hazard of 6 feet or more above a lower level exists to workers, each worker shall be protected from falling by fall arrest systems, or guardrail systems to a height of approximately 42 inches, or by covering openings. All floor or deck openings not used as material drops shall be covered over with materials substantial enough to support the weight of any loads which may be imposed upon them. Such materials shall be properly secured to prevent accidental movement.

When excavation is required, the Contractor shall provide protection for the public in accordance with §107-05K, Open Excavations and Trenches. The Contractor shall make provisions to control dust resulting from demolition operations by wetting the work area and debris or other appropriate measures.

A. Demolition Plan. Prior to any demolition or removal operations, the Contractor shall conduct an engineering survey, performed by a competent person, of the building, bridge, or other structure to determine its condition and the possibility of collapse of any portion, in accordance with 29 CFR 1926 Subpart T. Bridge data inspection reports will be made available by the Department, where available. Adjacent buildings or structures within 100 feet of the building or structure shall be included in the survey. If the Demolition Plan is required to be sealed by a Professional Engineer, the engineering survey shall be conducted under the direction of a Professional Engineer.

The Demolition Plan for the demolition, removal, or dismantling of a bridge structure longer than 20 feet shall be prepared, checked, and sealed by a Professional Engineer experienced in the design, construction, or demolition of such structures.

The Demolition Plan for a building, other than ordinary wood frame construction of 2-1/2 stories or less shall be prepared, checked, and sealed by a Professional Engineer or an Architect experienced in building design, construction, or demolition. The Demolition Plan for the demolition of ordinary wood frame construction buildings of 2-1/2 stories or less need not be prepared by a Professional Engineer.

The Demolition Plan for the removal of steel supported structural slabs, Type B, shall be prepared, checked, and sealed by a Professional Engineer, in accordance with §202-3.07.

The Demolition Plan for the removal of steel supported structural slabs – Type A, and concrete superstructure supported concrete slabs need not be prepared by a Professional Engineer.

Demolition Plans that are required to be prepared by a Professional Engineer or an Architect shall be submitted to the Engineer 30 calendar days prior to the start of demolition. Unless otherwise noted, all other Demolition Plans shall be submitted to the Engineer 14 calendar days prior to the start of demolition.

The Engineer may return the Demolition Plan if it does not adequately identify and address obvious safety and other identified conditions. The Engineer’s failure to return any Demolition for additional studies and recommendations shall not relieve the Contractor from the obligation of preparing an adequate Demolition Plan and conducting adequate engineering surveys that safeguard workers and the public.
When the Demolition Plan is required to be prepared by a Professional Engineer, the Professional Engineer shall prepare the following, as appropriate. When the Demolition Plan is not required to be prepared by a Professional Engineer, the Contractor shall prepare the following, as appropriate:

1. A plan of the work area including roadways, support structures, railroad tracks, canals or streams, both underground utilities and overhead utility lines, and any other information pertinent to demolition.
2. A description and catalog cuts of the type, size, and weight of cranes, heavy equipment, and trucks to be used.
3. A plan of the location of cranes, heavy equipment, and trucks.
4. Identification of components analyzed, with reference to controlling specifications or codes.
5. Identification of strength of materials (or allowable stresses) related to means and methods, within calculations or drawings.
6. Girder stability analysis, including non-composite girder analysis with dead load and equipment loads.
7. Current condition of superstructure and substructure. Indicate whether it is based on site visit and date, or latest inspection report and date.
8. Section loss of all components (including components in the load path), where applicable, both within calculations and on demolition drawings. State whether section loss is assumed percentage based on inspection report and date, or measured section loss based upon field inspection and date.
9. Demolition sequences (including deck removal), with a narrative description. Calculations associated with the Demolition Plan shall be included for each stage. Include saw cut locations.
10. Clear statement of critical assumptions, with guidance on contingency steps if conditions do not match assumptions.
11. The locations and details of supporting members, framing and foundation, etc., necessary to accomplish the partial demolition of a building.
12. Measures necessary to prevent a partial building demolition from affecting adjacent property.

The following shall be identified in the Demolition Plan, but need not be prepared by a Professional Engineer:

13. The locations and details of signs, barricades, curbing, and decking used to cover over holes in the flooring of a building.
14. Details of water diversion plans necessary for the proposed means and methods. Identify environmental ground and environmental water protection requirements, including location specific information.
15. Description of plans to contain and collect paint waste generated from subsequent cutting operations, or reference to other submittals.
16. Sequence of operations, including Work Zone Traffic Control requirements such as lane closures, required to perform the work.
17. Means and methods to control dust from being objectionable to nearby residents or potentially hazardous to workers.
18. Description of plans for abatement of all identified and impacted asbestos-containing materials.

B. Monitoring. A competent person is defined in 29 CFR 1926, Subpart C as someone who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are or will be unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. If the Demolition Plan is required to be sealed by a Professional Engineer per conditions stated herein, then the monitoring performed by a competent person shall be under the direction of a Professional Engineer.

The competent person shall monitor the on-going structural condition of surveyed buildings and structures prior to and during demolition, by observing them for the presence of excessive vibrations; by measuring and recording the width, extent, and progression of cracks; by measuring and recording
the plumbness and integrity of structural elements and bracing; and by making other observations as necessary. If these assessments indicate that potential for collapse of a structure or building exists, the competent person shall undertake measures to ensure safety. If these assessments indicate that the work is causing damage to or degradation of structural condition of a structure or building that is to remain or be relocated, the competent person shall undertake measures to prevent additional damage or degradation from occurring and, as directed by the Engineer, shall undertake measures necessary to reverse the degradation or repair the damage.

During the periods that personnel are required to work on, in, or around a building or structure to be demolished or relocated which is in a damaged or deteriorated condition by fire, flood, explosion, weather, or other cause, its elements shall be adequately braced to prevent collapse. The findings of monitoring assessments shall be promptly provided to the preparer of the Demolition Plan and to the Engineer, if the Demolition Plan has already been submitted.

C. Utility Facilities. The Contractor shall protect existing utility facilities during demolition, or if necessary, they shall be temporarily relocated prior to start of demolition work.

Before any structure or building served with or having utility facilities thereon is demolished, all utility services shall be shut off, capped, or otherwise made safe and controlled outside the building or off the structure, before the general demolition work is started. All severed sewer lines or drains emanating from the building or structure shall be capped or otherwise tightly sealed to prevent the entry of foreign materials into the main sewer or drain.

All electric circuits in any work area that is or may become wet or humid during the work shall be shut down and locked out. If electrical power is required, temporary circuits may be brought into the work area, provided such circuits are ground fault protected.

D. Paint Removal. Prior to beginning any paint removal operations, deposits of bird droppings and loosely adhered paint shall be removed by hand via shoveling or scraping.

The Contractor shall comply with the provisions of 29 CFR 1926.62 when working on steel structures coated with lead-based paint. The Contractor shall comply with all applicable regulations controlling the release of lead into the environment. In enclosed spaces, the Contractor shall remove paint for a minimum distance of 4 inches on each side of the centerline of cut, bolt row, or weld, or protect workers with air-line respirators in accordance with the requirements of 29 CFR 1926.354(c). Demolition Plans shall reference special project specific worker safety and health concerns, and protective measures shall be detailed in the Safety and Health Plan.

Prior to beginning any steel removal operations, paint shall be removed for a minimum distance of 4 inches on each side of the centerline of cut, bolt row, or weld using vacuum-shrouded paint removal equipment that removes paint, collects and contains the removed paint material, does not permit release of visible dust or debris, and does not vaporize paint into the atmosphere. Following paint removal work, loose paint material not contained by the paint removal equipment shall be collected by vacuums equipped with high efficiency particulate (HEPA) filters. Disposal of paint waste shall be performed in accordance with Section 571 Disposal of Paint Removal Waste.

In cases where the Contractor can clearly demonstrate that alternative work practices and engineering controls comply with applicable OSHA regulations associated with worker safety and health and applicable USEPA regulations associated with public and environmental protection, exception to the paint removal requirement may be granted by the Department as part of the Demolition Plan review and approval. Demolition Plans that propose the use of hydraulic shears without prior paint removal shall include Environmental Ground Protection and/or Environmental Water Protection in order to minimize potential impacts to the environment and/or the public. Demolition Plans that propose the use of torch cutting without prior paint removal shall include adequate containment and/or engineering controls to minimize potential impacts to the environment and/or the public. The Contractor shall ensure proper respiratory protection for exposures via initial personal monitoring. Interim protection of the workers, as defined by OSHA, shall be provided until exposures are
Local exhaust ventilation shall be used during periods of wind stagnation. Workers shall stand upwind from activity and ensure no downwind impacts to other, non-protected individuals, including the public. Torch cutting will not be approved in close proximity to sensitive public receptors, such as schools, pedestrian pathways, or buildings.

**E. Disposal of Materials.** All materials removed under this work, abandoned equipment, and fixtures of any kind remaining on any site after it is released to the Contractor are the property of the Contractor and, except for material other than those of a hazardous nature and materials incorporated into the work, shall be removed and disposed of in accordance with §107-10 Managing Surplus Material and Waste.

**F. Hazardous Material.** The Contractor shall remove and dispose of, or otherwise remediate, asbestos, hazardous chemicals, gases, explosives, flammable materials, or similarly dangerous materials in the building or on the property and will be paid separately.

The Contractor shall remove, or otherwise remediate, asbestos materials or other hazardous materials on each structure or building before demolition work begins. If it is not feasible to remediate hazardous materials from a building due to lack of structural integrity, or other unsafe conditions, the Contractor shall obtain a regulatory variance as applicable, and perform controlled demolition in accordance with applicable federal and state regulations.

202-3.02 Disposal of Buildings. The Contractor shall demolish buildings designated for disposal and released to the Contractor 30 days or more before the contract completion date in accordance with the contract documents. The Contractor shall demolish buildings on site without the use of explosives, unless approved by the Deputy Chief Engineer (Construction).

Any proposal to allow such building or any portion thereof to remain standing at the site, or to be relocated to another site, will be referred to the Regional Director for approval and shall be accomplished under terms and conditions established by the State.

**A. Unauthorized Entry.** The Contractor shall inspect all buildings released for demolition and shall prevent unauthorized entry to these buildings by boarding up or otherwise blocking potential entrances. If material blocking entrances is removed, the Contractor shall, after determining the building to be vacant, replace the removed material in such a manner as to keep the buildings from being re-entered.

**B. Pedestrian Access.** The Contractor shall maintain and keep safely passable and free from debris, snow and ice, all public walkways adjacent to the properties on which buildings to be demolished are located.

Active entrances to two or more story buildings and active walkways within 8 feet of two or more story buildings being demolished shall be completely protected for a minimum of 8 feet from the face of the building by sidewalk sheds, canopies or other means. Protection shall extend a minimum of 1 foot beyond each side of the building entrances, openings or walkways. Protection shall be designed by a Professional Engineer, and be capable of sustaining a load of 150 psf. No canopy or shed shall be designed to deflect falling material into an area where they could cause harm or injury to person or property.

For single story buildings, these requirements may be waived if the work may be satisfactorily and safely completed without protection.

**C. Removal of Salvaged Materials.** The Contractor shall remove all salvaged materials from the site. The Contractor shall not hold any sales, public or private, of salvaged equipment or material within the right of way. The Department does not guarantee the number of fixtures, quantity or quality of equipment or any other material of value existing in the building to be present upon its release to the Contractor.
D. Rodent, Insect, and Wildlife Control. The Contractor shall exterminate rodents and insects in each building so infested, in accordance with the requirements of the City, County or the NYS Department of Health. The Contractor or Subcontractor performing the extermination work shall have at least 5 years experience. If the building or structure to be demolished is inhabited by wildlife, the NYS Department of Environmental Conservation or the local animal control officer shall be contacted and given the opportunity to remove such wildlife before extermination or demolition operations are commenced. If inhabited by domesticated animals, the local animal control officer shall be given the opportunity to arrange for their removal.

Bait shall be placed at least 13 calendar days but not more than 30 calendar days before demolition is started, or at such other times as required by the City or County Health Department. Insects shall be controlled by spraying or fumigating. The Contractor shall seal the building if necessary for the treatment to be effective or to prevent migration of insect, pest, or vermin. Demolition work shall not proceed until the extermination is completed.

If extermination is being conducted because it was ordered by the City, County, or NYS Department of Health, the Contractor shall notify that office that the extermination has been completed and shall obtain their written concurrence that the extermination work was satisfactorily completed.

E. Demolition of Buildings. Unless mechanically demolished from the exterior, the demolition of multi-story buildings of more than 2-1/2 stories shall be accomplished story by story without accumulating rubble on the floors of the partially demolished structure. Signs warning of the hazard and of falling materials shall be posted at each level. Glass that will create a hazard if fragmented shall be removed.

If mechanical demolition is used, no worker shall be permitted at any location onto which debris may fall or which may become unstable or collapse as a result of the demolition operations. Only the minimum number of workers necessary for the performance of the work shall be permitted in those locations at other times until such time as the operations are complete and the debris has been removed.

If debris is dropped through holes in the floor without the use of chutes, the area onto which the material is dropped shall be completely enclosed with substantial barricades nominally a minimum of 42 inches high, and placed not less than 6 feet back from the projected edge of the opening above. If a hole is used by machines as a material drop, substantial timber or other curbing shall be securely anchored around the hole. The barricades, but not the curbing, may be moved aside temporarily during periods that the machines are actually using the hole. Barricades shall be promptly restored to their proper locations when the machines have ceased dropping material down the hole. Demolition work and workers shall not be permitted in lower areas until debris handling ceases above.

F. Partial Demolition of Buildings. If the work involved consists of demolishing only a portion of a building, the Contractor shall cooperate with the owner(s) of the remaining portion so that inconvenience is minimized.

The Contractor shall close the open portions of the buildings being partially demolished with construction similar to the remainder of the building and shall install supporting members, framing, and foundations to support the remaining structure in accordance with the Demolition Plan. Construction necessary to close the open portions shall meet the local building codes. Structural supports shall be of similar materials as the existing supporting members to which they frame or with which they share load or shall be compatible with them. The Contractor may use salvaged lumber for sheathing provided that such lumber is sound and suitable. The Contractor shall use new timber and lumber for all other purposes.

G. Demolition of Party Wall Structures. If the demolition of one or more units of a group of party wall structures leaves a wall or walls exposed, in accordance with the contract documents, the Contractor shall comply with the following:
1. Furring, plaster, chimneys to be removed, projecting parts, and the like shall be removed.
2. The roof shall be properly flashed, repaired, or otherwise treated to prevent leaks.
3. Walls shall be left in a presentable and sound weatherproof condition compatible in appearance with the remaining building and in conformance with local building codes.
4. Walls shall be made self-supporting, safe and weatherproof with construction similar to or consistent with the remaining building. Supports and bracing shall be installed in accordance with the contract documents.
5. Shoring necessary to prevent damage to adjacent property shall be placed on solid foundation in accordance with the contract documents.

H. Demolition of Foundations. After demolition of the structure, the Contractor shall remove the foundation walls to the depth of the lowest cellar floor, break up any cellar floor, remove any walkways or other materials, backfill the hole and grade the site; unless the removal would endanger adjacent utility facilities or infrastructure. If the hole is not backfilled promptly, it shall be protected with substantial fencing and signs in accordance with § 107-05 Restricted Areas.

I. Domestic Sewage Facilities. Septic tanks, leaching basins, cesspools and other similar facilities associated with buildings being demolished or those that will be abandoned shall be pumped free of septage or sewage, removed, and the resulting hole shall be backfilled in lifts of compacted suitable material. The facilities may be collapsed in place after pumping instead of removal. Septage recovered from the pumping operation shall be handled, transported, and disposed of in accordance with 6 NYCRR Part 364.

J. Basement Petroleum Storage Tanks. Aboveground petroleum storage tanks associated with buildings being demolished shall be emptied, cleaned, and removed. Petroleum storage tanks with a capacity greater than 1100 gallons that are regulated by NYSDEC, or are regulated by other local codes, and require closure, shall be emptied, cleaned, and closed in accordance with 6 NYCRR Part 619.3, and closure will be paid for under Section 629 Petroleum Storage Tank Closure. Any waste products removed from the tanks or generated during tank cleaning/removal operations shall be disposed of in accordance with §107-10 Managing Surplus Material and Waste.

202-3.03 Relocation of Buildings. The Contractor shall relocate buildings, to sites designated by the owner and approved by the Department, in accordance with the contract documents. Sites to which the buildings are to be moved will be furnished without cost to the Contractor.

A. Site Preparation. The Contractor shall construct all necessary foundations and cellar floors for the relocated building to meet applicable local building codes but not less than equivalent in construction to the existing features. The Contractor shall grade the new site, construct necessary driveways and sidewalks, topsoil and/or seed the area and perform other incidentally required items of work to prepare the site in accordance with the contract documents.

B. Moving Buildings. The Contractor shall conduct a precondition survey to establish current condition prior to the move, using written and photographic measures. The Contractor shall move the building safely and in a manner so as to cause the least possible damage to the building and the least possible interference with or inconvenience to its occupant(s). The Contractor shall arrange for any temporary rerouting of overhead lines or relocating guide wires and for the clearance of other obstructions. The Contractor shall repair any damage that may occur to the building, pavement and other features as a result of the move.

C. Restoration of Service Connections. The Contractor shall restore necessary gas, electrical, sanitary, water supply and other service connections at the building's final location, at least equivalent in
construction to the existing connections, so as to cause the least possible disruption in accordance with
the requirements of the Utilities and local building codes, and will be paid separately.

**D. Restoration Work.** The Contractor shall restore exterior portions of the building, including steps,
porches, railings, and other appurtenances, to as good and serviceable condition, as existed prior to its
relocation, in accordance with local building codes. Any property damaged or destroyed during the
execution of the work shall be repaired or replaced at no additional cost to the State.

**E. Demolition of Existing Foundations.** The Contractor shall demolish the existing foundation of any
relocated building, including those relocated by the owner in accordance with §202-3.02H *Demolition
of Foundations.*

**202-3.04 Dismantling and Storage of Superstructures.** The Contractor shall dismantle and store existing
superstructures in accordance with the contract documents. A superstructure is defined as that part of a
structure above, supported by, and including the bearings. The Contractor shall carefully remove concrete,
paving material and other materials from the existing superstructures so as to prevent damage to
superstructures to be stored. The parts of superstructure designated to be stored shall be protected, and
stored on site or at the locations designated. All stored members shall be adequately match-marked in order
to facilitate reassembly. Any parts of the superstructure designated for storage or to remain which are
damaged during the course of the operation or during storage shall be repaired or replaced at no additional
cost to the State.

**202-3.05 Removal of Superstructures.** The Contractor shall demolish and remove existing
superstructures at the site in accordance with the contract documents. A superstructure is defined as that part of a
structure above, supported by, and including the bearings. The removal of steel supported
structural slabs where the supporting structural steel is to remain shall be performed in accordance with
§202-3.07 *Removal of Steel Supported Structural Slabs.* The Contractor shall obtain the approval of the
Deputy Chief Engineer, Structures (DCES) for any proposal to allow such structure or any portion thereof
to remain standing on the site or to be relocated to another site.

The Contractor shall designate all areas that could become subject to collapse or that could become
unstable as a result of demolition activity as non-access areas, and clearly identify them. The public,
workers and equipment with operators shall remain outside these designated non-access areas at all times
during demolition operations or at any time the area is subject to potential superstructure collapse.

**202-3.06 Removal of Substructures.** The Contractor shall demolish and remove existing substructures
in accordance with the contract documents. A substructure is defined as that part of a structure below the
superstructure, such as abutments, piers, and wingwalls. The Contractor shall comply with the appropriate
construction details specified in Section 203 *Excavation and Embankment.* Excavations shall be dewatered
and kept free from water, snow and ice as necessary. If excavation protection is necessary to protect
structures or other improvements, or if the alternatives of laying back slopes or benching are not available,
the support system shall be as indicated in the contract documents.

Sheeting or piling shown in the contract documents which is integral with the substructure and is
designated to remain in place shall be cut off at the elevations shown. If indicated in the contract documents,
existing sheeting or piling shall be extracted. The Contractor may, with the permission of the Engineer,
extract sheeting or piling not shown to be extracted or designated to remain in place rather than cutting it
off at the elevations shown on the plans, at no additional cost to the State.

Resulting holes shall be backfilled with suitable material placed in lifts and compacted, and the area
regraded.

**202-3.07 Removal of Steel Supported Structural Slabs.** The Contractor shall remove steel supported
structural slabs in accordance with the contract documents. All concrete and other materials carried by the
supporting steel members of the superstructure shall be removed unless the plans specifically indicate removal under another item or that the material is to remain in place. Prior to beginning removal operations, the Contractor shall mark the location of the existing primary structural steel members on the surface of the slab. Prior to beginning any sawcutting of the structural slab in order to facilitate removal, the Contractor shall mark the edges of existing structural steel members in contact with the bottom of the slab on the slab surface, or make other adequate provisions approved by the Engineer to prevent damage to the underlying structural steel.

The Contractor shall protect existing structural steel while removing steel supported structural slabs. Nicks or gouges in existing structural steel to remain caused by demolition operations shall be reviewed by the DCES and the Contractor shall repair those damages in accordance with the Steel Construction Manual (SCM) and the direction of the DCES.

All unpainted structural steel surfaces exposed by concrete removal, against which new concrete will be subsequently placed, shall be cleaned sufficiently to ensure proper bond between the steel and concrete.

A. Removal of Steel Supported Structural Slabs with Shear Connectors. The Contractor shall remove all existing spiral shear connectors, so that the remaining cut surface is a maximum 3/4 inch from the surface of the structural steel. Spirals shall be cut in such a manner that the structural steel to remain is not damaged.

The Contractor shall retain existing shear studs undamaged. Existing shear studs removed or damaged during removal of structural slabs, shall be replaced by the Contractor in accordance with the provisions of the SCM, Section 7, Part C Stud Welding, at no additional cost to the State.

The Demolition Plan for the removal of steel supported structural slabs with shear connectors shall be either of two types, as described below:

1. Removal of Steel Supported Structural Slab (with shear connectors) –
   Type A. Under this type, the Demolition Plan for the structural slab removal need not be sealed by a Professional Engineer.

2. Removal of Steel Supported Structural Slab (with shear connectors) –
   Type B. Under this type, due to the increased risks of structural instability in this type of removal, the Demolition Plan for the structural slab removal shall be prepared, sealed, and checked by a Professional Engineer.

B. Removal of Steel Supported Structural Slabs without Shear Connectors. The Contractor shall remove steel supported structural slabs in accordance with the contract documents. Installation of new shear studs, if required, will be paid for separately.

The Demolition Plan for the removal of steel supported structural slabs without shear connectors shall be either of two types, as described below:

1. Removal of Steel Supported Structural Slab (without shear connectors) –
   Type A. Under this type, the Demolition Plan for the structural slab removal need not be sealed by a Professional Engineer.

2. Removal of Steel Supported Structural Slab (without shear connectors) –
   Type B. Under this type, due to the increased risks of structural instability in this type of removal, the Demolition Plan for the structural slab removal shall be prepared, sealed, and checked by a Professional Engineer.

202-3.08 Removal of Concrete Superstructure Supported Concrete Slabs. Concrete slabs shall be removed to expose the tops of the prestressed concrete beams and diaphragms while retaining the tie-in bar reinforcement, which is precast into the prestressed concrete beam and diaphragms. All other reinforcement and wire mesh shall be removed. The concrete slab shall be removed with chipping hammers not exceeding 40 lbs in weight with the bit removed. The Contractor shall exercise care during the execution of the work to avoid damaging or loosening material that is to remain. If the Contractor’s operations result in damage to concrete that is to remain, the Contractor shall stop work and make immediate corrections at no additional
cost to the State. Any damage caused by the Contractor’s operations to material that is to remain shall be repaired or replaced. If the concrete superstructure to remain is cut, or otherwise damaged by Contractor operations, the Contractor shall stop work immediately until a repair procedure is approved by the DCES. The Contractor may request in writing to the DCES, to mill the top of the deck to a maximum depth of 2 inches, or until the top mat of reinforcing is exposed, whichever is less. The request shall include the specifications for the piece of equipment to be utilized.

**A. Removal of Concrete Superstructure Supported Concrete Slab with Shear Connectors.** The Contractor shall remove concrete superstructure supported concrete slabs in accordance with the contract documents in such a way that the shear connectors to remain are undamaged. Any damage caused by Contractor operations to shear connectors to remain shall be replaced by a method approved by the DCES at no additional cost to the State.

**B. Removal of Concrete Superstructure Supported Concrete Slab without Shear Connectors.** The Contractor shall remove the concrete superstructure supported concrete slab in accordance with the contract documents.

### 202-4 METHOD OF MEASUREMENT

**202-4.01 General.** Vacant.

**202-4.02 Disposal of Buildings.** The work under disposal of buildings will be measured for payment on a lump sum basis for a specific building.

**202-4.03 Relocation of Buildings.** The work under relocation of buildings will be measured for payment on a lump sum basis for a specific building.

**202-4.04 Dismantling and Storage of Superstructures.** The work under dismantling and storage of superstructures will be measured for payment on a lump sum basis for a specific superstructure.

**202-4.05 Removal of Superstructures.** The work under removal of superstructures will be measured for payment on a lump sum basis for a specific superstructure.

**202-4.06 Removal of Substructures.** The quantity of removal of substructures to be measured for payment will be in cubic yards measured to the nearest whole cubic yard, computed from the payment lines.

**202-4.07 Removal of Steel Supported Structural Slab.** The quantity to be measured for payment will be in square feet of structural slab removed, measured to the nearest whole square foot. Measurements will not make any deductions for openings.

**202-4.08 Removal of Concrete Superstructure Supported Concrete Slab.** The quantity to be measured for payment will be in square feet of structural slab removed, measured to the nearest whole square foot.

### 202-5 BASIS OF PAYMENT

**202-5.01 General.** Vacant.

**202-5.02 Disposal of Buildings.** The lump sum price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Progress payments will be made monthly in proportion to the amount of work completed.
Suitable or select material obtained from other than the demolition site and used to fill foundation holes, and surface restoration will be paid for separately. Water used for dust control or compaction will be paid for separately if a contract pay item for water is included in the contract. Closure of basement petroleum storage tanks will be paid for separately if regulations require the tank to be closed. The cost of asbestos removal, abatement, and disposal will be paid for separately.

The cost of extermination shall be included in the lump sum price bid if the contract documents indicate that extermination work is required, otherwise it will be considered extra work.

202-5.03 Relocation of Buildings. The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including excavation necessary at the old or the new building site and water used for dust control or compaction if a contract pay item for water is not included in the original contract bid documents. Extermination shall be included in the lump sum price bid if the original contract bid documents indicate that extermination work is required. Progress payments will be made monthly in proportion to the amount of work completed.

If a property owner, upon agreement with the Department, removes the building, the Contractor will be paid 20% of the bid price for demolition of the existing foundation, walks and other facilities.

Suitable or select material obtained from other than the demolition site and used to fill foundation holes, and surface restoration will be paid for separately.

The work of reconnecting and providing services for the relocated building at its new site will be paid for separately.

202-5.04. Dismantling and Storage of Superstructures. The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Progress payments will be made in proportion to the amount of work completed. The cost of paint waste disposal will be paid for separately.

202-5.05. Removal of Superstructures. The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. Progress payments will be made in proportion to the amount of work completed. The cost of paint waste disposal will be paid for separately.

202-5.06 Removal of Substructures. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. Excavation and excavation protection required to access portions of the substructure for removal will be paid for separately.

Material obtained from other than the demolition site and used to fill substructure holes and surface restoration will be paid for separately. Water used for dust control or compaction will be paid for separately if a contract pay item for water is included in the contract. The cost of asbestos removal, abatement, and disposal will be paid for separately.

202-5.07 Removal of Steel Supported Structural Slabs. The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including any sawcutting performed in order to facilitate removal.

202-5.08 Removal of Concrete Superstructure Supported Concrete Slabs. The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including any sawcutting performed in order to facilitate removal. No additional payment will be made for removals, repairs or replacements made necessary due to the Contractor’s operations.
### Payment will be made under:

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<th>Item</th>
<th>Pay Unit</th>
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<td>Relocating Buildings</td>
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<td>Square Foot</td>
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**NOTE:** nnnn denotes serialized pay item for each building or structure.

### SECTION 203 - EXCAVATION AND EMBANKMENT

*(Last Revised January 2020)*

**203-1 DESCRIPTION.** This work shall consist of excavation, disposal, placement and compaction of all materials that are not provided for under another section of these Specifications, and shall be executed in conformance with payment lines, grades, thicknesses and typical sections specified in the contract documents.

**203-1.01 Definitions.**

**A. Unclassified Excavation.** Unclassified excavation shall consist of the excavation and disposal of all materials, of any description, encountered in the course of construction, unless otherwise specified in the contract. Estimated limits and descriptions of subsurface deposits and formations which may be shown in the contract documents are supplied as a part of Base Line Data.

**B. Embankment.** The embankment is the portion of a fill section situated between the embankment foundation and the subgrade surface, excluding any material placed under another section of these specifications.

**C. Embankment Foundation.** The embankment foundation is the surface upon which an embankment is constructed after all work required under §203-3.03A. *Embankment Foundation* has been completed.

**D. Subgrade Surface.** The subgrade surface is the surface of the road section upon which the select materials and/or subbase are placed.

**E. Subgrade Area.** The subgrade area is that portion of an embankment situated above either of the following, but excluding any material placed under another section of these specifications.
1. A line located 2 ft. below the subgrade surface and extended to the intersection with the embankment side slopes, or

2. The embankment foundation, whichever is higher.

The material and compaction requirements for the subgrade area in embankments are found in §203-2.01A. Subgrade Area Material and §203-3.03C. Compaction, respectively.

In cut sections, the subgrade area is not defined except where undercut and backfill with a select material item is specified or ordered: in such cases, the payment lines for undercut work shall define the subgrade area.

F. Embankment Side Slope Area. The embankment side slope areas are those cross-sectional areas of an embankment situated outside of lines projected downward and outward on a one on one slope from the edges of the subgrade surface to their intersection with the embankment foundation, but excluding any portion lying within a subgrade area.

G. Topsoil. See Section 713 Topsoil.

H. Suitable Material. A material whose composition is satisfactory for use in embankment construction is a suitable material. The moisture content of the material has no bearing upon such designation. In general, any mineral (inorganic) soil, blasted or broken rock and similar materials of natural or man made (i.e. recycled) origin, including mixtures thereof, are considered suitable materials. Contaminated material is not considered suitable. Determinations of whether a specific natural material is a suitable material shall be made by the Engineer on the above basis.

Recycled materials that the Department has evaluated and approved for general use shall be considered to be suitable material for embankment construction subject to the conditions for use as determined by the Department. The Regional Geotechnical Engineer and Geotechnical Engineering Bureau are available to provide guidance on the use of such materials. In general, the use of recycled materials must be also sanctioned by the Department of Environmental Conservation, usually in the form of a Beneficial Use Determination (BUD).

Glass from recycling facilities meeting the requirements of §733-05 Glass Backfill shall be considered suitable material for embankment construction.

Reclaimed Asphalt Pavement (RAP), and Recycled Portland Cement Concrete Aggregate (RCA) shall be considered suitable materials for embankment construction, subject to the following conditions for use:

RAP - The Contractor shall provide and place RAP conforming to the requirements of §733-06 Reclaimed Asphalt Pavement for Earthwork and Subbase.
RCA-The Contractor shall provide and place RCA conforming to the requirements of §733-07 Recycled Portland Cement Concrete Aggregate.

Pieces of broken up concrete pavement from on-site pavement removal or in-place recycling (i.e. rubblizing, crack and seat, break and seat, etc.) may be used in embankment construction. Refer to §203-3.03A. Embankment Foundation and §203-3.03B. Embankments.

I. Unsuitable Material. Any material containing vegetable or organic matter, such as muck, peat, organic silt, topsoil or sod, or other material that is not satisfactory for use in embankment construction under §203-1.01H. Suitable Material is designated as an unsuitable material. Certain man made deposits of industrial waste, toxic or contaminated materials, sludge, landfill or other material may also be determined to be unsuitable materials, based on an evaluation by the Department’s Geotechnical Engineering Bureau and Office of Environment, and the Department of Environmental Conservation.
J. **Borrow.** Borrow is material required for earthwork construction in excess of the quantity of suitable material available from the required grading, cuts and excavations. Borrow may be necessary even though not shown in the contract documents.

K. **Embankment Construction Control Devices.** Embankment construction control devices allow real-time observations of embankment construction to assess the actual performance of the embankment compared to that envisioned in the design phase. Settlement and pore water pressure are common measures of embankment performance. Techniques for monitoring settlement include a settlement rod or a surface settlement gauge. A settlement rod is an optical survey technique to monitor settlement of the embankment surface. The settlement rod(s) establish monitoring point(s) in relation to a reliable bench mark.

A surface settlement gauge is an optical survey technique to monitor settlement of the existing ground surface, below the embankment installation. The surface settlement gauge is installed prior to placing the embankment and extended upwards through the fill.

Pore water pressure monitoring may be used to determine the effective overburden diagrams (the basis of all geotechnical analyses), monitoring consolidation progress of embankments constructed over soft soils, evaluating seepage in natural slopes or earth dams (slope stability), checking the effectiveness of subsurface drainage facilities, or monitoring water well tests.

A piezometer is an instrument which provides measurements of pore water pressure at the elevation of the installed sensor. Pore pressure data is needed in a foundation soil to assess the excess pore water pressure and hence the undrained strength of the soil. Piezometers are used at various depths within cohesive foundation soils. Some piezometers are used in granular foundation soils to assess their drainage behavior.

L. **Proof Rolling.** Proof rolling consists of applying test loads over the subgrade surface by means of a heavy pneumatic-tired roller of specified design, to locate and permit timely correction of deficiencies likely to adversely affect performance of the pavement structure.

M. **Select Granular Fill – Slope Protection.** Select granular fill – slope protection is a material used to protect the grade of a slope from erosion and sloughing from runoff and groundwater seepage. Seepage is the slow movement of water through small openings and spaces in the surface of unsaturated soil into or out of a body of surface or subsurface water. Sloughing is a shallow surface failure caused by erosive removal of supporting material.

Select granular fill – slope protection is highly permeable while also providing sufficient frictional resistance to resist seepage forces and remain in place.

N. **Applying Water.** Under this work, the Contractor shall furnish and apply water for dust control. Moisture control for compaction purposes is the Contractor’s responsibility. Water shall not be applied in inclement weather or when the temperature is 32° F or less.

O. **Modifying Cut Slopes and Other Means of Obtaining Borrow.** The Regional Director may approve the modification of cut slopes and other means of obtaining material, which is not part of the contract, so long as provisions are made to prevent unsafe conditions, damage, and nuisances to property, wildlife areas, and haul routes within and outside the contract limits. Such approval may be granted only after review of a written proposal by the Contractor showing the final deposition of the material, the haul route, hauling hours, and provisions necessary to comply with the above. Should unanticipated conditions arise resulting in any unsatisfactory situation, the Engineer shall immediately rescind the approval pending satisfactory correction.

The following procedure shall apply to areas within the R.O.W. limits which are not designated as available sources of borrow by a Special Note in the contract proposal where the Contractor requests and is granted permission to modify slopes to obtain material for use on State contract work.
only. The Contractor will be required to reimburse the State with a rebate for the material obtained in these areas. Permission will not be granted to excavate material beyond the design slopes if it is to be used on other than State contract work.

The rebate to be obtained from the Contractor for this material is comprised of 1) A royalty based on the actual value of the excavated material, and 2) A credit for the difference in the Contractor's handling costs if these handling costs have been reduced. The royalty which is to be obtained for the excavated material shall be appropriate for the item for which it is to be utilized and shall be comparable to the current price being paid to purchase similar material in the area.

If the Contractor's handling costs associated with obtaining material from within the R.O.W. limits are greater than those for obtaining material from other acceptable sources, these additional handling costs must be borne by the Contractor. The royalty shall not be reduced to offset any increased handling costs incurred by the Contractor.

If the Contractor's handling costs associated with obtaining materials from within the R.O.W. limits are less than those for obtaining material from other acceptable sources, the differences shall be reimbursed to the State as a credit in addition to the royalty.

The difference in the Contractor's handling cost shall be determined by an analysis based on a comparison of haul lengths, hauling equipment, hauling operation, use of haul roads or public highways, preparation and restoration of the borrow areas, and any other variables involved.

Prior to modifying rock cut slopes, the Geotechnical Engineering Bureau must be consulted. If rock cut slopes are flattened sufficiently to eliminate the need for presplitting, an additional rebate will be necessary.

All special requirements to be fulfilled by the Contractor, at the Contractor's own expense, shall be clearly stated in the agreement. The foregoing requirement of receiving a rebate from the Contractor for material obtained by modification of slopes shall apply only to locations not designated in the Contract Documents.

P. Winter Earthwork. Compaction of soil during cold weather is difficult and can be impractical. Water acts as a lubricant aiding in the process of compaction. As the temperature decreases, the water becomes more viscous (less slippery) and inhibits efforts to pack the soil particles together. Eventually, the water becomes ice, at which point compaction is impossible. For this reason, New York State does not permit normal earthwork placement between November 1st thru April 1st unless there is an approved Winter Earthwork submittal.

Winter Earthwork is defined as construction operations requiring soil compaction performed from November 1st thru April 1st. The execution of Winter Earthwork requires modifications to compaction procedures, changes to material requirements, and/or additional equipment and structure assembly for controlling the weather effects on the material and existing ground conditions.

Although Winter Earthwork may be performed when the air temperature, ground temperature, or material temperature is at or below 32° F, frozen material will not be placed, nor will fill material be placed on ground frozen to any depth, in any work incorporated into the final product.

203-2 MATERIALS

203-2.01 General. The requirements for select materials and subgrade area materials are described below. All processing operations including washing, removal of oversize material, blending, or crushing shall be completed at the source of the material. The procedure for acceptance or rejection of these materials shall be in conformance with the procedures contained in the geotechnical control procedure “Procedure for the Control and Quality Assurance of Granular Materials”.

A. Subgrade Area Material. Subgrade area material shall consist of any suitable material having no particles greater than 6 in. in maximum dimension, unless Select Granular Subgrade with the well
graded rock option is used. In that case, refer to §733-13 Select Granular Subgrade. If concrete is used, any exposed mesh or rebar shall not exceed 1 in. in length. RAP is also permitted.

B. Glass Backfill. Provide backfill material meeting the requirements of §733-05 Glass Backfill.

C. RAP. Provide backfill material meeting the requirements of §733-06 Reclaimed Asphalt Pavement for Earthwork and Subbase.

D. RCA. Provide backfill material meeting the requirements of §733-07 Recycled Portland Cement Concrete Aggregate.

E. Miscellaneous. Necessary fill material for cleaning, grading and shaping the existing roadside section shall conform to the requirements of §203-2.01A, Subgrade Area Material.

203-2.02 Unclassified Excavation and Disposal. None Specified.

203-2.03 Embankment In Place. Provide backfill material meeting the requirements of §733-08 Embankment In Place.

1. Embankment In Place – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Embankment In Place.

203-2.04 Select Borrow. Provide backfill material meeting the requirements of §733-09 Select Borrow.

1. Select Borrow – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Borrow.

203-2.05 Select Fill. Provide backfill material meeting the requirements of §733-10 Select Fill.

1. Select Fill – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Fill.

203-2.06 Select Granular Fill. Provide backfill material meeting the requirements of §733-11 Select Granular Fill.

1. Select Granular Fill – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Granular Fill.

203-2.07 Select Granular Fill Slope Protection. Provide backfill material meeting the requirements of §733-12 Select Granular Fill Slope Protection.

1. Select Granular Fill Slope Protection – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Granular Fill Slope Protection.
203-2.08 Surface Settlement Gauges. Provide materials for the embankment construction control device surface settlement gauge meeting the requirements of §733-17 Surface Settlement Gauge.

203-2.09 Settlement Rods. Provide materials for the embankment construction control device settlement rod meeting the requirements of §733-18 Settlement Rod.

203-2.10 Piezometers. Provide materials for the piezometer installation meeting the requirements of §732-11 Open Well Piezometer.

203-2.11 Applying Water. Water used for dust control purposes may be obtained from any source.

203-2.12 Select Granular Subgrade. Provide backfill material meeting the requirements of §733-13 Select Granular Subgrade.

1. Select Granular Subgrade – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Granular Subgrade.

203-2.13 Select Structural Fill. Provide backfill material meeting the requirements of §733-14 Select Structural Fill.

1. Select Structural Fill – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Structural Fill.

203-2.14 Sand Backfill. Provide backfill material meeting the requirements of §733-15 Sand Backfill.

203-3 CONSTRUCTION DETAILS

203-3.01 General. The Contractor shall remove all soil, rock, and other material, and utilize or dispose of these materials as required by the contract documents. All excavation and embankment work shall be executed to payment lines shown in the contract documents.

All graded earth surfaces outside the roadway limits shall be smoothed and trimmed in reasonably close conformity (6± in.) of true grade. After trimming, the area shall be left in a compact and satisfactory condition, free of large stones or other objectionable materials, as determined by the Engineer.

Earthwork construction operations requiring compaction shall not be performed from November 1st thru April 1st except with a Winter Earthwork submittal subject to the provision of this Section and approved by the Regional Director or his designated representative. Winter earthwork operations constitute an additional risk to the Department and Winter Earthwork submittals should not be expected to be automatically approved. Winter Earthwork will be subject to the following restrictions:

● Transitioning from the normal construction season to the exempt winter earthwork months between November 1st and April 1st, the use of standard earthwork materials may be permitted only under the conditions where the air temperature, ground temperature and material temperature are all above 32° F at the time of placement. Modifications to compaction procedures, including but not limited to the use of thinner lifts, may be required when the temperatures are above 32° F but below 40° F at the time of placement.

● Between November 1st and April 1st, if the air temperature, ground temperature, or material temperature is at or below 32° F, earthwork may only proceed using material that meets the requirements of §733-16 Winter Earthwork and/or standard earthwork material placement utilizing the modified methods and procedures contained in the approved Winter Earthwork Submittal.
In all work incorporated into the final product, the Contractor shall not place material that is frozen, or place fill material on ground that is frozen to any depth regardless of the date.

**A. Winter Earthwork Submittal.** For Contractors choosing to proceed with earthwork construction operations requiring compaction between November 1st thru April 1st, provide the Engineer with a Winter Earthwork submittal, with a copy to the Regional Geotechnical Engineer, outlining the modifications to the materials and/or methods including the following:

1. **Material Requirements.** The material meets the requirements of §733-16 Winter Earthwork. Provide information on material composition and source substitute, if proposed.

2. **Material Placement.** Provide information on the proposed methods for controlling the weather effects on the material and existing ground conditions (i.e. insulation, enclosures, canvas and framework). Devise a plan to be outlined in the Winter Earthwork Submittal such that all snow, ice, and frozen material shall be removed from the surface of the ground on which embankment or backfill material is to be placed, and from the surface under construction before succeeding lifts are added.

3. **Procedures.** Provide verification procedures to ensure the existing ground is not frozen to any depth (e.g. test pits). Provide procedures to address freeze-thaw action in earthwork that has remained idle during temperature fluctuations (e.g. re-roll and seal the surface prior to placement of succeeding lift).

4. **Seasonal Adjustment Acceptance.** Provide acknowledgement of a transition period allowing the continued use of standard earthwork materials between November 1st and April 1st only under conditions where the air temperature, ground temperature and material temperature are all above 32° F at the time of placement. Provide acknowledgement of the winter earthwork restrictions stating that, if the air temperature, ground temperature, or material temperature is at or below 32° F, earthwork will only proceed using material that meets the requirements of §733-16 Winter Earthwork and/or standard earthwork material placement utilizing the modified methods and procedures contained in the approved Winter Earthwork Submittal.

Proceed with Winter Earthwork only after receiving written approval by the Regional Director or his designated representative subject to the provisions of this Section.

**B. Scheduling of Work to Minimize Soil Erosion and Water Pollution.** The Contractor shall ensure effective and continuous soil erosion and sediment control throughout the construction period. The Contractor shall prepare and submit for approval, plans and schedules for all excavation, stripping, embankment, fill and grading operations. Such plans and schedules shall include but are not limited to temporary and permanent erosion control measures specified in Section 209 Soil Erosion and Sediment Control, Section 610 Turf and Wildflower Establishment and Section 612 Sodding.

**C. Drainage and Grading.** The Contractor shall provide and maintain slopes, crowns and ditches on all excavation and embankments to ensure satisfactory surface drainage at all times. Ditches and other drainage facilities necessary to remove ponded water shall be constructed as soon as practical to have the work area dry during the progression of work. All existing culverts and drainage systems shall be maintained in satisfactory operating condition throughout the course of the work. If it is necessary to interrupt existing surface drainage, sewers or under-drainage, then temporary drainage facilities shall be provided until the permanent drainage work is complete. Top-of-slope interceptor ditches, where shown on the contract documents, shall be completed before adjacent excavation operations are
begun. In earth cuts, the Contractor shall progress excavation operations in such a manner that the portion of the cut immediately adjacent to the design slope is at least 5 ft. lower than the general level of the cut at all times until the lower payment line is reached.

The construction of these temporary drainage facilities shall be considered as incidental to the construction of the project and no additional payment will be allowed.

Any portion of an embankment or subgrade which has been damaged by the Contractor's equipment during the course of construction, shall be repaired and re-compacted by the Contractor at no additional cost to the State.

Where seepage causes instability of slopes, excavation and backfill or other corrective measures shall be performed as ordered by the Engineer and paid for under the appropriate item. Excavation for the installation of slope protection may be necessary at any time and location throughout the duration of the contract and may not necessarily coincide with the Contractor's performance of the general excavation work.

**D. Suitable Materials.** Moisture content has no bearing on the suitability of material to be used for embankment construction, however, the moisture content of a material may be such that its use will require manipulation. It is the Contractor's responsibility to determine the economics of using, or disposing of and replacing, such materials. Material determined by the Contractor to be uneconomical for use may be disposed of as specified under §203-3.02B. *Disposal of Surplus Excavated Materials* and replaced with other material at no additional cost to the State.

When a contract includes the item “Unclassified Excavation and Disposal”, all excavated suitable materials, including the excavation performed under “Structure Excavation” and “Trench and Culvert Excavation,” shall become the Contractor's property for disposal or use under another item of these specifications.

**E. Unsuitable Materials.** All excavated unsuitable materials shall be the Contractor's property for disposal as surplus materials under the provisions of §203-3.02B. *Disposal of Surplus Excavated Materials*.

**F. Borrow.** The management of a borrow source and the acceptability of all borrow material shall be subject to the approval of the Engineer at all times. The Contractor shall notify the Engineer at least ten (10) work days in advance of opening any borrow area, and request approval of the source under the pay item involved. Test pits required by the Engineer to evaluate the acceptability and limits of the source, shall be provided by the Contractor at the Contractor's own expense. Concurrent removal of material for more than one pay item from a single source or pit shall be prohibited except with the written permission of, and under such conditions and restrictions as may be imposed by the Engineer. All borrow pits shall be stripped of sod, topsoil and vegetable matter well in advance of any working face. The minimum distance by which stripping shall lead excavation for a given source shall be established by the Engineer to suit local conditions. Where a borrow source is not under direct control of the Contractor or where special conditions exist, the Engineer may waive any of the above requirements and establish alternative provisions for the control and acceptability of borrow.

Ordinary borrow will be accepted for use where the material qualifies under the definition of Suitable Material, §203-1.01H. *Suitable Material*. All borrow placed within the limits of Embankment or the Subgrade Area shall be placed in conformance with §203-3.03B. *Embankments* or §203-3.01G. *Subgrade Area* respectively, as appropriate, or where used for fill or backfill at structures, culverts and pipes, in conformance with §203-3.06 Select Granular Fill and §203-3.17 Select Structural Fill.

**G. Subgrade Area.** Where a subgrade area is defined in an embankment by §203-1.01E. *Subgrade Area*, the material placed shall conform to §203-2.01A. *Subgrade Area Material*, placed and compacted in conformance with §203-3.03B. *Embankments* and §203-3.03C. *Compaction*. Where
longitudinal and transverse changes from cut to fill are encountered in the work, a subgrade transition section shall be provided in conformance with Standard Sheet Earthwork Transition and Benching Details. Where a subgrade area becomes defined by §203-1.01E. Subgrade Area in a cut section, the materials placed and other details shall be as specified under §203-3.02C. Proof Rolling in Cut Sections 3. Procedure, unless otherwise required by the contract documents. Prior to subbase course placement, the surface on which the subbase is to be placed shall be thoroughly compacted to the satisfaction of the Engineer.

1. Subgrade Surface Tolerance. After compaction, the subgrade surface shall not be above design elevation at any location.

203-3.02 Unclassified Excavation and Disposal.

A. Rock Excavation. Presplitting is required where the design rock slope is 1 vertical on 1 horizontal or steeper and the vertical height of the exposed rock slope exceeds 5 ft. Ripping will not be allowed within 10 ft. of a slope that requires presplitting. Test sections will be required at the outset of presplit drilling and blasting operations for the evaluation of the presplit rock slopes by a Departmental Engineering Geologist. The Contractor will be required to completely expose the presplit rock face in the test section for evaluation prior to any further presplit drilling.

All rock slopes shall be thoroughly scaled and cleaned. For rock excavations involving multiple lifts, scaling of upper lifts shall be completed prior to drilling and fragmenting of lower lifts. Scaled rock slopes shall be stable and free from possible hazards of falling rocks or rock slides that endanger public safety. If, after scaling, such conditions still exist, a determination of the cause will be made by a Departmental Engineering Geologist and if it is determined that the conditions are the result of poor quality work or improper methods employed by the Contractor, the Contractor shall provide approved remedial treatment, at no expense to the State. Such treatment may include, but is not necessarily limited to, laying back the slope, rock bolting, or shotcreting. In no case shall the subgrade be trimmed prior to the completion of the scaling operation at any location.

1. Presplitting. Prior to drilling presplitting holes, the overburden shall be completely removed to expose the rock surface along the presplitting line. The methods of collaring the holes to achieve required inclination and alignment shall be approved by the Engineer.

The presplitting holes shall be a maximum of 4 in. in diameter, spaced not more than 3 ft. center to center along the slope, and drilled at the designed slope inclination for a maximum slope distance of 60 ft. When excavation operations are conducted in multiple lifts, the presplitting holes for successive lifts may be offset a distance of not more than 3 ft. for a design slope of 1 vertical on 1 horizontal and not more than 1 ft. for slopes of steeper design; however, a presplitting hole shall not be started inside the payment line. The Contractor shall control the presplit drilling operations by using proper equipment and technique to achieve the design slope and maximum bench between lifts. If presplitting is conducted in lifts, each lift shall be of approximately equal depth. All presplitting holes shall be checked and cleared of obstructions immediately prior to loading any holes in a round. All presplitting holes shall be loaded with a continuous column charge manufactured especially for presplitting which contains not more than 0.35 lbs. of explosive per foot. The top of the charge shall be located not more than 3 ft. below the top of rock. A bottom charge of not more than 3 lbs. of packaged explosive may be used; however, no portion of any bottom charge shall be placed against a proposed finished slope. Each presplitting hole shall be filled with No. 1A crushed stone stemming meeting the gradation requirements of §703-02 Coarse Aggregate. The presplitting charges shall be fired with detonating cord extending the full depth of each hole and attached to a trunk line at the surface. Detonation of the trunk line shall be with blasting cap(s) and shall precede the detonation of fragmentation charges within the section by a minimum of 25 milliseconds. Presplitting shall
extend for a minimum distance equal to the burden plus 3 ft. beyond the limits of fragmentation blasting within the section.

2. Fragmentation Blasting. Fragmentation holes, or portions thereof, shall not be drilled closer than 4 ft. to the proposed finished slope. Where presplitting is required, fragmentation holes adjacent to the presplitting holes shall be drilled parallel to the presplitting holes for the full depth of the production lift at a spacing not exceeding the spacing of the production pattern. Only packaged explosives shall be used 10 ft. or less from a design slope which requires presplitting regardless of the construction sequence.

Fragmentation charges shall be detonated by properly sequenced millisecond delay blasting caps.

3. Explosive Loading Limits. In the absence of more stringent requirements, the maximum quantity of explosives allowed per delay period shall be based on a maximum particle velocity of 2 in./s at the nearest structure to be protected. In the absence of seismic monitoring equipment, the following explosive loading limits shall apply:

**DISTANCE EQUAL TO OR LESS THAN 212 ft. FROM THE NEAREST STRUCTURE**

| a. When the distance from the proposed blasting area to the nearest structure to be protected is 6 ft. or less, no blasting shall be allowed. |
| b. When the distance between the blasting area and the nearest structure to be protected is greater than 6 ft. and equal to or less than 15 ft., a maximum of \( \frac{1}{4} \) lb. of explosives per delay period (minimum of 25 milliseconds) blasting cap shall be allowed. |
| c. When the distance between the blasting area and the nearest structure to be protected is greater than 15 ft. and equal to or less than 212 ft., a Scaled Distance of 30 ft. shall be utilized to determine the maximum amount of explosive allowed per delay period (minimum of 25 milliseconds) blasting cap. The Scaled Distance Formula is as described below: |

\[
SD = \frac{D}{\sqrt{E_{\text{max}}}}
\]

where:
- \( SD \) = Scaled Distance
- \( D \) = Distance from blasting area to nearest structure to be protected in feet

or

\[
E_{\text{max}} = \frac{D^2}{(SD)^2}
\]

where:
- \( E_{\text{max}} \) = Maximum pounds of explosive per delay period (minimum of 25 milliseconds) blasting cap

**DISTANCE GREATER THAN 212 ft. FROM THE NEAREST STRUCTURE**

| a. When the blaster elects to utilize more than 50 lbs. of explosive per delay period (minimum of 25 milliseconds) blasting cap, a seismograph shall be employed to monitor the blasting vibrations generated. The initial loading shall be computed using a Scaled Distance of 30 ft. The resulting particle velocity measured by the seismograph shall be evaluated by a |
Departments Engineering Geologist. The Geologist's evaluation shall be the basis for adjusting the Scaled Distance.

No separate payment shall be made for this work. The cost shall be included in the appropriate excavation item. The above requirements shall in no way relieve the Contractor of liability for any damage incurred as a result of the blasting operations.

**B. Disposal of Surplus Excavated Materials.** Only unsuitable materials, or that portion of suitable material excavated in excess of the quantity required to construct all embankments on the project, shall be considered as surplus.

Where disposal of surplus materials cannot be accommodated within the right of way, the excess shall become the Contractor's property for disposal. Surplus material disposed of within the right-of-way shall be placed in accordance with §107-10 Managing Surplus Material And Waste.

**C. Proof Rolling in Cut Sections.** Immediately prior to final trimming of the subgrade surface and placement of subbase materials in cut sections, all areas of the subgrade surface within roadway limits shall be proof rolled according to the requirements of this subsection. This work, and any delays due to this work, shall be considered incidental to the excavation item.

1. **Purpose.** In cut sections, the purpose of proof rolling is to determine the location and extent of areas below the subgrade surface that require corrective undercutting and are not so specified in the contract documents.

2. **Equipment.** The proof roller used in embankment sections, as specified in §203-3.03D. Proof Rolling in Embankment Sections 1. Equipment, shall be employed for proof rolling in cut sections except that the roller shall be loaded to achieve a single stress level in operation, using a gross ballasted weight of 30 tons and all tires inflated to 40 psi.

3. **Procedure.** Two complete passes shall be applied over all elements of the area to be proof rolled. Where any portion of the cut subgrade surface other than that which has been damaged by the Contractor's operations fails to provide a satisfactory support for the proof rolling operation, the Engineer may order corrective undercut and backfill work performed. Backfill of undercuts shown in the contract documents or ordered by the Engineer shall be in conformance with §203.3-13 Select Granular Subgrade. Where natural soil below this course will not support the weight of the construction equipment, and when ordered by the Engineer, the course shall be placed in one lift. No additional proof rolling shall follow corrective work.

4. **Exceptions.** Proof rolling of the subgrade surface in cut sections will not be required in any area where the subgrade surface is in a rock cut, or where undercut and backfill has been previously performed. The Engineer may order undercutting and backfill without proof rolling of any cut where the need for corrective work, as determined by the Engineer, is obvious without actual proof rolling. The Engineer may also delete proof rolling in any cut section where, based upon a written evaluation by a Departmental Geotechnical Engineer, proof rolling would be detrimental to the work.

**203-3.03 Embankment In Place.**

**A. Embankment Foundation.** After completion of the work required under Section 201 Clearing and Grubbing, and Section 202 Removal of Structures and Obstructions, the embankment foundation shall be prepared. Sod and topsoil shall be removed where the final pavement grade is 6 ft. or less above the existing ground surface and in other areas designated in the contract documents or by the
Engineer. Prior to embankment construction and subbase course placement, the surface on which the embankment and/or subbase is to be placed shall be thoroughly compacted to the satisfaction of the Engineer. Unsuitable materials other than sod and topsoil shall be removed to the depths shown in the contract documents or as directed by the Engineer. Underwater areas shall be filled in accordance with §203-3.04 Select Borrow or §203-3.05 Select Fill and paid for under its appropriate item.

Where embankments are to be constructed over ground that will not adequately support embankment construction equipment, an initial layer of fill may be allowed to form a working platform. The need, manner of construction, and thickness of such a layer shall be subject to approval of the Engineer, and the layer will be permitted only where the lack of support is, as determined by the Engineer, not due to deficient ditching, grading or drainage practices or where the embankment could be constructed in the approved manner by the use of different equipment or procedures. Thicknesses of up to 3 ft. may be permitted for such a layer. Concrete or asphalt slabs may be used at the bottom of such a layer, provided they are placed horizontally.

In locations where embankments are to be constructed on hillsides or against existing embankments with slopes steeper than 1 vertical on 3 horizontal, the slopes shall be benched. Required benches shall be constructed as shown on the Standard Sheet Earthwork Transition and Benching Details.

Where old pavement is encountered within 2 ft. of the top of the subbase course, it shall be broken up or scarified.

B. Embankments. The embankment shall be constructed of suitable material as defined by §203-1.01H. Suitable Material. Embankment material shall not be placed on frozen earth, nor shall frozen soils be placed in any embankments. Embankment material shall be placed and spread in lifts (layers) of uniform thickness, then uniformly compacted as specified under applicable portions of §203-3.03C. Compaction. During embankment construction operations, earth moving equipment shall be routed so as to prevent damage to any compacted lift. Damage to any compacted lift at any time during the course of construction, such as rutting under the loads imposed by earth moving equipment, shall be fully repaired by the Contractor at his/her own expense prior to placement of any overlying materials. At the close of each day's work, the working surface shall be crowned, shaped and rolled with smooth steel wheel or pneumatic tired rollers, for positive drainage.

Particles with a dimension in excess of 3/4 of the loose lift thickness are designated as oversized particles. Oversized particles shall be removed prior to compaction of the lift and may be placed in the Embankment Side Slope Area.

Pieces of concrete or asphalt may be used provided that the voids between the pieces are completely filled, and the greatest dimension of any piece does not exceed 3/4 the loose lift thickness. Exposed mesh or rebar shall not exceed 1 in. in length.

Embankments constructed using rock products or pieces of concrete shall be spread by bladed equipment on each lift to minimize the formation of large voids as the work progresses. The top lift of a rock or concrete fill shall be chinked.

When permitted by a note in the contract documents, stumps, logs, and other materials may be placed in the Embankment Side Slope Area, provided that: 1) such matter is deposited and compacted concurrent with the adjacent embankment, and; 2) any stumps or woody material are covered by not less than 2 ft. of soil beneath the exposed side slope surface.

Glass shall not be placed in contact with synthetic liners, geogrids, geotextiles or other geosynthetics.

C. Compaction

1. General Requirements. It shall be the Contractor's responsibility to properly place and compact all materials in the road section and other locations specified in the contract documents, and to correct any deficiencies resulting from insufficient or improper compaction of such
materials throughout the contract period. The Contractor shall determine the type, size and weight of compactor best suited to the work at hand, select and control the lift (layer) thickness, exert control over the moisture content of the material, and other details necessary to obtain satisfactory results. During the progression of the work, the Department will inspect the Contractor's operations and will permit the work to continue where:

**a.** Lift thickness is controlled and does not exceed the maximum allowed according to the equipment classifications in subparagraph 2. *Compaction Equipment*, of this subsection, and the equipment meets all specified class criteria. Thinner lifts and lighter equipment than the maximum allowed may be necessary for satisfactory results on some materials.

**b.** The compactive effort (number of passes and travel speed) is uniformly applied and not less than that specified for the given equipment class and lift thickness. Higher efforts than the minimum allowed may be necessary for satisfactory results on some materials.

**c.** The Engineer concludes from a visual observation that adequate compaction has been attained, with the exception of backfill at structures, culverts, pipes, conduits, and direct burial cables. However, the State reserves the right to perform density tests at any time. When tests are performed, the results shall indicate that not less than 90% of Standard Proctor Maximum Density is attained in any portion of an embankment, or 95% in a subgrade area, or as specified for other items with a percent maximum density requirement.

**d.** Significant rutting under the action of the compactor is not observed on the final passes on a lift.

Whenever the Contractor's operations do not conform to the above criteria, or requirements contained in other subparagraphs of this subsection, the Engineer will prohibit placement of an overlying lift until the Contractor takes effective corrective action.

As part of the Department's Quality Assurance (QA) program, the Engineer or his representative may verify the adequacy of the compaction at any time through QA testing. When the Engineer determines that QA tests are necessary, the Contractor shall provide any assistance requested to facilitate such tests. Such assistance shall include but will not be limited to excavation and backfill of test pits and holes. This work shall be considered to be incidental construction.

Damage to any compacted lift at any time during the course of construction such as rutting under the loads imposed by earth moving equipment, shall be fully repaired by the Contractor at his/her own expense prior to placement of any overlying materials.

2. *Compaction Equipment*. The selection of compaction equipment is the Contractor's responsibility, but shall be subject to meeting the requirements of this subparagraph and approval by the Engineer with respect to its provisions. All compaction equipment shall be marked by a permanently attached manufacturer's identification plate designating the name of the manufacturer, model number and serial number of the machine as minimum identification. This plate shall be installed in a readily visible location. Compaction equipment lacking such an original manufacturer's identification plate, or with altered or illegible plates, will not be recognized as acceptable compaction equipment. Any equipment not principally manufactured for soil compaction purposes and equipment which is not in proper working order in all respects shall not be approved or used. The Engineer will also withhold approval of any compactor for which the Contractor cannot furnish manufacturer's specifications covering data not obvious from a visual inspection of the equipment and necessary to determine its classification.
The term, “pass,” for any type of compactor, shall denote one direct vertical application of compactor effort over all elemental areas of a lift surface. Terms in common parlance, such as “coverage,” “trips,” etc., have no significance, equivalence, or application under these specifications.

**TABLE 203-1  PNEUMATIC-TIRED COMPACTOR CLASSIFICATIONS**

<table>
<thead>
<tr>
<th>Pneumatic Compactor Class</th>
<th>Tire Requirements</th>
<th>Range of Ballasted Wheel Loads (lbs. per Wheel)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tire Size</td>
<td>No. Plys</td>
</tr>
<tr>
<td>A</td>
<td>7.50 x 15</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>7.50 x 15</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>7.50 x 15</td>
<td>14</td>
</tr>
<tr>
<td>D</td>
<td>9.00 x 20</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>E</td>
<td>11.00 x 20</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>F</td>
<td>13.00 x 24</td>
<td>18</td>
</tr>
</tbody>
</table>

* Inflation pressure for not less than the last two passes on each lift. May be reduced during earlier passes and gradually increased to this level.

**a. Pneumatic-Tired Compactors.** This type of compactor shall be classified for use according to the requirements of Table 203-1. For the lift thickness selected by the Contractor, the minimum class and wheel load which will be allowed on that lift thickness, shall be as shown in Figure 203-1.
The minimum effort for all pneumatic compactors shall be 6 passes, at speeds up to 12 ft./sec on no more than the first 2 passes, and all subsequent passes at speeds of 6 ft./sec or less.

b. Smooth Drum Vibratory Compactors. This type of compactor is defined as a machine which primarily develops its compactive effort from the vibrations created and is classified for use according to the developed compactive force rating (CFR) per linear inch of drum width.

The CFR is defined as follows:

\[
CFR = \frac{\text{Unsprung Drum Weight (lbs.)} + \text{Dynamic Force (lbs.)}}{\text{Drum Width (in.)}}
\]
The unsprung drum weight is the static weight of the drum and appurtenances without any reaction transmitted to the drum from the main chassis of the compactor. The dynamic force produced is dependent on the frequency of vibration, and therefore, CFR ratings shall be determined for the actual operating frequency of the compactor. Approval for vibratory compactors shall be confined, however, to equipment operating at not less than 1100 vpm, nor more than 1500 vpm, and those where the actual dynamic force at the actual operating frequency is at least 2.5 times the unsprung drum weight.

Conversion of manufacturer's published ratings, at a given frequency, shall be made with the following equation:

\[
F_2 = \frac{F_1(V_2)^2}{(V_1)^2}
\]

where:
- \(F_1\) = Dynamic Force at Rated Frequency
- \(F_2\) = Dynamic Force at Operating Frequency
- \(V_1\) = Rated Frequency
- \(V_2\) = Operating Frequency

For the lift thickness selected by the Contractor, the minimum CFR rating and minimum effort on such a lift, shall be as shown in Figures 203-2B&C, respectively. Non-Centrifugal (Vertical force only) types of vibratory compactors shall be approved as above, less 175 lbs./in. before using Figures 203-2 B&C as a minimum number of passes at a single specified speed. An equivalent effort, relating varying numbers of passes to other speeds is given by the equation:

\[
\text{Speed } X = \frac{(\text{Specified Speed}) \times (\text{Min. Passes at Speed } X)}{(\text{Specified Min. Passes})}
\]

The Contractor may choose to alter the specified minimum pass requirement, provided that speed is adjusted to the value given by this equation and does not exceed 6 ft./sec.
Where vibratory compactors are used on a project, the Contractor shall furnish for the exclusive use of the Engineer, one vibrating reed tachometer per project, plus one additional tachometer for each group of two vibratory compactors in excess of two per project. Tachometers shall have a frequency range adequate to cover operating frequencies of all vibratory compactors used on the project and shall have scale divisions of 50 vpm or less. Tachometers may be placed on the ground surface near the compactor when making readings, or with suitable damping materials interposed, placed directly on the compactor drum frame.

The dispensations permitted under this specification for vibratory compactors are contingent upon proper operation of the equipment at all times during compaction operations. In any instance where the Engineer encounters any problems with operators rolling without
vibration, for any reason, and immediate and effective corrective action is not taken by the Contractor, the Engineer will halt the work until the problem is resolved. If continuing problems of this nature occur, the Engineer may suspend all provisions of this subparagraph and consider the vibratory compactors as smooth steel wheel rollers classified according to their gross weight.

c. Sheepsfoot and Segmented Pad Foot Rollers. This type of compactor shall be defined as a machine which is primarily designed to compact a lift from the bottom to the top.

The maximum loose layer thickness of the material to be compacted shall be equal to the length of the feet plus 15%. The end area size and configuration of the feet shall be selected by the Contractor to suit the characteristics of soil being compacted.

Where sheepsfoot and segmented pad foot rollers are used, with or without vibration, the number of passes required for job control shall be determined by a jobsite test in which the feet penetrate into the loose lifts and, with further passes, eventually and substantially “walk out” of the layer. This job control shall then be established for that machine, lift thickness and material, provided that adequate moisture control is continuously maintained per §203-3.03C. Compaction 3. Moisture Control. Sheepsfoot and segmented pad foot rollers shall be operated at speeds not exceeding 6 ft./sec., when towed and 15 ft./sec. when self-propelled.

d. Smooth Steel Wheel Rollers. Smooth steel wheel rollers shall be considered as primary compactors on layers whose maximum thickness, after compaction, is 8 in. When so used, the roller shall have a nominal gross weight of not less than 10 tons, exert a minimum force of not less than 300 lbs/in. of width on the compression roll faces, and a minimum of 8 passes shall be applied over each lift with the roller operating at a speed not exceeding 6 ft./sec.

When the Contractor employs smooth steel wheel rollers exclusively for surface compaction, leveling or finishing operations on lifts previously compacted by other types of primary compactors, the above restrictions shall not apply.

This section applies to non-vibratory rollers or vibratory rollers operated in the static mode only.

e. Other Type of Compactors. Compactor types other than those classified above, may be employed by the Contractor, subject to approval by the Engineer of the proposed minimum applied effort (minimum number of passes and travel speed) and maximum lift thickness. Such approval by the Engineer will be based upon the results of appropriate on-site field tests.

f. Compaction Equipment for Confined Areas. In areas inaccessible to conventional compactors, or where maneuvering space is limited, impactor rammers, plate or small drum vibrators, or pneumatic buttonhead compaction equipment may be used with layer thickness not exceeding 6 in. before compaction. Hand tampers shall not be permitted. The Engineer may approve or reject any of the above described mechanical devices based upon the results of appropriate on-site field tests.

3. Moisture Control. All fill or backfill material to be compacted, shall be at a moisture content for adequate compaction of that material using the compactor selected by the Contractor to perform the work. The Contractor shall be responsible for determining the appropriate moisture content, and for controlling it within the proper limits as the work is progressed. When water must be added to a material, it may be added on the lift or in the excavation or borrow pit. Water added on the lift, however, shall be applied by use of an approved pressure distributor. Distributors must be approved and documented by the Engineer. Documentation by the Engineer shall be adequate evidence of approval. Water added shall be thoroughly incorporated into the
soil, and the soil shall be manipulated to attain uniform moisture distribution. When the moisture content of a lift about to be compacted exceeds the required amount, compaction shall be deferred until the layer has dried back to the required amount. Natural drying may be accelerated by blending in a dry material or manipulation alone, to increase the rate of evaporation. Increased loose lift thickness caused by blending in a dry material, however, may necessitate a change in compaction equipment and/or methods to meet the minimum provisions of subparagraph 2. Compaction Equipment of this subsection.

D. Proof Rolling in Embankment Sections. Immediately prior to final trimming of the subgrade surface and placement of subbase materials in embankment sections, all areas of the subgrade surface within roadway limits shall be proof rolled according to the requirements of this subsection. This work, and any delays due to this work, shall be considered incidental to the embankment item.

1. Equipment. The proof roller shall consist of a chariot type rigid steel frame with a box body suitable for ballast loading up to 50 tons gross weight, and mounted on four pneumatic tired wheels acting in a single line across the width of the roller on its transverse load center line. The wheels shall be equipped with 18.00 x 24 or 18.00 x 25, 24 ply tires, and shall be suspended on articulated axles such that all wheels carry approximately equal loads when operating over uneven surfaces.
2. **Determination of Roller Stress.** Initially, the gross ballasted weight and tire inflation pressure of the proof roller shall be adjusted to the highest stress level shown in Figure 203-3 based on:

   a. The general description of the subgrade soils.

   b. The estimation of the relative subgrade support within the subgrade soil description range.

   The initial roller stress for embankments constructed of rock shall be the maximum level listed in Figure 203-3 (50 Gross Tons, 130 Tire psi).

   The roller shall be operated briefly to establish the acceptability of the initial stress level. Proof rolling of the embankment shall be performed at the next lower stress level whenever operation of the roller at a higher stress level is accompanied by consistent lateral displacement of soil out of the wheel paths.

3. **Procedure.** After an acceptable stress level is established, two complete passes of the roller shall be applied over all elements of the area to be proof rolled. Any deficiencies disclosed during the proof rolling operation shall be corrected. Subsidence depressions shall be filled with material similar to the subgrade soil and then compacted in a normal manner. After compaction, these areas shall be proof rolled again. Corrective work shall be judged complete and accepted by the Engineer when all elements of the subgrade surface over a given embankment show a satisfactory uniform response to the proof roller.

4. **Exceptions.** Proof rolling of the subgrade surface in embankment sections will not be required in any area where:

   a. Due to restrictions in available access and/or maneuvering space, use of the proof roller may damage adjacent work;

   b. The proof roller will approach a culvert, pipe or other conduit closer than 5 ft. in any direction.

203-3.04 **Select Borrow.** The management of a select borrow source and the acceptability of all select borrow material shall be in conformance with §203-3.01F. *Borrow.*

   Underwater areas shall be filled with select borrow to 2 ft. above the water surface at the time of placement and in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents.

   All select borrow placed within the limits of Embankment or the Subgrade Area shall be placed in conformance with §203-3.03B. *Embankments* or §203-3.01G. *Subgrade Area* respectively, as appropriate, or where used for fill or backfill at structures, culverts and pipes, in conformance with §203-3.06 *Select Granular Fill* and §203-3.17 *Select Structural Fill.*

203-3.05 **Select Fill.** Underwater areas shall be filled with select fill to 2 ft. above the water surface at the time of placement and in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents.

   All select fill placed within the limits of Embankment or the Subgrade Area shall be placed in conformance with §203-3.03B. *Embankments* or §203-3.01G. *Subgrade Area* respectively, as appropriate, or where used for fill or backfill at structures, culverts and pipes, in conformance with §203-3.06 *Select Granular Fill* and §203-3.17 *Select Structural Fill.*
203-3.06 Select Granular Fill. The type of material to be used in bedding, filling and backfill at culverts, pipes, conduit and direct burial cable shall be in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents. Do not use RAP. Do not use slabs or pieces of either concrete or asphalt.

Fill or backfill material at culverts and pipes shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. Compaction. A minimum of 95% of Standard Proctor Maximum Density will be required. When placing fill or backfill around culverts and pipes, layers shall be deposited to progressivly bury the pipe or culvert to equal depths on both sides. The limits to which this subsection will apply shall be in accordance with the Standard Sheets or as modified in the contract documents.

Fill or backfill for conduit or cable placed in a trench shall be carefully placed in a horizontal layer to a depth of 6 in. over the top of the conduit or cable. This layer of material shall not be compacted, however, the remaining portion of the trench shall be backfilled in accordance with the preceding paragraph. Where cables or conduits are placed and backfilled by a machine in one operation, the above requirements for backfilling do not apply.

Where sheeting has been used for the excavation, and incremental removal of sheeting is not specified in the contract documents, sheeting shall be pulled when the trench has been backfilled to the maximum unsupported trench depth allowed by 29 CFR 1926.

203-3.07 Select Granular Fill Slope Protection. The Contractor shall perform the excavation in accordance with the requirements for “Unclassified Excavation and Disposal” as described elsewhere in these specifications. The Contractor shall then spread material conforming to the requirements given in §733-12 Select Granular Slope Protection, in one layer to its full thickness by a method approved by the Engineer. The work shall be performed where shown in the contract documents or where directed by the Engineer in accordance with the Standard Sheets, and details shown on the contract documents.

Compaction of the slope protection is not required. Slope Protection shall be either of two types, as described below:

A. Select Granular Fill, Slope Protection - Type A. Under this type, the Contractor shall furnish and install the slope protection where shown in the contract documents in accordance with the details shown on the Standard Sheets.

B. Select Granular Fill, Slope Protection - Type B. Under this type, the Contractor shall furnish and install the slope protection where directed by the Engineer in accordance with the details shown on the Standard Sheets.

203-3.08 Surface Settlement Gauges. Surface settlement gauges shall be constructed, installed, and maintained where shown in the contract documents and in accordance with the details contained in the geotechnical control procedure “Settlement Gauges and Settlement Rods” covering construction, installation, maintenance, and abandonment of these devices.

Where surface settlement gauges are called for, it will be the Contractor's option to install pipe gauges or manometer gauges, unless a definite type is specified in the contract documents. Surface settlement gauges will be accepted for conformance with the specification requirements on the basis of an inspection of the installation by the Departmental Geotechnical Engineer.

203-3.09 Settlement Rods. Settlement rods shall be constructed, installed, and maintained where shown in the contract documents and in accordance with the details contained in the geotechnical control procedure “Settlement Gauges and Settlement Rods” covering construction, installation, maintenance, and abandonment of these devices.

Settlement rods will be accepted for conformance with the specification requirements on the basis of an inspection of the installation by the Departmental Geotechnical Engineer.
203-3.10 Piezometers. Piezometers shall be constructed, installed, and maintained at the locations shown in the contract documents and in accordance with the detailed drawings included in the contract documents.

203-3.11 Applying Water. None Specified.

203-3.12 Select Granular Subgrade. The type of material to be used in fill or backfill of undercuts shall be in conformance with the details shown in the contract documents or as ordered by the Engineer.

Fill or backfill material shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. Compaction. A minimum of 95% of Standard Proctor Maximum Density will be required.

203-3.13 Select Structural Fill. The type of material to be used in bedding, filling and backfill at structures shall be in conformance with the details shown on the appropriate Standard Sheet or as noted in the contract documents or as ordered by the Engineer. Do not use RAP. Do not use slabs or pieces of either concrete or asphalt.

Fill or backfill material at structures shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. Compaction. A minimum of 95% of Standard Proctor Maximum Density will be required. When filling behind abutments and similar structures, all material shall be placed and compacted in front of the walls prior to placing fill behind the walls to a higher elevation. The limits to which this subsection will apply shall be in accordance with the Standard Sheets or as modified in the contract documents.

Where sheeting has been used for the excavation, and incremental removal of sheeting is not specified in the contract documents, sheeting shall be pulled when the trench has been backfilled to the maximum unsupported trench depth allowed by 29 CFR 1926.

203-3.14 Sand Backfill. The type of material to be used in bedding and filling shall be in conformance with the details shown in the contract documents or as ordered by the Engineer.

Bedding or fill material shall be deposited in horizontal layers not exceeding 6 in. in thickness prior to compaction. Compaction of each layer shall be as specified under §203-3.03C. Compaction. A minimum of 95% of Standard Proctor Maximum Density will be required.

203-4 METHOD OF MEASUREMENT

203-4.01 General. Quantities for all items of work with payment units in cubic yards will be computed from payment lines shown in the contract documents. Work performed beyond any designated payment line, including any offset required for the construction of presplit rock slopes in lifts, will not be included in the computation of quantities for the item involved.

For any item paid for in its final position, no additional quantity will be measured for payment to make up losses due to foundation settlement, compaction, erosion or any other cause.

Cross-sectioning, for the purpose of determining quantities for payment, will be employed only where payment lines are not shown in the contract documents or Standard Sheets, and cannot be reasonably established by the Engineer.

Quantities for benching will be computed for payment from the details and instructions shown on the Standard Sheet Earthwork Transition and Benching Details.

The excavation of unsuitable materials designated as topsoil under Section 713 Topsoil, will be included in the quantity measured for the appropriate unclassified excavation item, without distinction.

Where the item, “Embankment in Place,” is designated for the project by the proposal, all borrow of ordinary suitable materials shall be incidental to the work of that item.
203-4.02 Unclassified Excavation and Disposal. Unclassified excavation and disposal will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the original position for all excavation within right-of-way limits. No deduction shall be made for any pipes, culverts, structures, or other obstructions, unless these are measured for payment under another contract item. Excavation for borrow of suitable materials for embankment construction, shall not be included in the computation for this work.

203-4.03 Embankment in Place. Embankment in place will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final compacted position. Any additional quantity of material required to compensate for embankment settlement shall not be included in the measurement of this item. The quantities of embankment will exclude the total volume of pipes, culverts, other roadway items, and granular backfill within the payment lines for such granular backfill.

203-4.04 Select Borrow. Select borrow will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the original position.

203-4.05 Select Fill. Select fill will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final compacted position.

203-4.06 Select Granular Fill. Select granular fill will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final compacted position. A deduction shall be made for pipes (based on nominal diameters) and other payment items when the combined cross-sectional area exceeds 1 ft² unless otherwise shown in the contract documents. No deduction will be made for the cross-sectional area of an existing facility.

203-4.07 Select Granular Fill Slope Protection. Select granular fill slope protection will be measured in cubic yards, measured to the nearest whole cubic yard, computed in the final position.

203-4.08 Surface Settlement Gauges. Surface settlement gauges will be measured by the number of devices satisfactorily installed.

203-4.09 Settlement Rods. Settlement rods will be measured by the number of devices satisfactorily installed.

203-4.10 Piezometers. Piezometers will be measured by the number of devices satisfactorily installed.

203-4.11 Applying Water. The unit of measurement of water will be one pressure distributor per calendar day, denoted hereafter as one p.d.d., for dust control. Where the Contractor works in more than one separate and distinct shift per calendar day, each shift shall be considered as one p.d.d. A single shift plus overtime work, however, shall be considered as one p.d.d. The quantity thus determined shall be applied directly as the quantity to be paid for where the distributors used have a capacity of 3,000 gal. or less.

Provided that the Engineer determines that the total operating distributor capacity (number and sizes of all distributors) employed is reasonably commensurate with the needs for water application, additional payment will be allowed for distributors exceeding 3,000 gal. in capacity as follows:

<table>
<thead>
<tr>
<th>Distributor Capacity</th>
<th>Pressure Distributor per Calendar Day Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,000 gal. &lt; distributor capacity &lt; 5,000 gal.</td>
<td>p.d.d.’s will be multiplied by 1.5</td>
</tr>
<tr>
<td>5,000 gal. ≤ distributor capacity</td>
<td>p.d.d.’s will be multiplied by 2.0</td>
</tr>
</tbody>
</table>
No additional quantity shall be measured for payment for compaction purposes.

203-4.12 Select Granular Subgrade. Select granular subgrade will be measured in cubic yards, measured to the nearest whole cubic yard, in the final compacted position.

203-4.13 Select Structural Fill. Select structural fill will be measured in cubic yards, measured to the nearest whole cubic yard, in the final compacted position. A deduction shall be made for pipes (based on nominal diameters) and other payment items when the combined cross-sectional area exceeds 1 ft² unless otherwise shown in the contract documents. No deduction will be made for the cross-sectional area of an existing facility.

203-4.14 Sand Backfill. Sand backfill will be measured in cubic yards, measured to the nearest whole cubic yard, in the final compacted position. A deduction shall be made for pipes (based on nominal diameters) and other payment items when the combined cross-sectional area exceeds 1 ft² unless otherwise shown in the contract documents. No deduction will be made for the cross-sectional area of an existing facility.

203-5 BASIS OF PAYMENT

203-5.01 General-All Items. The unit price bid shall include the cost of furnishing all labor, materials, and equipment as necessary to complete the work, except where specific costs are designated or included in another pay item of work. Incidental costs, such as acquisition of borrow pits or material outside of the right-of-way, rock drilling and blasting, compaction and special test requirements, stockpiling and re-handling of materials, precautionary measures to protect private property and utilities, to form and trim graded surfaces, proof rolling, re-proof rolling, corrective work disclosed by proof rolling and any delays caused by this corrective work, shall be included in the unit price of the pay item where such costs are incurred. The exception is that corrective work ordered in cut sections based on an evaluation of proof rolling will be paid for under the appropriate excavation and backfill items.

Quantities for any additional items of work or substitution of material in accordance with the approved Winter Earthwork submittal shall be furnished at no cost to the State.

203-5.02 Unclassified Excavation and Disposal. The provisions of §203-5.01 General-All Items apply including the following:

The unit price bid shall cover all costs of required excavation within the right of way limits, and all costs of disposal if the excavated materials are not used under another pay item.

203-5.03 Embankment In Place. The provisions of §203-5.01 General-All Items apply.

203-5.04 Select Borrow. The provisions of §203-5.01 General-All Items apply.

203-5.05 Select Fill. The provisions of §203-5.01 General-All Items apply.

203-5.06 Select Granular Fill. The provisions of §203-5.01 General-All Items apply.

203-5.07 Select Granular Fill Slope Protection. The provisions of §203-5.01 General-All Items apply.

203-5.08 Surface Settlement Gauges. The provisions of §203-5.01 General-All Items apply including the following:
The unit price bid shall cover all costs of providing, installing and maintaining each device, including excavation, trenching and backfill during the course of the work. No payment will be made under any other item of the contract for any work associated with these items.

When each installation is completed, 75% of the item unit price will be paid. The remaining 25% will be paid when each device has been properly maintained and is abandoned according to the procedures contained in the geotechnical control procedure “Settlement Gauges and Settlement Rods”. Unless otherwise specified in the proposal, the unit price shall also include the costs of removal.

203-5.09 Settlement Rods. The provisions of §203-5.01 General-All Items apply including the following:

The unit price bid shall cover all costs of providing, installing and maintaining each device, including excavation, trenching and backfill during the course of the work. No payment will be made under any other item of the contract for any work associated with these items.

When each installation is completed, 75% of the item unit price will be paid. The remaining 25% will be paid when each device has been properly maintained and is abandoned according to the procedures contained in the geotechnical control procedure “Settlement Gauges and Settlement Rods”. Unless otherwise specified in the proposal, the unit price shall also include the costs of removal.

203-5.10 Piezometers. The provisions of §203-5.01 General-All Items apply including the following:

The unit price bid shall cover all costs of providing, installing and maintaining each device, including excavation, trenching and backfill during the course of the work. No payment will be made under any other item of the contract for any work associated with these items.

When each installation is completed and the device placed in satisfactory operation, 75% of the unit price will be paid. The remaining 25% will be paid when all earthmoving and slope work is completed in the vicinity of each installation. Any installation rendered inoperative due to damage by construction equipment after partial or full payment, shall be immediately repaired or the full amount of such payment shall be deducted from other monies due the Contractor under the contract.

203-5.11 Applying Water. The unit price bid per one operating pressure distributor per calendar day for applying water shall include the costs of furnishing all labor, material and equipment necessary for dust control.

203-5.12 Select Granular Subgrade. The provisions of §203-5.01 General-All Items apply.

203-5.13 Select Structural Fill. The provisions of §203-5.01 General-All Items apply.

203-5.14 Sand Backfill. The provisions of §203-5.01 General-All Items apply.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>203.02</td>
<td>Unclassified Excavation and Disposal</td>
<td>Cubic Yards</td>
</tr>
<tr>
<td>203.03</td>
<td>Embankment In Place</td>
<td>Cubic Yards</td>
</tr>
<tr>
<td>203.05</td>
<td>Select Borrow</td>
<td>Cubic Yards</td>
</tr>
<tr>
<td>203.06</td>
<td>Select Fill</td>
<td>Cubic Yards</td>
</tr>
<tr>
<td>203.07</td>
<td>Select Granular Fill</td>
<td>Cubic Yards</td>
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<td>203.0801</td>
<td>Select Granular Fill, Slope Protection - Type A</td>
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<td>Select Granular Fill, Slope Protection - Type B</td>
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</tr>
<tr>
<td>203.10</td>
<td>Surface Settlement Gauges</td>
<td>Each</td>
</tr>
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<td>203.12</td>
<td>Settlement Rods</td>
<td>Each</td>
</tr>
<tr>
<td>203.13</td>
<td>Piezometers</td>
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</tr>
<tr>
<td>203.1601</td>
<td>Applying Water</td>
<td>P.D.D.</td>
</tr>
</tbody>
</table>
SECTION 204 - FLOWABLE FILL

204-1 DESCRIPTION. The work shall consist of mixing and placing flowable fill at the locations shown in the contract documents.

204-1.01. Controlled Low Strength Material. Controlled Low Strength Material (CLSM) is an acceptable alternative to compacted soil backfill in confined spaces. CLSM consists of cement, water and, at the Contractor’s option, fly ash, aggregate or chemical admixtures in any proportions such that the final product meets the strength and flow consistency requirements included in the specification. The mix is proportioned to be self leveling and does not require compaction. It is much lower in strength than concrete, making future excavation possible.

204-1.02. Lightweight Concrete Fill. Lightweight Concrete Fill is an engineered geotechnical material with a unique strength/density relationship which can be used to reduce loads on soft foundation soils, buried structures, or against retaining walls. Lightweight Concrete Fill consists of a Portland cement matrix containing uniformly distributed, non-interconnected air voids introduced by a foaming agent. The flowability and cementitious properties provide a product that is self leveling and does not require compaction.

204-2 MATERIALS.

204-2.01 Controlled Low Strength Material. Provide backfill material meeting the requirements for CLSM as stated in §733-01 Flowable Fill.

204-2.02 Lightweight Concrete Fill. Provide backfill material meeting the requirements for Lightweight Concrete Fill as stated in §733-01 Flowable Fill.

204-3 CONSTRUCTION DETAILS.

204-3.01 Controlled Low Strength Material.

A. CLSM Submittal. Submit to the Engineer (1) a mix design, with certified test results supplied by a qualified independent testing laboratory for the CLSM verifying the unconfined compressive strength meets the requirements of the specification, and (2) the methods of installation to be employed. Include in the CLSM placement sequence, a procedure to account for subsidence during the settling and curing process.

B. CLSM Production. Mix the materials at a stationary mixing plant which is either a continuous or a batch type plant. A batch is defined as the amount of material that can be mixed at one time. Design the mix of materials to accurate proportions, either by volume or by weight, so that when the materials are incorporated in the mix a thorough and uniform mix will result.

If the CLSM can be placed within 30 minutes of the end of mixing, then open haul units may be used for transport. If it cannot be placed within 30 minutes after the end of mixing, it must be transported by a rotating drum unit capable of 2-6 rpm.
For work involving quantities of CLSM less than 2.5 yd$^3$, the Contractor may use a small portable mixer. Provide a mixer capable of mixing CLSM that has the specified unconfined compressive strength and flow consistency. Mix all components so as to produce a uniform product.

C. CLSM Placement - General. Do not place CLSM that is frozen, or place CLSM on frozen ground. Do not expose CLSM to freezing temperatures until after it has gained its requisite strength, abiding by the Provisions for Curing in Cold Weather in Section 555 Structural Concrete.

If the CLSM is to be placed via pumps, the placement sequence shall be such that the equipment is able to access the entire volume to be filled without separating the mixture.

Keep CLSM encapsulated with soil or protected by other means so as to prevent erosion and environmental degradation.

D. CLSM Placement – at Structures, Culverts, Pipes, Conduits and Direct Burial Cables. Place the CLSM in accordance with the installation details shown on the Standard Sheet.

When placing CLSM for pipe backfill, discharge the material onto the top and at the center of the pipe.

Do not place CLSM in contact with aluminum pipe, including connections, fixtures, etc., unless the aluminum has been thoroughly coated with Zinc Chromate Primer, §708-04 Zinc Chromate Primer, or an equivalent alternative as approved by the Materials Bureau.

Do not place CLSM containing fly ash in direct contact with cast iron or ductile iron pipes, fittings or appurtenances.

In situations where CLSM is used as backfill around pipe, take precautions to counteract the pipe’s buoyancy.

E. CLSM – QA Testing. The Department maintains a Quality Assurance (QA) program for CLSM. The Department will sample and test specimens of the CLSM during placement to compare its properties to the specification requirements and verifying the spread diameter and unconfined compressive strength of the in-place material. The QA program provides oversight of the Contractors Quality Control (QC) process, to reveal changes which may occur in the approved mix design.

Several scenarios may develop as a result of the QA testing.

1. The properties are shown to meet the requirements of the specification for the type(s) identified in the contract documents. No action will be taken.
2. The properties are shown to be outside the requirements of the specification for the type(s) identified in the contract documents.
   a. If the results are within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the material may remain in-place contingent upon an agreed credit. If a credit cannot be agreed upon, the scenario reverts to 2.b.
   b. If the results are not within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the entire lift (and all overlying lifts) of material will be removed and replaced at the Contractor’s expense.

204-3.02 Lightweight Concrete Fill.

A. Lightweight Concrete Fill Submittal. Submit to the Engineer (1) a mix design, with certified test results supplied by a qualified independent testing laboratory for the Lightweight Concrete Fill verifying the wet cast density and unconfined compressive strength meets the requirements of the specification for the type(s) identified in the contract documents, and (2) the methods of installation to be employed.
B. Lightweight Concrete Fill Production. Generate foam in accordance with the manufacturer’s recommendations for inclusion into the mix.

Mix the materials at a stationary mixing plant which is either a continuous or a batch type plant. A batch is defined as the amount of material that can be mixed at one time. Design the mix of materials to accurate proportions, either by volume or by weight, so that when the materials are incorporated in the mix, a thorough and uniform mix will result.

Locate equipment such that the mixed product is capable of being pumped into place properly.

C. Lightweight Concrete Fill - Placement. A representative of the supplier of the foaming agent shall be on site during the initial placement and at such times as requested by the Engineer to advise the Contractor on his operation. The lightweight concrete fill shall be placed in lifts not to exceed 24 in. unless otherwise approved by the Engineer. Subsequent lifts shall be placed only after a minimum 12 hour waiting period has been observed.

At the end of each pour, exposed surfaces shall be roughened with a stiff broom or scored with a tool. The Lightweight Concrete Fill shall be placed on supporting surfaces which have been cleaned of loose debris, sand, dust, or other foreign materials to the satisfaction of the Engineer.

Do not place Lightweight Concrete Fill that is frozen, or place Lightweight Concrete Fill on frozen ground. Do not expose Lightweight Concrete Fill to freezing temperatures until after it has gained its requisite strength, abiding by the Provisions for Curing in Cold Weather in Section 555 Structural Concrete.

D. Lightweight Concrete Fill – QA Testing. The Department maintains a Quality Assurance (QA) program for Lightweight Concrete Fill. The Department will sample and test specimens of the Lightweight Concrete Fill material during placement to compare its properties to the specification requirements and verifying the wet cast density and unconfined compressive strength of the in-place material. The QA program provides oversight of the Contractors Quality Control (QC) process, to reveal changes which may occur in the approved mix design.

Several scenarios may develop as a result of the QA testing.

1. The properties are shown to meet the requirements of the specification for the type(s) identified in the contract documents. No action will be taken.
2. The properties are shown to be outside the requirements of the specification for the type(s) identified in the contract documents.
   a. If the results are within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the material may remain in-place contingent upon an agreed credit. If a credit cannot be agreed upon, the scenario reverts to 2.b.
   b. If the results are not within an acceptable margin as determined by the Department through an independent analysis of the site specific conditions, the entire lift (and all overlying lifts) of material will be removed and replaced at the Contractor's expense.

204-4 METHOD OF MEASUREMENT.

204-4.01. Controlled Low Strength Material. CLSM will be measured for payment in cubic yards measured to the nearest 0.1 cubic yard computed from the payment lines shown on the contract documents.

A deduction will be made for pipes (based on nominal diameters) and other features when the combined cross-sectional area exceeds 1 ft².

No additional quantity shall be measured for payment to make up losses due to foundation settlement, compaction, erosion or any other cause.
Cross sectioning, for the purpose of determining quantities for payment, will be employed only where payment lines are not shown on the contract documents or Standard Sheets, and cannot be reasonably established by the Engineer.

**204-4.02. Lightweight Concrete Fill.** Lightweight Concrete Fill will be measured for payment in cubic yards measured to the nearest 0.1 cubic yard computed from the payment lines shown on the contract documents.

**204-5 BASIS OF PAYMENT.**

**204-5.01 Controlled Low Strength Material.** The unit price bid shall include the costs of all labor, material, and equipment necessary to satisfactorily complete the work.

**204-5.02. Lightweight Concrete Fill.** The unit bid price shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

*Payment will be made under:*

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<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tbody>
<tr>
<td>204.01</td>
<td>Controlled Low Strength Material (CLSM)</td>
<td>Cubic Yard</td>
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<tr>
<td>204.02</td>
<td>Controlled Low Strength Material (CLSM) (No Fly Ash)</td>
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<td>204.03</td>
<td>Lightweight Concrete Fill (Type A)</td>
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<td>204.04</td>
<td>Lightweight Concrete Fill (Type B)</td>
<td>Cubic Yard</td>
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**SECTION 205 - CONTAMINATED SOIL**

(Last Revised January 2019)

**205-1 DESCRIPTION.**

**205-1.01 General.** Soil contamination may include:

- Petroleum products, which may include, but are not limited to: gasoline, heating oils, diesel fuel, kerosene, jet fuel, lubricating oils, motor oils, greases, and other fractions of crude oil;
- Contaminants associated with past Manufactured Coal Gas Plant (MGP) operations;
- Other contamination by organic constituents including volatile organic compounds;
- Metal(s) such as lead, chromium, and/or other heavy metals; and/or
- Any other constituents that require specialty disposal of the soil.

Additional information regarding contaminated soil may be available in a Special Note entitled *Soil Characterization Information* and/or in a *Contaminated Materials Assessment Report*, if such Special Note and/or Report were prepared by the Department during project design.

**205-1.02 Segregation and Storage.** This work shall consist of segregating contaminated soil from non-contaminated soil during excavation, and the temporary storage and management of contaminated soil (pending sampling, analysis and ultimate disposition) in accordance with an accepted Contaminated Material Handling Plan.

**205-1.03 Field Organic Vapor Monitoring.** This work shall consist of screening soil for contamination during excavation using field vapor monitoring equipment and observations. This work shall be performed by an independent firm hired by the Contractor and completed in accordance with an accepted Field Organic Vapor Monitoring Plan.

**205-1.04 Sampling and Analysis.** This work shall consist of collecting soil samples and arranging for samples to be analyzed at a laboratory in accordance with an accepted Sampling Plan. The laboratory
shall be accredited for the specified parameters by the New York State Department of Health (NYSDOH) under the Environmental Laboratory Approval Program (ELAP). The results of the laboratory analysis will determine or confirm the final regulatory classification of the soil for appropriate handling, transportation, treatment and disposal methods and requirements.

205-1.05 Transportation and Disposal. This work shall consist of transporting and disposing of contaminated soil, and completing any other related activities, in accordance with an accepted Disposal Plan. For shipping and disposal purposes, the regulatory classification of the soil (as either contaminated non-hazardous industrial waste or RCRA regulated hazardous waste) will be based on investigations conducted prior to award or based on the results of laboratory analysis included in this section.

205-1.06 Reuse of Contaminated Soil. This work shall consist of the reuse of contaminated soil within the contract limits as embankment, fill or other appropriate on-site use. Contaminated soil areas and reuse locations, if provided, are indicated in the contract documents or shall be determined and approved by the Department. The reuse of contaminated soil may be deemed appropriate based upon the following a) an investigation conducted prior to the contract award and/or sampling and analysis conducted during project construction and the qualification of the soil placement as a generic beneficial use determination (BUD) or b) as a site specific BUD obtained from the NYSDEC. The material must be considered suitable material as per Section 203.

205-2 MATERIALS.

205-2.01 General. As per the Contaminated Material Handling Plan, (Section 205-1.02).

205-2.02 Segregation and Storage. None Specified.

205-2.03 Field Organic Vapor Monitoring. Field organic vapor monitoring shall be conducted using a photoionization detector (PID) with a 10.2eV or higher ultraviolet lamp. The PID shall have a minimum detection range of 0.1 ppm to 2,000 ppm and shall be calibrated with isobutylene or other appropriate calibration gas.

A flame ionization detector (FID) may be used in lieu of a PID if a written request and justification is submitted by the Contractor and approved by the Department. The FID shall have a minimum detection range of 1.0 ppm to 50,000 ppm and shall be calibrated with appropriate calibration gas.

205-2.04 Sampling and Analysis. None Specified.

205-2.05 Transportation and Disposal. None Specified.

205-2.06 Reuse of Contaminated Soil. None Specified.

205-3 CONSTRUCTION DETAILS.

205-3.01 General. Work activities shall be performed in accordance with the contract documents and with applicable Contaminated Material Handling Plan, Field Organic Vapor Monitoring Plan, Sampling Plan and/or Disposal Plan. The Contractor shall initiate any measures necessary to protect the safety and health of workers and the general public based on the potential hazards associated with the contaminated soil.

A. Regulatory Compliance. The Contractor shall conduct all tasks in accordance with all applicable Federal, State, County, and local regulations including, but not necessarily limited to:

- 6 NYCRR 360 - Solid Waste Management Facilities;
• 6 NYCRR 364 - Waste Transporter Permits;
• 6 NYCRR 371 - Identification and Listing of Hazardous Wastes (Defines Resource Conservation and Recovery Act (RCRA) defined hazardous wastes;
• 6 NYCRR 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transports and Facilities (applicable to soils regulated as hazardous wastes only);
• 6 NYCRR Part 375 – Environmental Remediation Program;
• 49 CFR 100 to 180 - USDOT Hazardous Materials Transport and Manifest System Requirements (applicable to soils regulated as hazardous wastes only);
• CP – 51/SOIL Cleanup Guidance (NYSDEC Policy).

B. Preparation of Plans and Advance Notification Letters. The Contractor shall be required to prepare one or more of the plans described below. Two (2) copies of each applicable plan shall be submitted to the Engineer for acceptance at least 30 calendar days prior to commencing work in areas identified as potentially contaminated.

Plans and notification letters shall be prepared based on the type(s) of contamination and locations identified in the contract documents. If a different type of contamination is encountered during work, and additional plans and notification letters must be written, the 30 calendar day lead time for submittals may be modified by the Engineer as appropriate.

1. Contaminated Material Handling Plan (CMHP). If the segregation and storage item is included in the contract, a CMHP shall be prepared. The CMHP shall describe the procedures to be used to segregate contaminated soil during excavation, soil storage/stockpile procedures, and safety and health issues. The following information shall be included in the CMHP:
   • Name and address of the plan preparer;
   • Contract name, contract number and description;
   • Describe procedures to be used to segregate contaminated soil during excavation;
   • Location of intended soil stockpile, trucks, roll-off container and other storage areas;
   • Describe how contaminated soil will be moved to soil storage locations;
   • Describe how soil storage/stockpile locations will be prepared and managed;
   • Describe how potential air quality impacts such creation of dust particulates and vapors will be minimized to protect air quality within, adjacent to or downwind from the project.
   • Describe air monitoring procedures to be used during work, define action levels, and explain the response if action levels are exceeded; The protocol and procedures shall consider action levels for both work personnel and also perimeter/community action levels based on the nature of the contamination and activities conducted
   • Hazardous substance evaluation - types of chemicals associated with the waste to be generated,
   • Hazard assessment - physical and toxic effects associated with the waste to be generated;
   • Personal protective clothing (PPC) and personal protective equipment (PPE) to be used or available on-site;
   • Names of key personnel, emergency contacts and phone numbers;
   • List the OSHA training each worker has received. At least one worker must have completed supervisor training per 29 CFR 1910.120(E)(4);
   • General and site-specific safety rules, with emergency response procedures and directions to the nearest hospital (with map);
   • Decontamination procedures for personnel and equipment; and
   • Disposal of contaminated PPC and PPE;
2. **Field Organic Vapor Monitoring Plan (FOVMP).** If the field organic vapor monitoring item is included in the contract, a FOVMP shall be prepared. The following information shall be included in the FOVMP:
   - Name and address of the plan preparer;
   - Name, address, experience and qualifications of the independent firm performing the field organic vapor monitoring.
   - Name, address, experience and qualifications of each individual who will conduct the field organic vapor monitoring. Each individual shall be thoroughly trained in sampling protocols, organic vapor monitoring procedures, and equipment calibration procedures.
   - Type(s) of organic vapor monitoring equipment to be used – model, manufacturer and details of the PID or FID equipment that will be used to conduct field organic vapor monitoring; and
   - Description of the field organic vapor monitoring and calibration procedures to be used.

3. **Sampling Plan.** If a sampling and analysis item is included in the contract, a Sampling Plan must be prepared. The following information shall be included in the Sampling Plan:
   - Name and address of the plan preparer;
   - Name, address, telephone number, and ELAP certification number of the proposed NYSDOH ELAP accredited laboratory;
   - Name, address, experience and qualifications of each individual who will collect soil samples. Each individual shall be thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements.
   - List of all laboratory tests required by the disposal/treatment facility
   - Describe the sample collection and handling procedures to be used; and
   - Sampling schedule or a description of the sampling frequency to be used to facilitate prompt disposal of stored soil.

   If sampling and analysis items are not included in the contract, a separate Sampling Plan is not required, and the Contractor shall perform any soil sampling and analysis required under the disposal item.

4. **Disposal Plan.** If a disposal item(s) is included in the contract, a Disposal Plan shall be prepared. The following information shall be included in the Disposal Plan:
   - Name and address of the plan preparer;
   - Name of disposal/treatment facility, address, telephone number and contact person;
   - Copy of applicable permits and/or licenses held by the disposal/treatment facility;
   - EPA Identification Number and/or State Facility Identification Number issued to the disposal/treatment facility;
   - Method(s) of disposal/treatment that will be used;
   - Signed letter from the disposal/treatment facility stating it is authorized under law to accept the type of waste being generated, their intent to accept the contaminated waste generated by this contract, and a list of the laboratory tests required by the facility;
   - Name of waste transporter, address, telephone number and contact person;
   - EPA Identification Number and/or State Transporter Identification Number issued to waste transporter; and
   - Copies of all waste transporter permits and/or license plate numbers for vehicles that will be used for transport of waste from the site to the intended disposal/treatment facility;

   If a sampling and analysis item(s) is not included in the contract, the following information shall be included in the Disposal Plan for any sampling and analysis that will be conducted:
• Name, address, telephone number, and ELAP certification number of the proposed NYSDOH ELAP accredited laboratory.
• Name, address, experience and qualifications of each individual who will collect soil samples. Each individual shall be thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements.
• List of all laboratory tests required by the disposal/treatment facility;
• Describe the sample collection and handling procedures to be used; and
• Sampling schedule or a description of the sampling frequency to be used to facilitate prompt disposal of stored soil.

5. **Advance Notification Letters (Letters).** At least 10 calendar days prior to commencing work in contaminated areas, the Contractor shall prepare and submit Advance Notification Letters, (Letters) to the Engineer, the appropriate NYSDEC Regional Office (Environmental Remediation, Spill Prevention and Response), and the local fire department. The Letters shall include the dates that work will occur in contaminated areas, work locations, soil storage/stockpile locations, and the name, field office address and phone number of the Engineer. The Contractor shall provide the Engineer with a copy of the Letters sent to the NYSDEC and fire department.

205-3.02 Segregation and Storage. The Contractor shall have an accepted CMHP prior to commencing work within potentially contaminated soil areas. Contaminated soil areas are identified in the contract documents. Soil determined to be contaminated (by PID/FID screening or observation) shall be segregated from non-contaminated soil and stored pending sampling, analysis and disposal. If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil. The Contractor shall notify the Engineer immediately if soil is discovered that appears to contain unknown contaminants or soil that varies significantly from the type of contamination identified in the contract documents. The Department will determine the preliminary regulatory classification of the suspect soil and will determine how the soil is to be managed.

The Contractor shall not store contaminated soil for more than 40 calendar days, with this time limit beginning on the first day soil is placed in a stockpile, truck-bed or roll-off container. If the Engineer approves additional storage time for soil determined to be contaminated non-hazardous industrial waste, the Contractor shall also request approval from NYSDEC for any storage greater than 60 calendar days. If the Engineer approves additional storage time for soil determined to be RCRA regulated hazardous waste, the Contractor shall also obtain approval from NYSDEC for any storage greater than 90 calendar days. Contaminated soil may be placed in stockpiles, trucks or roll-off containers as follows:

**A. Stockpiles.** The Contractor shall prepare and maintain stockpiles as follows:

1. **Preparation of Stockpile Areas.**
   • The area shall be graded to provide positive drainage away from intended stockpile locations.
   • All stones, roots, debris and other objects that may puncture polyethylene ground protection shall be removed.
   • The ground surface where soil will be stockpiled shall be covered with a minimum of 10-mil or 2 layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
   • Stockpile locations shall be within the right-of-way and accepted by the Engineer prior to use.

2. **Stockpile Protection.**
• At the end of each work day, contaminated soil stockpiles shall be completely covered with a minimum of 10-mil or 2 layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
• Stockpile covers shall be weighted or secured by appropriate means to prevent tearing or removal by weather conditions.
• Stockpiles shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.

• Stockpile covers, site grading, signing and security measures shall be properly maintained for the duration of storage.
• Damaged covers and other protections shall be repaired or replaced by the Contractor within 24 hours after notification. If this work is not satisfactorily completed within 24 hours, no further stockpiling shall be allowed until such work is completed.

B. Trucks or Roll-off Containers. The Contractor shall prepare and maintain trucks and roll-off containers as follows:
• The interior of truck-beds and roll-off containers shall be lined with 10-mil or 2 layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
• At the end of each work day, trucks and roll-off containers storing soil shall be completely covered with waterproof tarpaulins. Tarpaulins shall be placed over the top of the truck bed or container (rather than over the soil inside) and shall extend over the sides to prevent water accumulation and the evaporation of contaminants.
• Tarpaulins shall be weighted or secured by appropriate means to prevent tearing or removal by climatic conditions.
• Trucks and roll-off containers shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.
• Trucks, roll-off containers and tarpaulins shall be properly maintained for the duration of soil storage.
• Damaged tarpaulins and protections shall be repaired or replaced by the Contractor within 24 hours after notification. If this work is not satisfactorily completed within 24 hours, no further soil storage shall be allowed until such work is completed.
• Trucks and roll-off containers storing contaminated soil shall be located as described in CMHP.

205-3.03 Field Organic Vapor Monitoring. The Contractor shall hire an independent firm to perform field organic vapor monitoring in accordance with the accepted FOVMP. The individual conducting the monitoring, hereafter referred to as the Field Monitor, shall be experienced and thoroughly trained in sampling protocols, organic vapor monitoring procedures, and equipment calibration procedures. The Field Monitor shall screen potentially contaminated soil during excavation using field vapor monitoring equipment (PID/FID) and visual observations. Based on the screening results, the Field Monitor shall direct the Contractor on the proper segregation of the material.

Field organic vapor monitoring shall be conducted when working in the contaminated soil areas identified in the contract documents, or whenever unusual or suspicious soil conditions based on visual or odor evidence are encountered during excavation. The Contractor or Field Monitor shall notify the Engineer immediately if soil is discovered that appears to contain unknown contaminants or soil that varies significantly from the type of contamination identified in the contract documents. (For health and safety reasons, personnel shall not evaluate odor by placing soil directly to the nose or by inhaling vapors from grab or bag samples).
The Field Monitor shall calibrate the PID/FID on a daily basis prior to starting field work and shall determine a background measurement. Excavated soil shall be tested with the PID/FID at intervals that will ensure the soil is being properly assessed for contamination. The PID/FID will be used to take head space readings from bag samples with the soil temperature at least \(50^\circ\text{F}\). The Field Monitor shall maintain detailed and legible field notes indicating work locations, nature of work being performed, PID/FID head space readings, time of readings, pertinent measurements, visual and odor observations, quantities of both contaminated and non-contaminated soils excavated at each location, storage/stockpile locations, work hours, weather conditions, and any unusual conditions encountered. The Contractor shall provide the Engineer with a copy of all field notes within 5 work days from their recording.

The segregation threshold established below (25ppm) is based on gasoline being the predominant contaminant. If a different contaminant(s) is present or suspected, a different segregation threshold may need to be established. Alternative segregation thresholds may be designated in the contract documents.

PID/FIDs detect and measure gas concentrations (specifically volatile organic compounds); they do not quantify or identify the contaminants in the soil. Therefore, PID/FID readings can not determine specific contaminant concentrations within the soil.

Segregate soil as follows:

**A. Non-Contaminated Soil.** Soil with PID/FID head space readings less than 25 ppm and exhibiting no other evidence of contamination (visual or olfactory evidence) shall be considered non-contaminated. Unless further analysis is performed for confirmation of the non-contaminated soil, this soil will be considered uncontaminated.

**B. Contaminated Soil.** Soil with PID/FID head space readings equal to or greater than 25 ppm and/or soil exhibiting other evidence of contamination (visual or olfactory evidence) shall be considered contaminated. This soil shall be segregated from non-contaminated soil and placed in stockpiles or containers. If sampling and analysis provisions are included for the segregated soil, the results of laboratory analysis will be used to determine its regulatory classification. If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil.

**205-3.04 Sampling and Analysis.** The Contractor shall have an accepted Sampling Plan prior to commencing work within potentially contaminated areas. Sampling shall be conducted by individuals thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements. Accepted sampling practices shall be used to obtain representative composite sample(s) and/or grab sample(s) as required for the specific analyses to be completed. Representative samples shall be collected from stored soil as soon as possible after excavation. Soil shall be taken from a depth greater than one foot within the stockpile. Each composite sample shall include a minimum of four sample points. Grab samples shall be collected in a manner so as to best characterize the extent of contamination of the soil in question and best characterize the extent of contamination of the pile. If any soil areas are present with field indications of contamination discretely different than the other areas (i.e., significantly elevated PID/FID readings, staining, etc.), the area may require a separate sample and the Engineer shall be alerted to approve additional sample and analysis. Analyses shall be completed at a NYSDOH ELAP accredited laboratory that is certified to perform the required tests. Analyses shall be completed within 10 work days of sample collection. The Contractor shall provide the Engineer with a copy of all reports within 2 work days of their receipt from the laboratory.

Soil shall not be added to any stockpile, truck or roll-off container after its contents have been sampled. If soil is added after sampling, or sampled soil is otherwise tampered with, the Contractor shall re-sample the soil at no additional cost to the State.

Conduct specified analyses as follows:
A. Petroleum Contamination Parameter Analysis. Samples shall be analyzed for petroleum contamination constituents (total constituent analysis) in accordance with CP – 51/Soil Cleanup Guidance, Gasoline and Fuel oil, Tables 2 and 3 using USEPA Method 8260 for volatile organics and methyl t-butyl ether (MTBE) and USEPA Method 8270 for base/neutrals.

B. Hazardous Waste RCRA Toxicity Characteristic Analysis. Samples shall be analyzed for Hazardous Waste RCRA Toxicity Characteristics Leaching Procedure (TCLP) constituents. Analysis shall be for full TCLP constituents on the sample extract as prepared by USEPA Method 1311.

C. Ignitability of Solids Analysis. Samples shall be analyzed for ignitability by USEPA Method 1030.

D. pH of Soil and Waste. Samples shall be analyzed for pH measurement by USEPA Method 9045.

E. Polychlorinated Biphenyls (PCB) Analysis. Samples shall be analyzed for PCBs by USEPA Method 8082.

F. Total Petroleum Hydrocarbons (TPH) Analysis. Samples shall be analyzed for petroleum hydrocarbons, USEPA Method 8015, gasoline range organics (GROs) and/or diesel range organics (DROs).

205-3.05 Transportation and Disposal. The Contractor shall have an accepted Disposal Plan prior to the transportation and disposal of contaminated soil. Contaminated soil shall not be transported until all sampling and analysis, as required by the Department or by the Disposal facility, have been performed and laboratory reports have been provided and accepted by the Department.

A. Transportation Off Site.
1. For the duration of transportation, roll-off containers and truck beds shall be completely covered with secured waterproof tarpaulins to prevent water infiltration, evaporation of contaminants and spillage of contaminated soil.
2. The Contractor shall take immediate action to remedy any situation involving a release of contaminated soil during loading or while in transit.
3. Contaminated soil shall not be combined with material from any other source.
4. Contaminated soil shall be transported in vehicles with valid Waste Transporter permits for New York State (and other required permits/licenses from any other states as applicable). The Contractor shall provide a copy to the Engineer of the waste transporter permit documenting that the transporter is authorized to transport waste to the intended disposal/treatment facility. The Contractor shall complete any required shipping papers, labeling, placarding, and weighing/load measurements and shall provide copies of required documentation to the Engineer.
5. Contaminated soil that is determined to be a regulated hazardous waste per the criteria of 6 NYCRR Part 371 shall be shipped with a hazardous waste manifest to a treatment/disposal facility permitted to accept the waste. The Contractor shall complete all required manifests, labeling, placarding, land disposal restriction notifications, and other requirements for shipping and tracking hazardous wastes and shall provide copies of required documentation to the Engineer. The Engineer will provide the Contractor with the EPA Identification Number(s) issued to the Department as the hazardous waste generator and will sign the generator certification statements.

B. Disposal/Treatment. Contaminated soil shall be disposed of by the methods and procedures described in the accepted Disposal Plan. Soil characterization information, field identification and confirmation laboratory analyses, if included in the contract, will be used to determine appropriate
classification and category of soil for disposal. Each category of surplus or waste soil shall be handled and disposed of based upon its characterization in accordance with the requirements outlined in §107-10 Managing Surplus Material and Waste for the following categories:

- Uncontaminated Soil;
- Contaminated Non-hazardous Industrial Waste; or
- Hazardous Waste regulated by 6 NYCRR Part 371

Soils characterized as contaminated as Hazardous Waste or as Non-hazardous Industrial Waste shall be disposed of and paid for per the items 205.0501 and 205.0502 respectively.

Contaminated soil shall be transported to a disposal/treatment facility within 40 calendar days from the start of storage. The Contractor shall complete under this item any soil sampling and analysis required by the disposal/treatment facility that is not specifically included in the contract.

C. Documentation. The Contractor shall provide the Engineer with copies of all receipts from the disposal/treatment facility which indicate the actual quantity of waste received within 2 work days of receipt from the facility. For soil determined to be RCRA regulated hazardous waste, the Contractor shall also provide the Engineer with the appropriate copies of each signed manifest within 2 work days of receipt. Any manifest discrepancies, including the need for exception reporting, shall be reported immediately to the Engineer and shall be resolved by the Contractor.

205-3.06 Reuse of Contaminated Soil. The Contractor shall place contaminated soil as embankment, fill or other appropriate on-site use as determined and approved by the Department, and in accordance with the contract documents. Only appropriate soils placed in appropriate locations as included in the contract documents shall be reused.

205-4 METHOD OF MEASUREMENT.

205-4.01 General. (Vacant)

205-4.02 Segregation and Storage. The work under segregation and storage will be measured for payment on a lump sum basis.

205-4.03 Field Organic Vapor Monitoring. The quantity for payment will be in hours of field organic vapor monitoring performed, measured to the nearest one-half hour.

205-4.04 Sampling and Analysis. The quantity to be measured for payment will be the number of soil samples analyzed as included in the contract documents.

205-4.05 Transportation and Disposal. The quantity to be measured for payment will be in tons of contaminated soil transported to a disposal/treatment facility, measured to the nearest 0.1 ton. If measurement of the contaminated soil by weight is not feasible, a conversion factor of 1.4 tons per cubic yard will be used to determine the quantity for payment.

205-4.06 Reuse of Contaminated Soil. The quantity to be measured for payment will be in cubic yards of contaminated soil stockpiled for reuse, computed to the nearest whole cubic yard.

205-5 BASIS OF PAYMENT. The price bid shall include the cost of all labor, materials and equipment necessary to complete the work. Excavation will be paid for separately.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>205.02nn</td>
<td>Segregation and Storage of Contaminated Soil</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>
205.03 Field Organic Vapor Monitoring of Contaminated Soil Hour
205.0401 Petroleum Contamination Parameter Analysis Each
205.0402 Laboratory Analysis for Hazardous Waste RCRA Toxicity Characteristic Each
205.0403 Laboratory Analysis for Ignitability Each
205.0404 Laboratory Analysis for pH Each
205.0405 Laboratory Analysis for Polychlorinated Biphenyls (PCB's) Each
205.0406 Laboratory Analysis for Total Petroleum Hydrocarbons– Gasoline Range Organics Each
205.0407 Laboratory Analysis for Total Petroleum Hydrocarbons– Diesel Range Organics Each
205.0501nn Disposal of Contaminated Hazardous Waste Soil Ton
205.0502nn Disposal of Contaminated Non-Hazardous Waste Soil Ton
205.06nn Reuse of Contaminated Soil Cubic Yard

Note: nn denotes serialized pay item for each discrete contaminated area of property as indicated on the plans. The serialized items allow for different plans and different disposal procedures for discretely different areas and nature of the contamination.

SECTION 206 - TRENCH, CULVERT AND STRUCTURE EXCAVATION

206-1 DESCRIPTION

206-1.01 General. This work shall consist of the excavation of materials and backfill or disposal of excavated material required for trenches, culverts, structures, conduit and direct burial cable not otherwise provided for in other sections of these specifications. All such excavation shall be unclassified excavation as defined in §203-1.01. The work shall be conducted in accordance with 29 CFR 1926 Subpart P.

206-1.02 Structure Excavation. The work specified under this item shall include the excavation for all bridge foundations, walls and other major structures and backfill of suitable excavated material if another item is not specified.

206-1.03 Trench and Culvert Excavation. The work specified under this item shall include the excavation of all materials and backfill or disposal of excavated material required for trenches, culverts, pipes, manholes, drainage structures and other minor structures, conduit and direct burial cable.

206-1.04 Conduit Excavation and Backfill including Surface Restoration. The work specified under this item shall include the excavation, necessary backfill and surface restoration required for conduits and direct burial cables.

206-1.05 Test Pits. The work specified under this item shall include the excavation and backfill of test pits at locations shown in the contract documents, or as directed by the Engineer. Excavation and backfill methods, limits and equipment used shall be approved by the Engineer. This work will not relieve the contractor of the responsibility to locate underground facilities as required under 16 NYCRR 753.

206-2 MATERIALS. (Not Specified).

206-3 CONSTRUCTION DETAILS

206-3.01 General. The appropriate construction details specified for “Excavation and Embankment” in §203-3.01 through §203-3.14 shall apply to the work specified in this section.

The excavation shall be dewatered and kept free from water, snow and ice when necessary.

Special care shall be taken not to disturb the bottom of the excavation, and not to remove the material
at final grade until just before the structure is placed.

The provisions of §203-3.01D Suitable Materials and/or §203-3.01E Unsuitable Materials shall apply to all material excavated under this section which is not used as backfill.

The Contractor shall carry out all excavation operations in a safe and prudent manner so that the workers, the public, and adjacent public and private property will be protected from unreasonable hazard in accordance with §107-05K. Open Excavations and Trenches.

Slopes may not be steeper than allowed by 29 CFR 1926 Subpart P.

When excavation is required for the installation of conduit or direct burial cable, the Contractor shall notify the Engineer upon completion of the excavation. No conduit or cable shall be placed in the excavation until the Engineer has approved the depth and cross-section.

When the Contractor, in placing conduits, direct burial cable or utilities, excavates into the pavement, subgrade, subbase, or shoulder courses, such courses must be replaced in kind, character and condition, to maintain a uniform road section, except when the Contract Documents specify that other materials shall be used.

206-3.02 Structure Excavation. The Contractor’s competent person shall verify field conditions, including excavation depth, groundwater, and soil conditions with the Engineer in accordance with 29 CFR 1926 Subpart P prior to performing structure excavation for all bridge foundations, walls and other major structures.

The Contractor shall backfill with suitable excavated material if a separate backfill item is not specified in the contract documents.

206-3.03 Trench and Culvert Excavation. The Contractor’s competent person shall verify field conditions, including excavation depth, groundwater, and soil conditions with the Engineer in accordance with 29 CFR 1926 Subpart P prior to performing trench and culvert excavation.

For utility lines, exclusive of conduit and cable lines, of less than 12 inches in diameter, the excavation width shall be the actual bottom width necessary to properly perform the installation work required, or 3 feet, whichever is less.

206-3.04 Conduit Excavation and Backfill including Surface Restoration. When the Contractor is required to excavate through Portland cement concrete, asphalt concrete, composite pavement, or sidewalk, a saw cut shall be made along neat lines and to the depth as shown in the contract documents or as directed by the Engineer.

Any damage to existing pavement, sidewalk, curb or other facilities caused by the Contractor’s operations under this item shall be repaired by the Contractor at no additional cost to the State.

206-3.05 Test Pits. The Contractor shall excavate and backfill test pits in order to determine existing underground utility type, size and/or condition where new utility connections to existing facilities are proposed. The Contractor shall excavate and backfill test pits in a manner approved by the Engineer that prevents damage to wrappings, coatings or other protective coverings, such as by hand digging, vacuum excavation or similar non-destructive locating equipment. The limits of the excavation shall be those sufficient to determine existing utility type, size and/or condition.

206-4 METHOD OF MEASUREMENT

206-4.01 General. The quantity of excavation will be in cubic yards, to the nearest whole cubic yard, computed from payment lines shown on the plans or the appropriate standard sheets. Work performed beyond any designated payment line will not be included in the computation of quantities for the item involved.

206-4.02 Structure Excavation. Vacant.
206-4.03 Trench and Culvert Excavation. Unless otherwise shown or indicated on the contract plans, payment lines for excavation of pipe and culvert lines, and minor structures will be determined as follows:

A. Bottom Payment Line. The elevation of the bottom payment line will be the invert elevation of the pipe, conduit, or culvert. For pipes, conduits, or culverts of nominal horizontal dimensions of 12 to 144 inches, the width of the excavations at the bottom payment line will be the nominal inside horizontal dimension of the pipe, conduit, or culvert plus 4 feet, or three (3) times the nominal inside horizontal dimension, whichever is less; for pipes with a nominal horizontal dimension greater than 144 inches the width will be as shown on the appropriate standard sheets or in the contract documents. For concrete and smooth interior corrugated polyethylene pipe, twice the minimum wall thickness will be added to the preceding. For concrete pipe, the bottom payment line is the Bedding Control Line shown on the applicable standard sheet.

B. Top Payment Line. The top payment line will be the surface at the centerline of the pipe, culvert or conduit immediately prior to commencing trench excavation.

C. Side Payment Lines. The side payment lines of the excavation will be vertical to the bottom payment line.

For utility lines, exclusive of conduit and cable lines, of less than 12 inch diameter, the excavation width will be the actual bottom width necessary, as determined by the Engineer, to properly perform the installation work required, or 3 feet, whichever is less.

D. Payment Lines for Minor Structures. Payment lines for minor structures will be vertical from the bottom of the footing and will extend vertically from a line 2 feet from the perimeter of the structure footing. The top payment line shall be the same as for (B) above. The bottom payment line will be the bottom of footing elevation, or the bottom of undercut elevation as directed by the Engineer.

206-4.04 Conduit Excavation and Backfill including Surface Restoration. The quantity of conduit and/or cable excavation and backfill including surface restoration for payment will be the number of linear feet measured along the center of the conduit and/or cable placed, in accordance with the methods stated below.

Wherever a pair or group of conduits and/or cables are physically connected together, they will be considered as a single conduit and/or cable.

A. Wherever conduit and/or cable in the same trench are physically separated laterally by 6 inches or more between centerlines, as shown on the plans or as directed by the Engineer, the linear feet measurement will be made along the center of each conduit and/or cable.

B. Wherever a pair or group of conduits and/or cable in the same trench are physically separated laterally by less than 6 inches between centerlines of adjacent conduit and/or cable, as shown on the plans or as directed by the Engineer, the linear feet measurement for those conduits and/or cable will be made along the center of that pair or group of conduit and/or cables.

206-4.05 Test Pits. The quantity to be measured for payment will be the number of test holes excavated and backfilled in accordance with the contract documents.

206-5 BASIS OF PAYMENT

206-5.01 General. The cost for necessary guarding to protect the public from open trenches, and that required for the protection to ensure the safety of the workers, and for any necessary excavation support
shall be included in other items. Progress payments will be made after the excavation has been completed and prior to the completion of other work included under this item, including but not limited to pumping and backfilling. Payment will be made, at the unit price bid, for 75% of the quantity excavated within the prescribed payment lines. The balance of the quantity excavated will be paid for upon proper completion of backfill placement.

No extra payment will be made for the cost of any materials excavated or placed outside the payment lines shown on the plans or as described in this specification. No extra payment will be made for excavation protection or support systems not shown in the contract plans, unless use of such systems is directed by the Engineer.

With exception of the Conduit Excavation and Backfill including Surface Restoration item, the work of replacing pavement, subcourses and shoulder courses will be paid for and performed under the provisions of their respective items and subsections.

206-5.02 Structure Excavation. The unit price bid for this work shall include the cost of labor, materials and equipment required to satisfactorily complete the work including the costs of excavation, backfill (except select backfill paid for separately), disposal of excavated material, presplitting rock excavations where required, and keeping the site dewatered and free from earth, water, ice and snow where necessary. Payment for Sheeting, Cofferdams or Temporary Water Diversion Structures required by the contract documents will be made in accordance with the appropriate item.

Where cofferdams are specified for structure excavation, the work required to keep the site free from earth, water, ice and snow shall be included in the item for cofferdams when necessary.

206-5.03 Trench and Culvert Excavation. The unit price bid for this work shall include the cost of labor, materials and equipment required to satisfactorily complete the work, including the costs of excavation, backfill (except select backfill paid for separately), disposal of excavated material, presplitting rock excavations where required, and keeping the site dewatered and free from earth, water, ice and snow when necessary.

206-5.04 Conduit Excavation and Backfill including Surface Restoration. The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily excavate and backfill the trench, including sawcutting, and to restore and replace any pavement, shoulder, and sidewalk courses, subcourses, curbs, drives, lawns and other top surfaces as required to complete the work.

206-5.05 Test Pits. The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily excavate and backfill the test pit and replace any pavement, shoulder and sidewalk courses, subcourses, curbs, drives, lawns and other top surfaces required to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>206.01</td>
<td>Structure Excavation</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>206.0201</td>
<td>Trench and Culvert Excavation</td>
<td>Cubic Yard</td>
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<tr>
<td>206.03</td>
<td>Conduit Excavation and Backfill including Surface Restoration</td>
<td>Foot</td>
</tr>
<tr>
<td>206.05</td>
<td>Test Pit Excavation</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTION 207 - GEOSYNTHETICS

207-1 DESCRIPTION
207-1.01 Geotextiles. The work shall consist of furnishing and installing approved Geotextile of the Class and Type indicated, at the locations, and in the manner shown on the plans or as directed by the Engineer, in writing, prior to performing the work.

207-1.02 Geomembranes. The work shall consist of furnishing and installing approved Geomembrane, including the preparation of the surface upon which the Geomembrane is placed, at the locations and in the manner shown on the plans or as directed by the Engineer, in writing, prior to performing the work.

207-1.03 Prefabricated Composite Drains for Structures. The work shall consist of furnishing and installing an approved Prefabricated Composite Structural Drain (PCSD) or Prefabricated Composite Integral Abutment Drain (PCIAD) as specified at the location(s) shown on the contract documents or as directed by the Engineer, in writing, prior to performing the work.

Prior to installation, the Contractor shall furnish the Engineer with copies of the manufacturer’s literature with details and installation requirements for the PCSD or PCIAD. If not included in the manufacturer’s literature, a letter identifying the geotextile wrap shall also be provided to the Engineer.

207-2 MATERIALS. Materials shall meet the requirements specified in the following subsections of Section 700 – Materials.

<table>
<thead>
<tr>
<th>Geotextiles</th>
<th>§737-01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotextile Bedding</td>
<td>§737-01 A.</td>
</tr>
<tr>
<td>Geotextile Separation</td>
<td>§737-01 B.</td>
</tr>
<tr>
<td>Geotextile Drainage</td>
<td>§737-01 C.</td>
</tr>
<tr>
<td>Geotextile Slope Protection</td>
<td>§737-01 D.</td>
</tr>
<tr>
<td>Geotextile Stabilization</td>
<td>§737-01 E.</td>
</tr>
<tr>
<td>Turbidity Curtain</td>
<td>§737-01 F.</td>
</tr>
<tr>
<td>Silt Fence</td>
<td>§737-01 G.</td>
</tr>
<tr>
<td>Geomembranes</td>
<td>§737-02</td>
</tr>
<tr>
<td>Prefabricated Composite Structural Drains</td>
<td>§737-04</td>
</tr>
<tr>
<td>Prefabricated Composite Integral Abutment Drains</td>
<td>§737-05</td>
</tr>
</tbody>
</table>

Materials shall be subject to the Department’s Quality Assurance (QA) program outlined in Section 737.

Adhesives used for joining geotextiles shall be fast-tacking, not be detrimental to the performance, lifespan or function of the geotextile, and create a bond strong enough to meet AASHTO M288 requirements for seam efficiency.

207-3 CONSTRUCTION DETAILS

207-3.01 Geotextiles

A. General. The Geotextiles shall be protected from exposure to sunlight during transport and storage. After placement, the Geotextile shall not be left uncovered for more than two (2) weeks.

Traffic or construction equipment will not be permitted directly on the Geotextile. Geotextiles may be joined by sewing, using adhesive or overlapping. Sewn seams shall be lapped a minimum of 4 in. and double sewn. The thread used to sew the seam shall be nylon or polypropylene. Geotextiles that are joined using adhesive shall be lapped a minimum of 4 in. Overlapped seams shall have a minimum overlap of 20 in. except when placed under water where the overlap shall be a minimum of 3 ft. All seams shall be subject to the approval of the Engineer. Geotextile which becomes torn or damaged due to the Contractor’s operations shall be replaced or patched at no cost to the State. The patch shall extend 3 ft. beyond the perimeter of the tear or damage.
B. Bedding and Slope Protection. The Geotextile shall be placed and anchored on a prepared surface approved by the Engineer. The Geotextile shall be laid loosely but in intimate contact with the soil so that placement of the overlying materials will not stretch or tear the Geotextile. Where Geotextile is placed above water, the backfill placement shall begin at the toe and proceed up the slope.

Where Geotextile is placed under water, the long dimension (provided that the width dimension is wider than the channel width) shall be placed parallel to the direction of flow. If the width dimension is not wider than the channel width, the long dimension shall be placed perpendicular to the direction of flow. Successive Geotextile sheets shall be overlapped so that the upstream sheet is placed over the downstream sheet. As the Geotextile is placed under water, the backfill material shall be placed on it to the required thickness. The Geotextile placement shall not progress more than 50 ft. ahead of the backfill placement.

Rip-rap, stone filling (Heavy) or stone filling (Medium) shall not be dropped onto the Geotextile from a height greater than 1 ft. Slope protection and smaller sizes of stone filling shall not be dropped onto the Geotextile from a height exceeding 3 ft.

C. Separation and Stabilization. The Geotextile shall be placed as directed by the Engineer. The Geotextile shall be laid loosely but in intimate contact with the soil so that placement of the overlying material will not stretch or tear the Geotextile.

D. Drainage. The Geotextile shall be placed to conform loosely to the shape of the trench. After placing the filter material, the Geotextile shall be folded over the top of the filter material to produce a minimum overlap of 12 in. The Geotextile shall then be covered with the subsequent course.

207-3.02 Geomembranes. The Geomembrane shall be protected during transport and storage. The surface upon which the Geomembrane is to be placed shall be within reasonable conformity to the proposed grade. Traffic or construction equipment will not be permitted directly on the Geomembrane. Care shall be exercised by workers when walking or working on the Geomembrane.

Seams shall be sealed as per the manufacturer’s recommendations and to the satisfaction of the Engineer. The edges of the Geomembrane shall be secured in the manner shown on the contract plans or as directed by the Engineer.

Geomembrane which becomes torn or damaged shall be replaced or patched as ordered by the Engineer. The patch shall extend 3 ft. beyond the perimeter of the tear or damage and the seams shall be approved by the Engineer.

207-3.03 Prefabricated Composite Drains for Structures. The Contractor shall install the drain in conformance with the manufacturer’s installation procedures. The drain shall be installed so that the backfill, when placed, will be in contact with the geotextile and forms a continuous drainage layer without interruption within the drain’s plane. In installations where concrete is to be poured against the prefabricated composite drain, only drains with impermeable cores will be allowed. At all locations, a positive outlet for the water in the drain shall be provided. This may involve making a hole in the core at the weep hole locations for approved drains with an impermeable core. Do not puncture the geotextile. Any damaged geotextile shall be repaired.

Adhesive shall be applied to the wall surface, and not directly to the drain.

During all periods of shipment and storage, the drain shall be wrapped and protected from direct exposure to sunlight, mud, dirt and debris.

Care shall be exercised while backfilling to prevent damage to the drain. Repairs or replacements of drain damaged by construction operations shall be performed, as directed by the Engineer, at no cost to the State.

207-4 METHOD OF MEASUREMENT
207-4.01 Geotextiles

A. General. The quantity of Geotextile will be the number of square yards computed from the payment lines indicated in the contract documents. Measurement will not be made for Geotextile used for repairs, seams, or overlaps. If taken, the amount of quality assurance samples will be added to this quantity.

B. Drainage. The quantity of Geotextile will be measured in area based on the theoretical perimeter determined from the typical section indicated in the contract documents.

207-4.02 Geomembranes. The quantity of Geomembrane will be the number of square yards computed from the payment lines indicated in the contract documents. Measurement will not be made for Geomembranes used for repairs, seams, or overlaps.

207-4.03 Prefabricated Composite Drains for Structures. The quantity of PCSD or PCIAD will be measured in square yards installed computed from the payment lines indicated in the contract documents.

207-5 BASIS OF PAYMENT

207-5.01 Geotextiles. The unit price bid shall include the cost of furnishing all labor, equipment, and materials necessary to complete the work, including the cost of preparing the surface upon which the Geotextile is placed. No payment will be made for replacement or repairs.

207-5.02 Geomembranes. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including the cost of preparing the surface upon which the Geomembrane is placed and securing the edges of the Geomembrane. No payment will be made for replacement or repairs.

207-5.03 Prefabricated Composite Drains for Structures. The unit price bid shall include the cost of furnishing all labor, equipment, and material necessary to complete the work. No payment will be made for repairs or replacement.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>207.20</td>
<td>Geotextile Bedding</td>
<td>Square Yard</td>
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<td>207.21</td>
<td>Geotextile Separation</td>
<td>Square Yard</td>
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<td>207.22</td>
<td>Geotextile Drainage</td>
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<td>Geotextile Slope Protection</td>
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<td>207.24</td>
<td>Geotextile Stabilization</td>
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<td>207.25</td>
<td>Geomembrane</td>
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<td>207.26</td>
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<tr>
<td>207.27</td>
<td>Prefabricated Composite Integral Abutment Drain</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

SECTION 208 - STORMWATER MANAGEMENT FACILITIES

208-1 DESCRIPTION. The work in this section shall include work required for stormwater management facilities.

208-2 MATERIALS. Materials shall be as specified in the special specifications.
208-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

208-4 METHOD OF MEASUREMENT. As specified in the special specifications.

208-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 209 - SOIL EROSION AND SEDIMENT CONTROL
(Last Revised January 2019)

209-1 DESCRIPTION. This work shall consist of furnishing, installing, inspecting, maintaining, and removing soil erosion and sediment control measures as shown on the contract documents and as directed by the Engineer.

209-1.01 Erosion Control. Erosion Control is any action taken to reduce soil erosion and control sedimentation, including the use of mulch, straw/wood fiber mulch, seed and mulch, seed and straw/wood fiber mulch, rolled erosion control products, soil stabilizers, and pipe slope drains.

209-1.02 Sediment Control. Sediment Control is any action taken to minimize suspended solid material transport by water, including the use of sediment traps, turbidity curtains, sediment filter logs, silt fence, check dams, drainage structure inlet protection, and stabilized construction entrance/exits.

209-2 MATERIALS.

209-2.01 General. None specified.

209-2.02 Mulch-Temporary. The materials shall meet the requirements of the following subsections of §700 Materials and Manufacturing.

- Straw 713-19
- Wood Fiber Mulch 713-11

209-2.03 Seed-Temporary. The materials shall meet the requirements of the following subsections of §700 Materials and Manufacturing.

- Seeds 713-04
- Water 712-01

Seed shall be ryegrasses (annual or perennial) or cereal grasses suitable for the area as a temporary cover and which will not compete with the grasses sown later for permanent cover.

209-2.04 Check Dams. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

- Stone Filling 733-21
- Coarse Aggregate 703-02
- Sediment Filter Logs 713-20
- Geotextile 737-01
A. **Stone Check Dams.** Stone filling shall meet the requirements of §733-21 *Stone Filling, Light* and/or §703-02 *Coarse Aggregate*, size designation 1 or 2 as described in Table 703-04.

Geotextile bedding shall conform to §737-01 *Geotextiles*, Table 737-01A – Bedding Geotextile Requirements.

B. **Gravel Bag Check Dams.**

1. **Bags.** Bags shall be fabricated from reinforced woven geotextile that meets the requirements of §737-01 *Geotextile* with a strength class 1 or 2 and shall include ties. No burlap bags shall be allowed.

2. **Gravel.** Coarse aggregate shall meet the gradation requirements of size designation #1 or #2 of Table 703-4 and shall be used as the fill material.

Gravel bags shall be individually tied and double bagged. The bag with fill material shall be inversely inserted into the second bag in order to prevent leakage.

C. **Prefabricated Check Dams.**

1. **Temporary Silt Dike.** Temporary silt dikes shall be triangular in cross section, and have a height of at least 10 inches in the center with two equal sides and a 18 inch to 24 inch base. The inner material shall be urethane foam. The outer cover shall be a woven bedding type geotextile (§737-01; Table 737-01A) wrapped around the inner triangle and shall extend 24 inches to 36 inches beyond each side of the triangle base.

   Wire staples used to secure the prefabricated check dam shall be No. 11 gauge wire and be 6 inches to 8 inches long.

   Stone shall meet the requirements of §703-02 *Coarse Aggregate*, size designation 1 as described in Table 703-4. Stone filling shall be placed over the geotextile apron. Refer to the standard sheets for additional information.

2. **Sediment Filter Logs.** The materials for prefabricated sediment filter logs check dams shall meet the requirements of §713-20 *Sediment Filter Logs*.

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**209-2.05 Linear Measures.** The materials shall meet the requirements of the following subsections of Section 700 *Materials and Manufacturing*.

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotextiles</td>
<td>737-01</td>
</tr>
<tr>
<td>Sediment Filter Logs</td>
<td>713-20</td>
</tr>
</tbody>
</table>

**A. Silt Fence-Temporary.** A silt fence assembly shall consist of silt fence geotextile, posts, and fasteners and may include mesh support consistent with the Approved List.

1. **Geotextile.** Silt fence geotextile shall meet the requirements of §737-01 *Geotextiles*, G. Silt Fence and be listed in the Approved List.

2. **Posts.** Posts shall meet the following requirements:

   - Wood posts shall have a minimum cross section area of 3.5 square inches; steel post shall be “T” or “U” shaped in cross section, with a minimum weight of 1.33 pounds per foot.
   - Posts shall be a minimum of 40 inches long and shall be spaced according to the geotextile selected, as indicated in the Approved List.

3. **Mesh Support.** For those silt fence geotextiles on the Approved List that require a mesh support, the support shall consist of 14 gauge (minimum) welded wire mesh with a maximum 6 inch by 6 inch opening or polymeric mesh. All mesh support shall be a minimum of 30 inches in height.
4. Fasteners. Fasteners shall be heavy duty staples, hog rings, tie wires, or any other fastener compatible with the post material.

B. Sediment Filter Logs. A sediment filter log assembly shall consist of the sediment filter log and posts.

1. Posts. Posts shall be nominal 2 x 2 wood. The length of posts shall be at least 16 inches greater than the diameter of the log.

209-2.06 Sediment Traps-Temporary. The materials shall meet the requirements of the following subsections of §700 Materials and Manufacturing:

<table>
<thead>
<tr>
<th>Stone Filling</th>
<th>733-21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotextile</td>
<td>737-01</td>
</tr>
</tbody>
</table>

A. Impervious Embankment Material. Impervious embankment material shall be §733-08 Embankment in Place, §733-10 Select Fill, §733-11 Select Granular Fill, or §733-12 Select Granular Fill Slope Protection, and the impervious embankment material shall have the following gradation:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 inch</td>
<td>90 – 100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>50 – 100</td>
</tr>
<tr>
<td>1/4 inch</td>
<td>40 – 90</td>
</tr>
<tr>
<td>#40</td>
<td>30 – 85</td>
</tr>
<tr>
<td>#200</td>
<td>25 - 75</td>
</tr>
</tbody>
</table>

B. Gravel Bags.

1. Bags. Bags shall be fabricated from reinforced woven geotextile that meets the requirements of §737-01 Geotextile with a strength class 1 or 2 and shall include ties. Burlap bags will not be allowed.

2. Gravel. Coarse aggregate used as fill material shall meet the gradation requirements of size designation 1 or 2 of Table 703-4.

Each gravel bag shall be individually tied and double bagged. The bag with fill material shall be inversely inserted into the second bag in order to prevent leakage.

C. Geotextile Bedding. The geotextile bedding material shall meet the requirements of §737-01 Geotextile, Table 737-01A. Bedding Geotextile.

D. Riser Pipe. Riser Pipe shall be 16 gauge corrugated steel, aluminum or polyethylene and perforated with 1 inch diameter holes or slits spaced 6 inches vertically by 6 inches horizontally and placed in the concave portion of the corrugations. No holes will be allowed within 6 inches of the outlet pipe.

E. Hardware Cloth. Hardware cloth wire shall meet ASTM A740-98 Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric), be 23 gauge (minimum) and have 1/4 inch or 1/2 inch openings.

F. Geotextile Drainage Fabric. The geotextile drainage fabric shall meet the requirements of §737-01 Geotextile, Table 737-01C Drainage Geotextile Requirements.
G. Steel Base Plates. Steel base plates shall be 1/4 inch minimum thickness.

H. Outlet Pipes. The outlet pipe shall be 12 inch 16 gauge corrugated steel pipe.

I. Stone Filling. Stone filling shall meet the requirements of §733-21 Stone Filling.

209-2.07 Pipe Slope Drain-Temporary. The materials shall meet the requirements of the following subsections of §700 Materials and Manufacturing.

- Smooth Interior Corrugated Polyethylene Pipe 706-12
- Corrugated Interior Polyethylene Pipe 706-14
- Corrugated Steel Pipe 707-02
- Corrugated Aluminum Pipe 707-13
- Stone Filling 733-21
- Coarse Aggregate 703-02
- Geotextile 737-01

A. Pipe. The pipe shall be corrugated plastic pipe per §706-14 or corrugated metal pipe (CMP) per §707-02 or 707-13 or other material as approved by the Engineer. The pipe shall have soil-tight or better connections. Refer to the standard sheets for direction on pipe sizes.

B. Gravel Bags.
   1. Bags. Bags shall be fabricated from reinforced woven geotextile that meets the requirements of §737-01 Geotextile with a strength class 1 or 2 and shall include ties. No burlap bags shall be allowed.

   2. Gravel. Coarse aggregate used as fill shall meet the gradation requirements of size designation 1 or 2 of Table 703-4.

   Each gravel bag shall be individually tied to prevent leakage.

C. Geotextile Bedding. Geotextile bedding shall meet the requirements of §737-01 Geotextile for Geotextile Bedding as described in Table 737-01A.

D. Crushed Stone or Stone Filling. Crushed stone or stone filling shall meet the requirements of §733-21 Stone Filling.

E. Sediment Filter Logs. A sediment filter log assembly shall consist of the sediment filter log and posts.

   1. Posts. Posts shall be nominal 2 x 2 wood. The length of posts shall be at least 16 inches greater than the diameter of the log.

Pipe slope drain materials may consist of new or used material in satisfactory condition. Pipe couplings shall be appropriate for the pipe and as recommended by the Manufacturer. End sections may be galvanized steel or aluminum.

209-2.08 Rolled Erosion Control Products and Soil Stabilizers. The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

- Rolled Erosion Control Products and Soil Stabilizers 713-07
The Type and Class shall be as specified in the contract documents.

**209-2.09 Construction Entrance/Exit-Temporary.** The materials shall meet the requirements of the following subsections of this Section and §700 Materials and Manufacturing.

- Straw 713-19
- Wood Fiber Mulch 713-11
- Seeds 713-04
- Water 712-01
- Coarse Aggregate 703-02
- Geotextiles 737-01

**A. Geotextile.** Geotextiles shall meet the requirements of §737-01 E. Geotextile Stabilization, Strength Class 1.

**B. Crushed Stone or Gravel.** Crushed stone or gravel shall meet the requirements of size designation #3 on Table 703-4.

**C. Drainage Pipes.** The drainage pipe may be steel, aluminum or polyethylene and consist of new or used material in satisfactory condition and suitable for the intended use.

**D. Fill Material.** Fill material shall meet the requirements of §733-08 Embankment In Place, §733-10 Select Fill, §733-11 Select Granular Fill, or §733-12 Select Granular Fill Slope Protection.


**209-2.10 Turbidity Curtain-Temporary.** The materials shall meet the requirements of the following subsections of §700 Materials and Manufacturing.

- Turbidity Curtain 737-01F.

The Turbidity Curtain shall be a commercially available, pre-assembled system, including a geotextile, flotation system, bottom weight, and anchoring and securing mechanism. If assembled in panels, it shall include a secure mechanism for joining panels together. Hemmed pockets shall be sewn or heat bonded to contain flotation material, bottom weights, and for anchor lines. The flotation material shall maintain buoyancy if punctured or cut. The bottom weight shall be sufficient to hold the curtain in a vertical position. For sites not subject to tidal or heavy wave action, the curtain shall be capable of molding to conform to bottom contours so that suspended sediment is prevented from escaping underneath the curtain. Anchorage lines shall be provided of sufficient strength and number to support the curtain and maintain it in position under normally expected conditions. End anchors shall be provided, with intermediate anchor points (for stakes or anchors) such that unanchored spans do not exceed 100 feet, sufficient to maintain the turbidity curtain in place. Where the turbidity curtain is constructed in panels, anchor-line and shackle connections securing the panels together shall be sufficient for normally expected current, wind, or wave conditions.

**209-2.11 Drainage Structure Inlet Protection-Temporary.** The materials shall meet the requirements of the following subsections of Section 700 Materials and Manufacturing.

- Coarse Aggregate 703-02
- Geotextiles 737-01
Sediment Filter Logs

A. Silt Fence. Geotextile shall meet the requirements of §737-01 G. Silt Fence and be listed in the NYSDOT Materials and Equipment Approved List (Approved List). Drainage Structure Inlet Protection assembly shall consist of silt fence geotextile, posts, frame and fasteners and may include mesh support consistent with the Approved List.

1. Post/Frame. Shall be 2 inch by 4 inch nominal dimension wood posts a minimum of 40 inches long.

2. Mesh Support. For those silt fence geotextiles on the Approved List that require a mesh support, the support shall consist of 14 gauge (minimum) welded wire mesh with a maximum 6 inch x 6 inch opening or polymeric mesh. All mesh support shall be a minimum of 28 inches in height.

3. Fasteners. Fasteners shall be heavy duty staples, hog rings, tie wires, or any other fastener compatible with the post material.

B. Prefabricated. Prefabricated drainage structure inlet protection shall be a temporary silt dike or sediment filter log.

1. Temporary Silt Dike. Temporary silt dikes shall be triangular in cross section, and have a height of at least 10 inches in the center with two equal sides and a 18 inch to 24 inch base. The inner material shall be urethane foam. The outer cover shall be a woven bedding type geotextile (§737-01; Table 737-01A) wrapped around the inner triangle and extends 24 inches to 36 inches beyond each side of the triangle base.

   Wire staples used to secure the prefabricated check dam shall be No. 11 gauge wire and be 6 inches to 8 inches long.

2. Sediment Filter Logs. Sediment Filter Logs shall meet the requirements of §713-20 Sediment Filter Logs. A sediment filter log assembly shall consist of the sediment filter log and posts. Posts shall be nominal 2 x 2 wood and be at least 16 inches longer than the diameter of the log. Logs to be left in place will be noted on plans.

C. Concrete Block. Concrete blocks with holes used for inlet protection shall conform to the requirements of C 90 ASTM. Non-woven geotextile shall conform to the requirements described in §737-01C Drainage Geotextiles, Class A.

1. Crushed Stone. Crushed stone shall meet the gradation requirements of size designation 1 or 2 of Table 703-02.

2. Hardware Cloth. Hardware cloth wire shall meet ASTM A740-98 Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric), be 23 gauge (minimum) and have 1/4 inch or 1/2 inch openings.

3. Geotextile Drainage Fabric. The geotextile drainage fabric shall meet the requirements of §737-01 Geotextile, Table 737-01C Drainage Geotextile Requirements.

D. Excavated.

1. Geotextile. §737-01 Geotextile, Table 737-01C Drainage Geotextile, Class A.
2. Crushed Stone. §703-02 Coarse Aggregate, size designation 1 as described in Table 703-4.

209-3 CONSTRUCTION DETAILS.

209-3.01 General. In the event of conflict between these requirements and pollution control laws, rules, regulations or permit conditions by other federal or state agencies, the more restrictive shall apply.

Soil erosion and sediment control shall be performed consistent with §107-12 Water Quality Protection and included as part of the construction schedule submitted by the Contractor in accordance with §108-01 Start and Progress of Work.

To the extent practicable, this work shall be coordinated with other items of work specified elsewhere in the contract documents. The intent is to assure effective and continuous erosion and sediment control throughout the construction phase and post construction to reduce the impacts of soil loss on receiving waters and adjacent properties.

Sediment controls shall be installed prior to performing grubbing, excavation, and borrow or fill operations, except for those actions necessary to install the sediment controls. The Contractor shall limit the area of clearing and grubbing, excavation, borrow and embankment operations in progress commensurate with their capability to minimize erosion and sediment transport and keep the finish grading, mulching, seeding and other temporary and/or permanent control measures current in accordance with the approved schedule. The Engineer may determine that a potential for erosion or sediment transport exists and direct the Contractor to install temporary erosion controls earlier. When permanent soil erosion and sediment control measures cannot be installed due to seasonal or other limitations, temporary soil erosion and sediment control measures shall be installed. Prior to removing or disturbing any erosion or sediment control measure that may be required to be reestablished due to continual grading operations, the Contractor shall verify the proposed progression of operations and the reestablishment of control measures with the Engineer to ensure the continuity of erosion and sediment control. Sediment control measures shall not be removed without the Engineer’s approval.

A. Inspection and Maintenance. Soil erosion and sediment control measures shall be inspected and maintained by the Contractor for the duration of the contract, including winter shutdown, etc. Inspection and maintenance shall continue until after the permanent stabilization measures are established and the temporary control measures are removed. The remaining disturbed area shall be permanently stabilized in accordance with the contract documents.

All temporary controls shall be inspected by the Contractor at least every seven calendar days and after each runoff event to determine if the practice is functioning as intended. All inspections shall be completed within one calendar day.

Within 1 work day from completion of the inspection, the Contractor shall:

- Repair or rebuild the practice to function as originally intended.
- Remove sediment deposition which reaches one half the height of the practice.

All sediment removed during maintenance of the practice shall be considered unsuitable material and disposed of in accordance with §203-3.01E Unsuitable Material. Material shall be disposed of away from sensitive resources including wetlands, water courses or other bodies of water.

Where erosion control materials have been used on final grades that have been permanently seeded, the Contractor shall care for the areas until acceptance of the Contract or acceptance of the turf, whichever is later. Where necessary, such care may include, but is not limited to providing warning signs or barricades for protection against traffic. In addition to routine maintenance, any surface that has settled, become gullied, or otherwise damaged due to the Contractor’s operations shall be repaired at no additional expense to the state to reestablish the grade and soil conditions that existed prior to placing erosion control materials.
209-3.02 Mulch-Temporary. The Contractor shall have the capability to mulch any disturbed areas on any given day (e.g., those areas where earthwork operations are ongoing, etc.). The Contractor shall apply mulch on disturbed areas consistent with the approved project schedule or no later than seven days after grading. Straw mulch shall be spread uniformly in a continuous blanket at a rate of 2 tons per acre. Wood fiber mulch shall be applied at a rate of 1.5 tons per acre. Mulch may be spread by hand, mechanical spreaders, or blowers.

209-3.03 Seed and Mulch-Temporary. The Contractor shall apply seed and mulch on disturbed areas that will remain idle for more than fourteen days and regraded at a later date. The Contractor shall clean all equipment involved in seeding to remove all unwanted plants, seeds and propagules prior to starting work.

Prior to the application of seed, all areas where compaction has occurred shall be scarified. The seed bed shall be loose and friable for positive seed retention.

The Contractor shall spread ryegrass at a rate of 30 pounds per acre or cereal grasses spread at a rate of 100 pounds per acre to uniformly cover the ground. The Contractor shall evenly distribute seed by any method of sowing that does not injure the seeds in the process of spreading.

The Contractor shall spread mulch immediately following application of seed. If using straw mulch, it shall be spread uniformly in a continuous blanket at an approximate rate of 2 tons per acre by hand, or by mechanical spreaders or blowers. Mulch and seed shall not be placed simultaneously, except in the case of hydroseeding. The Contractor shall secure straw mulch to the soil surface by crimping or applying a soil stabilizer immediately after mulching, then water the seeded area. The application of water shall not result in damage to the seeded area including the redistribution of seeds (congregating seeds as a result of ponding or pooling water) or soil erosion (rilling).

The Contractor shall water the temporary seed and mulch area until seed has germinated. Maintenance of temporary seed and mulch areas shall include re-seeding, as necessary, to achieve temporary stabilization.

209-3.04 Check Dams. Check dams shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents. A bedding type geotextile (§737-01 Geotextiles) or stone (§733-21 Stone Filling, Light or §703-02 Coarse Aggregate) scour protection shall be placed as indicated in the contract documents.

Temporary Silt Dike check dams shall be attached to the ground with wire staples. Staples shall be placed according to Manufacturer’s instructions.

Sediment Filter Log prefabricated check dams shall be installed according to Manufacturer’s instructions. Sediment Filter Logs shall be removed at the end of the contract, unless noted otherwise in contract documents.

209-3.05 Linear Measures. Linear measures shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents.

A. Silt Fence-Temporary. Silt fence shall be removed when disturbed soil upslope of the practice has been fully stabilized with permanent vegetation, pavement or stone.

B. Sediment Filter Logs. Sediment filter logs shall be removed when disturbed soil upslope of the practice has been fully stabilized with permanent vegetation, pavement or stone, or sediment filter logs may be left in place on long or steep slopes to provide long-term runoff control. Logs to be left in place will be noted on plans.

209-3.06 Sediment Trap-Temporary. Sediment traps shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents.
The area under which the berm will be constructed shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared of woody vegetation. All work shall be performed in accordance with §201 Clearing and Grubbing and paid for separately.

A. Gravel Bag or Sediment Filter Log Berm. Gravel Bag or Sediment Filter Log Berms shall be constructed in accordance with the standard sheets and to the dimensions and locations shown in the contract drawings.

B. Earth Berm. The earth berm embankment shall be constructed consistent with the requirements of §203 Excavation & Embankment, except as herein modified. Immediately prior to placement of the impervious embankment material, the earth surface on or against which fill is to be placed, shall be thoroughly scarified to a depth of 6 inches and compacted to not less than 95 percent of Standard Proctor Maximum Density. Impervious embankment material shall then be deposited in lifts not exceeding 8 inches and compacted to not less than 95 percent of Standard Proctor Maximum Density. The moisture content of all impervious embankment material shall not be greater than 2 percent above Optimum Moisture Content as determined by AASHTO T-99 Standard Method of Test for Moisture-Density relations of Soils using a 5.5 pound Rammer and a 12 inch Drop, Method C at the time of compaction.

C. Riser and Outlet Pipe. The riser and outlet pipe shall be installed in accordance with the standard sheets and to the dimensions and locations shown in the contract documents.

209-3.07 Pipe Slope Drain-Temporary. Pipe slope drain shall be installed in accordance with the contract documents and standard sheets. Additional right-of-way may be required to accommodate this practice.

209-3.08 Rolled Erosion Control Products and Soil Stabilizers. Rolled Erosion Control products and Soil Stabilizers shall be installed or applied as specified in the contract documents and/or according to Manufacturer’s instructions. For areas at final grade, all loose stones, clods, sticks, or other undesirable material shall be removed in accordance with the Manufacturer’s recommendations or as specified in the contract documents. Where topsoil is specified, the rolled erosion control product will be installed within 2 work days of topsoil placement and soil stabilizers shall be applied according to Manufacturer’s instructions.

A. Rolled Erosion Control Products. Construct according to the Manufacturer’s recommendations and the following as minimum installation technique:

1. Class I and Class II, Rolled Erosion Control Products. Rolled erosion control products (RECP) shall be placed without stretching on the freshly prepared surface so that it lays loosely on the soil and in contact with the soil at all points; and then it shall be rolled or tamped firmly into the soil surface. The upper end of each roll shall be turned down and buried to a depth of 6 inches with the soil firmly tamped against it. RECP shall be placed so that all edges shall have a minimum overlap of 6 inches. RECP shall be held tightly to the soil by anchors driven firmly into the ground. Anchors shall be spaced not more than 40 inches apart on the sides and along the centerline of all drainage ways. Unless otherwise specified in the contract documents, lengths of rolled erosion control products shall not exceed 50 feet. If the RECP needs to be spliced in the middle of a slope be sure the RECP is “shingled” with the upgrade RECP overlapping the downgrade RECP. To continue the row downslope, a new section of fabric shall be applied by burying the fabric to a depth of 6 inches with the soil firmly tamped against it, and the upper section of fabric overlapping the downslope section by a minimum of 4 inches. Seams shall be staggered at alternating elevations. RECP ends and splices shall have anchors spaced at 24 inch intervals.
2. Class III Turf Reinforcement Mat (TRM). Type A and Type B TRMs shall be completely filled with topsoil immediately after installation. Type C and Type D TRMs, which contain a composite, do not need to be filled with topsoil unless recommended by the Manufacturer. To prevent initial soil loss, Type A and Type B TRMs shall be covered with one of the following materials, which will be paid for separately.

For Slope application:
1. Class IV-Soil Stabilizer
2. An approved RECP (Class I or II)
3. Mulch

For Channels:
1. An approved RECP (Class I or II)

B. Class IV Soil Stabilizers. These materials shall be applied as recommended by the Manufacturer. Type A & B are intended to be applied with hydroseeding equipment. Type B may also be placed through dry spreading. When dry spreading method is used, the Contractor shall apply the material uniformly. Where applied, Type A shall be a minimum of 1/4 inch thick. When Type A is used in conjunction with turf establishment, seeds must be sown separately and prior to the application of the soil stabilizer.

209-3.09 Construction Entrance/Exit-Temporary. Construction entrances/exits shall be placed where shown in the contract documents and constructed in accordance with the standard sheets, or as otherwise approved by the Engineer.

The Contractor shall grade, including excavating or placing fill, to prepare the original ground surface for the placement of a stabilized pad of at least 6 inches of coarse aggregate material, underlain by a geotextile. If necessary, a drainage pipe shall be installed to maintain the capacity of the ditch. The pipe dimension shall be consistent with the modified soil erosion and sediment control plan approved by the Engineer. All areas cut or filled and not stabilized by the construction Entrance/Exit material shall be covered with an erosion control treatment (temporary mulch, temporary seed and mulch, etc.) and shall be included in this pay item.

When wheel washing is performed, the washing area shall be located away from the construction entrance/exit in an area which will drain into an approved sediment control measure(s). The construction entrance/exit shall be maintained in a condition which will prevent tracking or flowing of sediment onto a paved public roadway. All sediment spilled, dropped, washed or tracked onto paved public roadway shall be removed immediately. In the event the entrance/exit is no longer performing properly (i.e. the entrance/exit aggregate becomes clogged with sediment), the Contractor shall top-dress the entrance/exit with additional coarse aggregate material.

209-3.10 Turbidity Curtain-Temporary.

A. Systems Requirements.

1. For sites not subject to tidal or heavy wave action, the curtain height shall provide sufficient slack to allow the top of the curtain to rise to the maximum expected high-water level (including waves), while the bottom maintains continuous contact with the bottom of the water body. The bottom edge of the curtain shall have a weight system capable of holding the bottom of the curtain down and conforming to the water body, so as to prohibit escape of turbid water under the curtain.

2. For sites subject to tidal or heavy wave action, the curtain height shall provide sufficient slack to allow the top of the curtain to rise to the maximum expected high-water level (including waves), while the bottom remains 24 inches above the bottom. The weight system shall hold the lower edge
of the curtain in place so as to allow 24 inches of clearance above the bottom at mean low water, so that the curtain does not stir up sediment by repeatedly striking the bottom.

3. If constructed in panels, panels shall be connected in such a manner as to prevent suspended particles passing through joints. Load lines shall be connected so as to develop the full strength of the line across the joint.

4. Flotation material shall be arranged so as to be flexible and to provide continuous support.

5. The flotation and curtain top shall be such as to provide a minimum of 4 inches of freeboard along the entire length of the curtain, to prohibit escape of turbid water over the top.

B. Installation

1. The turbidity curtain shall be installed as shown in the contract documents in accordance with the Manufacturer’s instructions. It shall be placed as close to the site of disturbance as possible without interfering with construction activity.

2. Turbidity curtain shall be installed and maintained in a manner that precludes passage of equipment, other than hand-held equipment or boats, to the water body outside the protected area.

3. The fully assembled turbidity curtain shall be prepared for installation by being furled and tied at intervals of 5 feet for the length of the curtain. It shall be placed and secured in the furled condition, then released to allow the bottom edge to sink.

4. At sites subject to tidal or heavy wave action, adjustment lines may be used to achieve the required height of the curtain.

5. At sites not subject to tidal or heavy wave action, excess curtain material shall lay on the bottom, away from construction activity.

6. Turbidity curtain shall be placed as nearly as possible parallel to current flow. It shall not be deployed across a flowing water course.

7. The ends of the installation shall be anchored securely well up the bank. Intermediate anchors of a type and number sufficient to hold the curtain in place under expected conditions shall be placed, and firmly fastened to the top of the curtain assembly. Maximum spacing between anchorage points shall not exceed 100 feet.

8. In situations with flow velocities that exceed 5 feet per second, use a redirection barrier. The redirection barrier shall be installed prior to installation of the turbidity curtain wherever possible, and care should be exercised in order to minimize disturbance of the bottom of the water body during installation of the redirection barrier.

C. Inspection and Maintenance

1. The turbidity curtain shall be inspected daily, with additional monitoring of performance during storms or significant flow events.

2. Any visible plume of turbid water passing beyond the curtain from the enclosed construction area shall constitute inadequate performance of the turbidity curtain. The Contractor shall
immediately modify, adjust, or repair any portion of the turbidity curtain to correct inadequate performance.

3. The turbidity curtain shall remain in place until the protected construction activities have ceased and there is no visible contrast between the water being contained and the water body being protected.

**D. Removal.**

1. The turbidity curtain shall be removed in such a way so as to minimize release of sediment.

2. Sediment behind the curtain may be removed before removal of the curtain, if directed by the Engineer. If so, any resulting turbidity must be allowed to settle before removal proceeds.

**209-3.11 Drainage Structure Inlet Protection-Temporary.** Drainage structure inlet protection shall be placed where shown in the contract documents and constructed in accordance with the standard sheets.

**209-4 METHOD OF MEASUREMENT.**

**209-4.01 General.** Vacant.

**209-4.02 Mulch-Temporary.** The quantity to be measured for payment will be in square yards to the nearest whole square yard of mulch-temporary installed.

**209-4.03 Seed and Mulch-Temporary.** This work will be measured in square yards to the nearest whole square yard of seed and mulch-temporary installed.

**209-4.04 Check Dam.**

**A. Check Dam – Temporary (Stone). Stone (Temporary and Permanent).** The work will be measured as the number of stone check dams installed.”

**B. Check Dam – Gravel Bag (Temporary).** The work will be measured as the number of each gravel bag check dam installed.

**209-4.05 Linear Measures.** The work will be measured as the number of linear feet to the nearest whole linear foot of silt fence or sediment filter logs installed. No additional measurement will be made for seams or overlaps.

**209-4.06 Sediment Traps-Temporary.** The work will be measured as the number of sediment traps installed.

**209-4.07 Pipe Slope Drains-Temporary.** The work will be measured as the number of pipe slope drains installed.

**209-4.08 Rolled Erosion Control Products and Soil Stabilizers.** The work will be measured as the number of square yards to the nearest square yard of rolled erosion control products and soil stabilizers installed.
209-4.09 **Construction Entrance/Exit-Temporary.** The work will be measured as the number of square yards to the nearest square yard of construction entrance/exit installed.

209-4.10 **Turbidity Curtain-Temporary.** This work will be measured in linear feet, to the nearest whole linear foot, of turbidity curtain installed.

209-4.11 **Drainage Structure Inlet Protection-Temporary.** This work will be measured as the number of linear feet to the nearest whole linear foot of drainage structure inlet protection installed. No additional measurements will be made for seams or overlaps.

209-5 **BASIS OF PAYMENT.**

209-5.01 **General.** The unit price bid for all work items shall include the cost of all labor, equipment, and materials necessary to satisfactorily complete the work, including the cost of removal of accumulated sediment.

Progress payments will be made for all sediment control measures as follows: Seventy-five percent of the price bid will be paid after installation of Check Dams, Silt Fence-Temporary, Construction Entrance/Exit-Temporary, Drainage Structure Inlet Protection-Temporary, Sediment Filter Logs and Turbidity Curtain-Temporary. Fifty percent of the price bid will be paid after installation of Sediment Traps and Pipe Slope Drains. The remaining percentage will be paid when the temporary practice is removed and the remaining area is permanently stabilized. Payment for Mulch-Temporary, Seed and Mulch-Temporary and Rolled Erosion Control Products and Soil Stabilizers will be paid in full after installation of the practice.

209-5.02 **Mulch-Temporary.** The unit price bid per square yard of mulch-temporary shall include the cost of all labor, equipment, and materials necessary to satisfactorily complete the work.

209-5.03 **Seed and Mulch-Temporary.** The unit price bid per square yard seed and mulch-temporary shall include the cost of all labor, equipment, and materials necessary to satisfactorily complete the work.

209-5.04 **Check Dams.** The unit price bid for check dams shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work.

209-5.05 **Linear Measures.** The unit price bid for silt fence-temporary or sediment filter logs shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

209-5.06 **Sediment Traps-Temporary.** The unit price bid for sediment traps-temporary shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work. Temporary seed and mulch and rolled erosion control product will be paid for separately.

209-5.07 **Pipe Slope Drains-Temporary.** The unit price bid for pipe slope drains-temporary shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work, including gravel bags, stone, sediment filter logs, manufactured silt dikes and/or other materials necessary to construct the practice.

209-5.08 **Rolled Erosion Control Products and Soil Stabilizers.** The unit price bid for rolled erosion control products and soil stabilizers shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work.

209-5.09 **Construction Entrance/Exit-Temporary.** The unit price bid for construction entrance/exit-temporary shall include the cost of all labor, material and equipment necessary to satisfactorily complete
the work. Payment will not be made for construction entrances associated with the Contractor’s facilities (e.g., staging areas, storage yards, borrow sites, etc.).

209-5.10 Turbidity Curtain-Temporary. The unit price bid for turbidity curtain-temporary shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

209-5.11 Drainage Structure Inlet Protection-Temporary. The unit price bid for drainage structure inlet protection – temporary shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

Payment will be made under:
Item No. Item Pay Unit

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<th>Item No.</th>
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<tbody>
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</table>
SECTION 210 - REMOVAL AND DISPOSAL OF ASBESTOS-CONTAINING MATERIAL (BUILDINGS, BRIDGES AND HIGHWAYS)

210-1 DESCRIPTION. This work shall consist of removal and disposal of asbestos-containing material (ACM) from locations designated in the Contract Documents and/or where directed by the Engineer. Additional contract-specific requirements may be found on the plans or in the proposal in a Special Note entitled "Asbestos Remediation Supplemental Requirements."

210-2 MATERIALS. All materials used in the performance of the work shall comply with all applicable regulatory standards. Respirators and filters shall comply with NIOSH and MSHA standards. HEPA filtration systems shall comply with ANSI Z9.2-79.

210-3 CONSTRUCTION DETAILS. Prior to beginning any work under this item, the Contractor shall supply the Engineer with proof that the firm performing the work has a valid asbestos handling license; that its insurance coverage whether provided by the Contractor or the Asbestos Subcontractor, is consistent with §107-06 Insurance and includes an asbestos-specific, occurrence-type policy with no deductible or sunset clause; that its project supervisor is a NYSDOL certified asbestos project supervisor; that all employees engaged in the work are properly certified and have current physical examinations and respirator fit tests; and that the proper notification of work beginning on the asbestos project has been given to the New York State Department of Labor (NYSDOL) and the United States Environmental Protection Agency (USEPA). The Contractor shall schedule a coordination meeting between the Asbestos Subcontractor and the Department contracted Asbestos Project Monitor to be held at least two (2) weeks before the start of any asbestos abatement work. The meeting shall be held at the Engineer’s Field Office unless otherwise approved by the Engineer.

The Contractor shall remove and dispose of ACMs in accordance with 12 NYCRR 56 or, if indicated, an approved variance thereof promulgated by the New York State Department of Labor (NYSDOL); the National Emission Standards for Hazardous Air Pollutants (NESHAP), promulgated by the United States Environmental Protection Agency (USEPA); and the Occupational Safety and Health Administration (OSHA). In the event of a conflict between these specification requirements and laws, rules and regulations of Federal, State, or local agencies, the more restrictive shall apply.

ACM shall be disposed of in accordance with 40 CFR Part 61 and all other requirements and laws, rules, and regulations of applicable Federal, State, or local agencies. Disposal sites which accept ACM for disposal shall be permitted by the New York State Department of Environmental Conservation (NYSDEC). If disposed of out-of-state, the rules, regulations, and laws of that state shall apply.

After the work is completed, the Contractor shall provide the Engineer with two copies of Daily Logs, Visitor Logs, Final Visual Inspection Logs and OSHA Air Monitoring records. The Contractor shall also provide the Engineer with a written certification that the material was disposed of in an approved waste disposal site. For friable waste this certification shall be in the form of a Waste Shipment Record. For
non-friable waste this certification shall include the name and address of the waste disposal site or sites used.

210-4 METHOD OF MEASUREMENT. The quantity of ACM to be measured for payment will be determined by one of the following methods:

210-4.01 Square Foot. The quantity to be measured will be the area, measured to the nearest 0.1 square foot, of asbestos-containing material removed and disposed of.

210-4.02 Foot. The quantity to be measured will be the length, measured to the nearest 0.1 foot, of asbestos-containing material removed and disposed of.

210-4.03 Lump Sum. The quantity will be measured for payment on a lump sum basis.

210-4.04 Fixed Price Lump Sum. The lump sum shown in the itemized proposal for this item will be considered the price bid even though payment will be made for the work performed. Should the amount shown be altered, the altered figures will be disregarded and the original price will be used to determine the total contract bid amount. Payments will be based on one or both of the following:

A. Agreed Price. An Agreed Price will be based on a cost analysis submitted by the Contractor and agreed to by the State prior to performing the work. The submittal shall include a detailed estimate from the licensed asbestos removal contractor for the cost of the removal and disposal.

B. Force Account. A separate Force Account will be maintained for the total asbestos removal work performed on each building, structure, or highway included in the work.

210-5 BASIS OF PAYMENT. Payment for the work under this specification shall include all labor, materials, equipment, and asbestos-related fees and insurances necessary to satisfactorily complete the work.

Payment shall not include Work Zone Traffic Control devices outside the regulated asbestos work area.

210-5.01 Square Foot, Foot, or Lump Sum Bid Items. Payment for 75% of the completed quantity will be made upon the Project Monitor's written concurrence with the Contractor's certification as to the following: that the building, structure, and/or highway is visually free of asbestos; that the removal of the asbestos containing material was performed as required; that the final clearance air monitoring results meet the acceptable level specified in 12 NYCRR 56; and, that the building(s), bridge(s), and/or highway(s) are certified by the asbestos Contractor to be available for normal demolition.

The remainder of the payment for completed work will be made upon receipt by the Engineer of a certified statement from the disposal facility, signed by an official thereof, that the asbestos-containing material has been accepted and disposed of in accordance with all applicable laws, codes, rules, and regulations.

210-5.02 Fixed Price Lump Sum. The fixed price lump sum published in the proposal is an amount estimated by the State to be adequate to complete the work. Payments under this work will be made by Force Account or by Agreed Price, or by a combination thereof.

Payment for 75% of the Agreed Price or Force Account charges will be made upon the Project Monitor's written concurrence with the Contractor's certification that the building, structure, and/or highway is visually free of asbestos; the removal of the asbestos containing material was performed as required; that the final clearance air monitoring results meet the acceptable level specified in 12 NYCRR
56; and, that the building(s), bridge(s), and/or highway(s) are certified by the asbestos Contractor to be available for subsequent demolition and/or construction.

The remainder of the payment for completed work will be made upon receipt by the Engineer of a written certification that the ACM was disposed of in an approved waste disposal site.

Asbestos-specific insurance premiums will be reimbursed as the actual and identifiable cost of the portion of the premium attributable to the work performed under the Fixed Price Lump Sum Item. No overhead or profit will be allowed on asbestos specific insurance premiums.

**Payment will be made under:**

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<tr>
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**Concrete Encased Pipe (Bridges & Highways)**

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**Underground Pipe (Bridges & Highways)**

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**Bond Breaker/Filler (Bridges & Highways)**

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**Caulking (Bridges & Highways)**

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**Miscellaneous (Bridges & Highways)**
SECTION 211 - INTERNALLY STABILIZED CUT STRUCTURES

211.1 DESCRIPTION. This work shall consist of designing, furnishing, installing, and testing an internally stabilized cut structure at the location(s) and to the elevation(s) shown in the contract documents.

211.1.01 Soil Nail Wall System. A Soil Nail Wall System is comprised of cement-grouted steel nail tendons, a drainage network and a facing system to internally stabilize a cut and/or underpin a structure.

A. Soil Nail Wall System (SNWS) Definitions.

1. **Soil Nail.** A passive reinforcing element which develops its reinforcing action through nail tendon/ground interaction. A soil nail includes the SNWS nail tendon, the SNWS nail head, grout, coatings, sheathing, couplers and encapsulation if used.

2. **SNWS Nail Tendon.** A steel bar installed into a slope to reinforce and strengthen the existing ground.

3. **SNWS Nail Head.** The nail head consists of the bearing plate and headed-stud. The bearing plate distributes forces at the nail end to the wall and ground behind the facing. The headed-stud provides anchorage of the nail head into the permanent facing.

4. **Grout.** Grout is used primarily as a transfer mechanism for stresses from the wall to the ground. The grout also provides a level of corrosion protection.

5. **Centralizers.** Centralizers are devices, typically PVC, installed at various locations along the length of the nail tendon to center the bar in the excavated hole to ensure a minimum thickness of grout cover.

6. **Corrosion Protection Elements.** These are physical and/or chemical coatings or systems used to inhibit corrosion. Nail tendons may have a fusion-bonded epoxy coating applied. For maximum protection, encapsulation consists of surrounding the nail tendon with a HDPE or PVC corrugated protective sheathing and filling the internal annulus with grout. Subsequent
to installing the encapsulated nail into the excavated hole, the outer annulus is also filled with grout.

7. **Temporary Wall Facing.** This consists of reinforced shotcrete installed to provide a connection between nail tendons, support the exposed soil within the nail tendon grid and provide protection against erosion and sloughing of the soil at the excavation face.

8. **Wall Drainage Network.** A system of drainage devices installed to prevent water pressure from developing behind the wall face. The system typically consists of a series of vertical geocomposite drainage strips and weep holes. Additional devices include footing drains and horizontal drains.


### 211-1.02 Grouted Tieback System

A Grouted Tieback System is comprised of cement-grouted steel tendons installed to internally stabilize and supplement the resisting force of an external support system retaining a cut and/or underpinning a structure.

#### A. Grouted Tieback System (GTS) Definitions.

1. **Grouted Tieback.** An active reinforcing element which transfers tensile loads from a structure to soil or rock. A grouted tieback includes all prestressing steel (tendon), the anchorage, grout, coatings, sheathing, couplers and encapsulation if used.

2. **GTS Tendon.** The steel used to transfer load from the anchorage to soil or rock.

3. **Anchorage.** That portion of the tieback, including bearing plate, nuts and wedges that is used to transfer load from the structure to a tendon.

4. **Bond Length (Fixed Length).** That portion of the tieback which is bonded to the soil or rock and transfers the tensile force from the tendon to the soil or rock.

5. **Tendon Bond Length.** The length of the tendon which is bonded to the grout. This is usually, but not necessarily, the same as the Bond Length.

6. **Stressing Length (Free Length).** That portion of the tendon which is not bonded to grout.

7. **Sheath.** That portion of the tieback which encases the tendon in the stressing length only.

8. **Encapsulation.** That portion of the tieback which encases or encapsulates the entire length of the tieback, including the sheath, to provide an additional barrier to corrosion.

9. **Pressure Grouting.** Grouting with a pressure greater than 50 psi.

10. **Alignment Load.** That load necessary to maintain position of the stressing and testing equipment.

11. **Total Movement.** The total elongation of the tieback under load, measured at the anchor head.

12. **Residual Movement.** The permanent set of the tieback resulting from stressing and releasing the tieback.

13. **Trumpet.** A steel pipe or tube, integrally attached to the bearing plate that surrounds the tendon in the vicinity of the structure.

14. **Creep Rate.** The magnitude of total movement measured during a load hold per log cycle of time.

15. **Centralizer.** A device used to center the bond length of the tieback in the hole to assure minimum grout cover over the tieback.

16. **Spacer.** A device used in strand tendons to separate each strand in the bond length to permit the grout to bond with each strand.

17. **GUTS.** The Guaranteed Ultimate Tensile Strength of the tendon.

### 211-2 MATERIALS

#### 211-2.01. Soil Nail Wall System (SNWS)

Ensure that the proper materials are supplied for the chosen system design.
A. SNWS Temporary. Provide materials meeting the following requirements:

1. **SNWS Soil Nail Tendon Assembly**. Provide components for assembling a soil nail tendon conforming to the requirements of §731-01 A. SNWS Temporary.

2. **SNWS Nail Grout**. Provide grout manufacture materials conforming to Table 211-1 SNWS Nail Grout Requirements:

<table>
<thead>
<tr>
<th>TABLE 211-1 SNWS NAIL GROUT REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Portland Cement, Type 1, 2, 3, or 5*</td>
</tr>
<tr>
<td>Flyash</td>
</tr>
<tr>
<td>Water</td>
</tr>
</tbody>
</table>

*Exception. Where high sulfate soil conditions exist, Portland Cement is limited to Type 2 or 5 only.

a. Admixtures. Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to review and acceptance by the Engineer. Acceptance will be based on the manufacturer’s name appearing on the Department’s Approved List. Accelerators and expansive admixtures are not permitted. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer’s recommendations.

3. **SNWS Shotcrete**. Provide shotcrete conforming to the requirements of Section 583 Shotcrete except that all mix designs must contain Blended Portland Cement (§701-03) Type IP containing silica fume.

4. **SNWS Welded Wire Fabric**. Provide welded wire fabric conforming to the requirements of §709-02 Wire Fabric for Concrete Reinforcement. Acceptance will be based on the manufacturer’s name appearing on the Department’s Approved List.

5. **SNWS Reinforcing Bars for Shotcrete Facing**. Provide No. 5 reinforcing bars for shotcrete facing conforming to the requirements of §709-01 Bar Reinforcement, Grade 60. Acceptance will be based on the manufacturer’s name appearing on the Department’s Approved List.

6. **SNWS Bearing Plates / Nuts**. Provide bearing plates conforming to the requirements of §715-01 Structural Steel. Provide hexagonal nuts conforming to AASHTO M 291, fitted with beveled washers or spherical seat to provide uniform bearing.

7. **SNWS Geotextile Drainage**. Provide geotextile drainage conforming to the requirements of §737-01 Geotextile, C. Geotextile Drainage.

8. **SNWS Geocomposite Drainage Strip**. Provide geocomposite drainage strips conforming to the requirements of §737-04 Prefabricated Composite Structural Drains.

9. **SNWS Drainage Aggregate**. Provide drainage aggregate conforming to the requirements of §733-20 Underdrain Filter Material, Type 1.
10. **SNWS PVC Connector and Drain Pipes**. Provide schedule 80 PVC connector and drain pipes conforming to the requirements of §706-15 *PVC Plastic Drain Pipe System*.

B. **SNWS Permanent**. Provide materials meeting the requirements §211-2.01 A. *SNWS Temporary* with the following exceptions:

1. **SNWS Soil Nail Tendon Assembly**. Provide components for assembling a soil nail tendon conforming to the requirements of §731-01 B. *SNWS Permanent*.

211-2.02. **Grouted Tieback System (GTS)**. Ensure that the proper materials are supplied for the chosen system design.

A. **GTS Temporary**. Provide materials meeting the following requirements:

1. **GTS Tieback Assembly**. Provide components for assembling a grouted tieback conforming to the requirements of §731-02 A. *GTS Temporary*.

2. **GTS Anchorage**. Provide anchorage capable of developing 95% of the GUTS and set so that only axial loads are applied. Provide bar tiebacks with spherical washers and spherical nuts at the anchorage.

3. **GTS Grout**. Provide grout manufacture materials conforming to the requirements of §211-2.01 A.2. *SNWS Nail Grout*. Epoxy resin will not be allowed as a substitute for cement grout.

   a. **Admixtures**. Provide admixtures, if used, conforming to the requirements of §211-2.01 A.2.a. *SNWS Admixtures*.

B. **GTS Permanent**. Provide materials meeting the requirements §211-2.02 A. *GTS Temporary* with the following exceptions:

1. **GTS Tieback Assembly**. Provide components for assembling a grouted tieback conforming to the requirements of §731-02 B. *GTS Permanent*.

211-3 **CONSTRUCTION DETAILS**

211-3.01. **Soil Nail Wall System (SNWS)**.

A. **SNWS Submittal**. Submit a design and design experience to the Engineer a minimum of 30 calendar days prior to start of work. Begin work only after receiving the Departments approval.

1. **Experience**. Submit as proof to the Deputy Chief Engineer Technical Services (DCETS):

   a. Three projects for which the Contractor or subcontractor performing the work has successfully installed soil nails within the past five years,

   b. The foreman and drill rig operators for this work have at least three years of experience, on at least three projects, in the installation of soil nails,

   c. Written documentation listing at least five permanent structural shotcrete walls successfully completed within the past five years, and

   d. Written documentation of the finishers and nozzlemen’s qualifications. Minimum qualifications include experience on at least three projects in the past three years in similar shotcrete application work. In addition, the nozzlemen must demonstrate the
ability to satisfactorily place the shotcrete. This will be based on either previous ACI
nozzlemen certification or satisfactory completion of preconstruction test panels.

2. **Working Drawings.** Submit the design and methods of construction to the DCETS for
approval. The design shall be completed, sealed and stamped by a Professional Engineer.

   Determine the soil nail length and grid spacing necessary to develop adequate load
capacity to satisfy nail testing acceptance criteria for the design parameters shown in the
contract documents. Provide the required partial safety factors, allowable strength factors,
and minimum global stability soil factors of safety in accordance with FHWA’s
“Geotechnical Engineering Circular No. 7 Soil Nail Walls”, Report No. FHWA-IF-03-017.

   Provide working drawings conforming to the size and type requirements in accordance
with §718-01 *Prestressed Concrete Units (Structural)* A. Size and Type. Include the
following:

   a. The proposed start date and proposed detailed wall construction sequence including:
      i. Plan describing how surface water will be diverted, controlled and disposed of.
      ii. Proposed methods and equipment for excavating the soil and/or rock to the staged
      excavation lifts indicated within the submitted design, including the proposed grade
      elevations for each excavation lift, shown on a wall elevation view.
      iii. Measures to ensure wall and slope stability during various stages of wall construction
      and excavation where discontinuous rows of nails will be installed (if applicable),
      information on space requirements for installation equipment, temporary shoring plans (if
      applicable), information on provisions for working in the proximity of underground
      facilities or utilities (if applicable).
      iv. Details of soil nail layout including lengths, grid spacing, encapsulation or epoxy
      coating details (if applicable) and design load (P) to resist design earth pressures.
      v. Proposed nail drilling methods and equipment including drillhole diameter and
      inclination proposed to achieve the specified pullout resistance values and any variation
      of these along the wall alignment.

   b. Nail grout mix design/shotcrete mix design including:
      i. Proportions of mix, including the Departments Approved List Brand Codes / Source
      Numbers, by weight and water-cement ratio.
      ii. Proposed admixtures, manufacturer, dosage, technical literature.

   c. Nail grout mix:
      i. Compressive strength test results supplied by a qualified independent testing
      laboratory verifying a minimum 3-day compressive strength of 1500 psi and a minimum
      28-day compressive strength of 3000 psi and the corresponding density of the fluid grout
      performed utilizing a Baroid Mud Balance in accordance with the American Petroleum
      Institute (API) Recommended Practice (RP) 13B-1: *Standard Procedure for Testing
      Water-Based Drilling Fluids.*

   d. Shotcrete mix:
      i. Compressive strength test results supplied by a qualified independent testing
      laboratory verifying a minimum 3-day compressive strength of 2000 psi and a minimum
      28-day compressive strength of 4000 psi.
      ii. Previous strength test results, from Departmental projects, for the proposed mix
      designs completed within 1 year of the start of construction may be substituted for initial
      verification of the required compressive strengths at start of production work

   e. Proposed nail grout placement procedures and equipment.

   f. Proposed nail testing methods and equipment setup including:
      i. Details of jacking frame and appurtenant bracing.
      ii. Details showing methods of isolating test nails during shotcrete application (i.e.,
methods to prevent bonding of the soil nail bar and the shotcrete facing during testing).

iii. Details showing methods of providing the temporary unbonded length and of grouting the temporary unbonded length of test nails after completion of testing.

iv. Equipment list.

g. Proposed shotcrete equipment, methods of shotcrete placement, of controlling and maintaining facing alignment, and location and shotcrete thickness.

3. **Calibrations.** Submit the following documentation to the Engineer at least 15 calendar days prior to the start of work:

a. Identification number and certified calibration records for each test jack and pressure gage and load cell to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, device identification number, and calibration test results and shall be certified for accuracy within 2% of the applied certification loads by a qualified independent testing laboratory within 90 days prior to submittal.

**B. SNWS Preproduction.** Prior to the start of the soil nailed wall installation, install a nail in accordance with the contract documents for preproduction verification testing at the location specified. Test the nail after installation as specified in §211-3.01 E SNWS Testing.

Provide positive control and discharge of all surface water that will affect the installation of the soil nail wall throughout the construction of the wall. Include methods and schedules to be consistent with the soil erosion and sediment control plan in accordance with §209-3.01 General. Maintain all ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost. Upon substantial completion of the wall, remove surface water control pipes or conduits from the site.

**C. SNWS Nail Installation.** Excavation shall be conducted in accordance with the applicable requirements of Section 206, Trench, Culvert and Structure Excavation, and the details specified in the contract documents. Excavate using procedures that prevent over-excavation, ground loss, swelling, air slaking or loosening, loss of support for completed portions of the wall, loss of soil moisture at the face, or ground freezing.

Drill holes for the soil nail installation using core drilling, rotary drilling, or auger drilling. Percussion drilling is prohibited unless approval for its use is granted by the DCETS. Install casing as required to maintain a clean and open hole. Utilize a drill bit with a diameter not smaller than the specified hole diameter minus ⅛ in. Extend the hole a minimum of 2 ft. beyond the nail length. Drill the holes to the inclination specified on the approved Working Drawings within a 3° tolerance.

Provide centralizers at a maximum of 10 ft. center-to-center spacing throughout the length of the nail to position the bar within 1 in. of the center of the hole and to provide a minimum 1 in. grout cover over bare or epoxy-coated bars or ½ in. grout cover over the encapsulation of an encapsulated nail. Size the centralizers to allow insertion of a tremie pipe to the bottom of the drillhole and to allow grout to freely flow up the drillhole. Provide a centralizer within 2 ft. of the top and bottom of the nail. Sag of the nail shall be taken into account when selecting centralizer diameter and spacing.

Insert the nail in the casing or hole after the hole is drilled to the final depth. Locate the nail within a 6 in. tolerance, in any direction. Location tolerances are applicable to only one nail and not accumulative over large wall areas.

Repair encapsulated nails that are damaged or defective in accordance with the manufacturer’s recommendations or remove them from the site.

Provide a colloidal mixer and grouting equipment capable of continuous mixing and producing grout free of lumps equivalent to the strength and consistency of the approved mix design created by the independent testing laboratory. Equip the grout pump with a grout pressure gage capable of measuring at least twice but not more than three times the intended grout pressure. Size the grouting equipment to enable the entire nail to be grouted in one continuous operation. Place grout within 60
minutes after mixing or within the time recommended by the admixture manufacturer, if admixtures are used. Grout not placed in the allowed time limit will be rejected.

Perform the grouting operation after the nail is inserted. Grout each drillhole within 2 hours of completion of drilling. To prevent air voids, fill the hole with grout progressively from the bottom to the top. Completely fill the drillhole in one continuous operation. Cold joints in the grout column are not allowed except at the top of the test-bond length of proof-tested production nails.

Maintain sufficient grout level within the casing to offset the external groundwater/soil pressure and prevent hole caving during casing removal for drillholes advanced by either cased or auger methods. Maintain grout head or grout pressures sufficient to ensure that the drillhole will be completely filled with grout and to prevent unstable soil or groundwater from contaminating or diluting the grout. Control grout pressures to prevent excessive ground heave or fracturing.

Remove the grout and nail if grouting is suspended for more than 30 minutes or does not satisfy the requirements of this specification or the approved Working Drawings, and replace with fresh grout and undamaged nail bar at no additional cost.

Test nails as specified in §211-3.01 E SNWS Testing.

D. SNWS Facing Elements. Install and secure all elements of the wall drainage network as shown on the approved Working Drawings. Secure the geocomposite drainage strips tightly to the excavation face to prevent shotcrete from contaminating the ground side of the geotextile. Geocomposite drainage strips shall be continuous. Splices to the geocomposite drainage strips shall be made with a 1 ft. minimum overlap such that the flow of water is not impeded. Install all elements of the drainage network, exclusive of the wall footing drains, prior to shotcreting. Clean the face of the excavation, and other surfaces to be shotcreted, of loose material, mud, rebound, overspray, or other foreign matter that could prevent or reduce shotcrete bond. Remove material that loosens as shotcrete is applied.

Place shotcrete in accordance with the requirements of Section 583-3.03 Placement.

Provide shotcrete equipment capable of delivering the premixed material accurately, uniformly and continuously through the delivery hose. Control shotcrete application thickness, nozzle technique, air pressure, and rate of shotcrete placement to prevent sagging or sloughing of freshly applied shotcrete.

Ensure that the thickness of shotcrete satisfies the minimum requirements as shown on the approved Working Drawings using shooting wires, thickness control pins, or other acceptable devices. Fill all depressions along the excavated face with shotcrete at no additional cost to the State.

Repair shotcrete surface defects as soon as possible after placement. Remove and replace shotcrete which exhibits segregation, honeycombing, lamination, voids, or sand pockets. In-place shotcrete determined not to meet the specified strength requirements will be subject to remediation.

Finish shotcrete with either an undisturbed gun finish as applied from the nozzle or a rough-screeded finish.

Attach a bearing plate and nut to each nail head as shown on the approved Working Drawings. While shotcrete is still plastic and before its initial set, uniformly seat the plate on the shotcrete by hand wrench tightening the nut. Where uniform contact between the plate and the shotcrete cannot be provided, set the plate in a bed of grout. After grout has set for 24 hours, tighten the nut using a hand wrench. Ensure bearing plates with headed studs are in intimate contact with the construction facing and the studs are located within the tolerances specified herein.

Locate the SNWS facing elements from the contract documents location and dimensions within the tolerances provided in Table 211-3 SNWS Tolerances for Facing Elements:

<table>
<thead>
<tr>
<th>Facing Element</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal location of wire mesh, rebar and headed studs</td>
<td>± ¼ in.</td>
</tr>
</tbody>
</table>
TABLE 211-3 SNWS TOLERANCES FOR FACING ELEMENTS

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of headed studs on bearing plate</td>
<td>± ¼ in.</td>
</tr>
<tr>
<td>Spacing between reinforcing bars</td>
<td>± 1 in.</td>
</tr>
<tr>
<td>Reinforcing lap</td>
<td>± 1 in.</td>
</tr>
<tr>
<td>Shotcrete thickness</td>
<td>± ⅜ in.</td>
</tr>
<tr>
<td>Nail head bearing plate</td>
<td>± 10° deviation from parallel to the wall face</td>
</tr>
</tbody>
</table>

Do not excavate to the next lift until nail installation, reinforced shotcrete placement, attachment of bearing plates, and nuts and nail testing has been completed and accepted in the current lift. Ensure nail grout and shotcrete have cured for at least 72 hours or attained at least their specified 3-day compressive strength before excavating the next underlying lift.

E. SNWS Testing. Perform preproduction verification, verification, and proof testing of designated test nails. Perform a preproduction verification test and verification tests on sacrificial test nails as described herein. Perform proof tests on production nails at locations selected by the Engineer and as described herein. Do not load or perform nail testing until the nail grout and shotcrete facing have cured for at least 72 hours and attained at least their specified 3-day compressive strength. Testing in less than 72 hours will only be allowed if the Contractor submits compressive strength test results, for tests performed by a qualified independent testing laboratory, verifying that the nail grout and shotcrete mixes being used will provide the specified 3-day compressive strength in the lesser time.

Provide a minimum 3 ft. temporary unbonded length in each test nail. Prior to testing, grout only the bonded length of the test nail. Determine the bonded length of the test nail based on the production nail bar grade and sized such that the allowable bar structural load is not exceeded during testing. The bond length shall not be less than 10 ft.

The maximum test load shall not exceed 80% of the GUTS of the nail. Monitor the jack load with a load cell. Provide the Engineer with the calibration curve for the load cell before start of testing.

Submit two copies of all test data to the Engineer.

1. PreProduction Verification Test. Perform a preproduction verification test prior to installation of production nails to verify the Contractor’s installation methods and nail pullout resistance. Testing requirements are contained in §211-3.01 E. 2. Verification Testing.

2. Verification Testing. Perform a minimum of 2 verification tests in each different soil/rock unit and for each different drilling/grouting method proposed to be used, at each wall location. Verification test nails will be sacrificial and not incorporated as production nails. Bare bars can be used for the sacrificial verification test nails.

Incrementally load verification test nails to a maximum test load of 3 times the design load (P) in accordance with Table 211-4 SNWS Verification Test Load Schedule. Record soil nail movements at each load increment.

<table>
<thead>
<tr>
<th>Load¹</th>
<th>Observation Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>1 minute</td>
</tr>
<tr>
<td>0.25 P</td>
<td>10 minutes</td>
</tr>
<tr>
<td>0.50 P</td>
<td>10 minutes</td>
</tr>
<tr>
<td>0.75 P</td>
<td>10 minutes</td>
</tr>
<tr>
<td>1.00 P</td>
<td>10 minutes</td>
</tr>
<tr>
<td>1.25 P</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>

TABLE 211-4 SNWS VERIFICATION TEST LOAD SCHEDULE
### TABLE 211-4 SNWS VERIFICATION TEST LOAD SCHEDULE

<table>
<thead>
<tr>
<th>Load</th>
<th>Observation Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.50 P (Load Hold)</td>
<td>60 minutes</td>
</tr>
<tr>
<td>1.75 P</td>
<td>10 minutes</td>
</tr>
<tr>
<td>2.00 P</td>
<td>10 minutes</td>
</tr>
<tr>
<td>2.50 P</td>
<td>10 minutes maximum</td>
</tr>
<tr>
<td>3.00 P (or failure)</td>
<td>10 minutes maximum</td>
</tr>
<tr>
<td>AL</td>
<td>1 minute (record permanent set)</td>
</tr>
</tbody>
</table>

1P = Design Load
AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied initially.

2The load hold portion of the verification test is a test load of 1.50 P, which shall be held constant for 60 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. Maintain load during the load hold portion of the test within 2% of the intended load by use of the load cell.

All load increments shall be maintained within 5% of the intended load except as noted for the load hold portion of the test.

The Department will review all verification tests to determine if the nail is acceptable. A nail will be accepted if the following three criteria are met:

a. A total load hold movement of less than 0.08 in. per log cycle of time between the 6 and 60 minute readings is measured during load hold testing and the creep rate is linear or decreasing throughout the load hold period.

b. The total measured movement at the maximum test load exceeds 80% of the theoretical elastic elongation of the test nail unbonded length.

c. A pullout failure does not occur prior to the 2.50 P load increment. Pullout failure is defined as the load at which attempts to further increase the test load simply result in continued pullout movement of the test nail. Although the nail will be incrementally loaded to a maximum test load of 3.00 P or failure, the test is deemed acceptable if the nail adequately performs under load up to 2.00 P. The pullout failure load shall be recorded as part of the test data.

3. **Proof Testing.** Perform proof testing on a minimum of 5% (1 in 20) of the production nails in each row or a minimum of 1 per row. The locations shall be designated by the Engineer. A verification test nail successfully completed during production work shall be considered equivalent to a proof test nail and shall be accounted for in determining the number of proof tests required in that particular row.

Production proof test nails shorter than 13 ft. in length may be constructed with less than the minimum 10 ft. bond length with the unbonded length limited to 3 ft.

Incrementally load the proof test nail to a maximum test load of 1.5 times the Design Load (P) in accordance with Table 211-5 SNWS Proof Test Load Schedule. Record the soil nail movements at each load increment.

### TABLE 211-5 SNWS PROOF TEST LOAD SCHEDULE

<table>
<thead>
<tr>
<th>Load</th>
<th>Observation Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 P</td>
<td>1 minute (record permanent set)</td>
</tr>
</tbody>
</table>
### TABLE 211-5 SNWS PROOF TEST LOAD SCHEDULE

<table>
<thead>
<tr>
<th>Load Level</th>
<th>Minimum Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Minimum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>0.25 P</td>
<td>Minimum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>0.50 P</td>
<td>Minimum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>0.75 P</td>
<td>Minimum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>1.00 P</td>
<td>Minimum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>1.25 P</td>
<td>Minimum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>1.50 P (Load Hold)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>10 minutes (or 60 minutes depending on total movement&lt;sup&gt;3&lt;/sup&gt;)</td>
</tr>
</tbody>
</table>

<sup>1</sup>P = Design Load  
AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

<sup>2</sup>Hold each load increment, except for the 1.5 P load, until the deflection stabilizes.

<sup>3</sup>The load hold portion of the proof test is a maximum test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 1 mm, the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 20, 30, 50 and 60 minutes.

All load increments shall be maintained within 5% of the intended load.

The Department will review all proof tests to determine if the nail is acceptable. A nail will be accepted if the following three criteria are met:

- **a.** A total load hold movement of less than 0.04 in. measured between the 1 and 10 minute readings or a total load hold movement of less than 0.08 in. is measured between the 6 and 60 minute readings and the creep rate is linear or decreasing throughout the load hold period.
- **b.** The total measured movement at the maximum test load exceeds 80% of the theoretical elastic elongation of the test nail unbonded length.
- **c.** A pullout failure does not occur at the maximum test load. Pullout failure is defined as the load at which attempts to further increase the test load simply result in continued pullout movement of the test nail. The pullout failure load shall be recorded as part of the test data.

Successful proof-tested nails meeting the above test acceptance criteria may be incorporated as production nails, provided that:

1. The unbonded length of the test nail drillhole has not collapsed during testing.
2. The minimum required drillhole diameter has been maintained.
3. The specified corrosion protection is provided.
4. The test nail length is equal to or greater than the scheduled production nail length.

Test nails meeting the above requirements shall be completed by satisfactorily grouting up the unbonded test length. Maintaining the temporary unbonded test length for subsequent grouting is the Contractor’s responsibility. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing, the proof test nail shall become sacrificial and shall be replaced with an additional production nail installed at no additional cost.
For nails that are unacceptable, the Contractor shall submit a written proposal containing a suggested course of action.

Construct and attach any permanent facing and insulating materials shown in the contract documents.

211-3.02. Grouted Tieback System (GTS).

A. GTS Submittal. Submit a design and design experience to the Engineer a minimum of 30 calendar days prior to start of work. Begin work only after receiving the Departments approval.

1. Experience. Submit as proof to the DCETS: (1) the names of two projects for which the Contractor or subcontractor performing the work has successfully installed grouted tiebacks within the past two years, (2) the foreman for this work having supervised the installation of grouted tiebacks on at least two projects in the past two years. Submit proof of prior experience with the subcontractor approval process.

2. Working Drawings. Submit the design and methods of construction to the DCETS for approval. The design shall be accomplished by a Professional Engineer.

   Determine the tieback type, size and bond length necessary to develop adequate load capacity to satisfy grouted tieback testing Acceptance Criteria for the design loads shown in the contract documents and in accordance with the Post Tensioning Institute Recommendations for Prestressed Rock and Soil Anchors. The minimum bond length shall be 10 ft. in rock and 15 ft. in soil. The minimum tendon bond length shall be 10 ft. The minimum stressing length shall be 15 ft. or as shown in the contract documents, whichever is greater. The tieback hole shall remain inside the right-of-way or easement limits shown in the contract documents.

   Provide working drawings conforming to the size and type requirements in accordance with §718-01 Prestressed Concrete Units (Structural) A. Size and Type. Include the following:

   a. A grouted tieback schedule including:
      i. grouted tieback number,
      ii. design load for each tieback,
      iii. type and size of tendon,
      iv. total tendon length,
      v. bond length, and tendon bond length if different from bond length,
      vi. stressing length.

   b. A drawing of the tieback and corrosion protection including:
      i. spacers and their location,
      ii. centralizers and their location,
      iii. couplers and their location,
      iv. stressing length corrosion protection,
      v. bond length corrosion protection,
      vi. anchorage and trumpet,
      vii. anchorage corrosion protection system.

3. Report. Submit a report to the Engineer within 30 calendar days after completion of the tieback work. The report shall contain:

   a. as-built drawings showing the locations of the tiebacks, total tendon lengths, stressing lengths and bond lengths,
   b. prestressing steel manufacturer's mill test reports for the tendons,
c. tieback installation notes (hole progression, caving, clean-out),
d. grouting records indicating the cement type, quantity injected and grout pressures,
e. tieback test results and graphs.

B. GTS Installation. The holes for the tiebacks may be either driven or drilled. The hole shall not be progressed in a location that requires the tendon to be bent in order to enable the bearing plate to be connected to the supporting structure. If operations cause subsidence or physical damage, immediately cease operations and repair the damage. The Contractor shall immediately revise operations to prevent reoccurrence of such damage. Any and all costs incurred due to this subsidence or physical damage shall be at no additional cost to the State. If the hole will not stand open, casing shall be installed as required to maintain a clean and open hole. The hole diameter shall be no less than 3 in. if using pressure grouting in the bond length and 4 in. if not using pressure grouting. The Contractor shall provide a drill bit with a diameter no less than the specified hole diameter minus ⅛ in. The hole shall extend a minimum of 2 ft. beyond the tendon length. The holes shall be located in elevation as shown in the contract documents, within a 3 in. tolerance. The holes shall be progressed to the inclination and alignment as specified in the contract documents, within a ±3° tolerance. All tieback holes shall be progressed perpendicular to the direction of the wall, as seen in the contract documents. Holes in rock shall be thoroughly cleaned of all dust, rock chips, grease or other material which may affect bond prior to inserting the tendon.

Strands shall not be coupled, except in the case of repairs of installed tendons or for extending stressed strand anchors.

A water-tightness test will be required for all tiebacks bonded in rock if grout is injected at a pressure of less than 50 psi. The water-tightness test shall be performed by filling the entire hole in the rock with water and subjecting it to a pressure of 5 psi as measured at the top of the hole. If the stressing length portion of hole is in soil or fractured rock, a packer or casing shall be used to allow the bond length to be pressure-tested. If the leakage rate from the hole, over a 10 minute period, exceeds 0.001 gal. of water per inch of hole diameter per foot of length of hole per minute, the hole shall be grouted, redrilled and retested. Should the subsequent water-tightness test fail, the entire process shall be repeated until results are attained which are within leakage allowances. If artesian or flowing water is encountered in the drilled hole, pressure shall be maintained on the grout until the grout has reached initial set.

The Contractor may eliminate the requirement for water-tightness tests in rock by using pressure grouting techniques. Pressure grouting requires that the drill hole be sealed and that the grout be injected until a 50 psi grout pressure, measured at the top of the hole, can be maintained on the grout for 5 minutes without further grout injection.

In the bond length, centralizers and their installed locations shall be subject to approval by the Engineer. Centralizers shall be provided at a maximum of 10 ft. center to center spacing throughout the bond length so that not less than ½ in. of grout cover along the bond length is achieved. A centralizer shall be provided at the bottom end of the tendon. Sag of the tendon shall be taken into account when selecting centralizer diameter and spacing. Multi-element tendons shall also employ spacers at maximum 10 ft. intervals throughout the bond length to ensure grout cover on all elements.

When the contract documents require encapsulation to provide double-corrosion protection for the tendons:

1. The tendon shall be encapsulated in a grout-filled corrugated tube of one of the types stated in the Materials section of this specification. The tendon may be grouted inside the encapsulation either before or after inserting the tendon into the drill hole. The bond length of the tendon shall be centralized to provide a minimum grout cover of 3/16 in. within the tube. Spacers shall be used along the tendon bond length for multi-element tendons to ensure good bond with the encapsulation grout.

2. Centralizers shall be used to provide a minimum of 5/16 in. of grout cover over the tendon bond length encapsulation. Centralizers shall be securely attached to the encapsulation and
shall be spaced at no more than 10 ft. A centralizer shall be provided at the bottom end of the tendon bond length encapsulation. A centralizer shall also be located a maximum of 5 ft. from the top of the bond length.

The bond length of the tendon shall be free of dirt, manufacturer’s lubricants, corrosion-inhibiting coatings or other deleterious substances prior to installation.

The tendon shall be inserted in the casing or hole without difficulty. If the tendon cannot be completely inserted, the Contractor shall remove the tendon and clean or redrill the hole to permit insertion. Partially inserted tendons shall not be driven or otherwise forced into the hole. Tendons shall not be subject to sharp bends. Care shall be taken to prevent damage to the tendon's corrosion protection and centralizers during handling and installation.

The grouting equipment shall be capable of continuous mixing and shall produce grout free of lumps. The grout pump shall be equipped with a grout pressure gage capable of measuring the highest working pressures attained plus 50 psi.

The annular space between the tieback and the drilled hole up to the level of the trumpet and between the tendon and encapsulation shall be filled with grout. In order to prevent air voids in the grouting operation, the hole shall be filled with grout progressively from bottom to top. Grouting of the stressing length shall be done at low pressure. The trumpet shall not bear on the top of the stressing length grout column during testing, to ensure that load applied to the tieback during testing is not transferred to the anchorage via the grout column.

The tieback shall be centered in the trumpet so that there is no contact between the two. The corrosion protection surrounding the stressing length of the tendon shall extend up beyond the bottom seal of the trumpet but shall not contact the bearing plate or anchor head during stressing and testing.

The anchor head shall be protected from corrosion during the interim between tieback installation and final corrosion protection installation by installing a temporary cap and filling the trumpet and anchor head with corrosion-inhibiting grease. Any detrimental corrosion shall be caused for rejection.

After installation, testing and acceptance of each tieback, the trumpet shall be filled with grout or corrosion inhibiting grease and the permanent corrosion protection of the anchorage shall be installed. The Contractor shall either:

1. place a water-tight steel cap, filled with corrosion inhibiting grease or grout, over the anchor head, or
2. encase the anchor head in concrete.

C. GTS Testing. Each tieback shall be tested. At no time shall a test or temporary load on any tendon exceed 80% of the GUTS of the tendon. The following tests are required:

1. Performance Tests: The first two anchors installed at each specified design load capacity and 5% of the remaining anchors shall be performance tested. These tests are used to determine residual movements.

2. Creep Tests: Creep tests shall only be performed where specified by a Special Note in the contract documents. These tests are performed to determine long term deformation behavior in plastic soils.

3. Proof Tests: Proof tests shall be performed on all anchors not performance or creep tested. These tests are used to verify load capacity.

4. Lift-Off Readings: Lift-off readings shall be taken on all tiebacks after the load has been transferred to the anchorage but prior to removing the jack.

5. Lift-Off Tests: Lift-off tests shall only be performed on tiebacks in rock. If required, lift-off tests shall be performed on at least 2 tiebacks at locations to be chosen by the Engineer. Additional tests, up to 10% of the total number of tiebacks may be directed by the Engineer.

Copies of all test results and graphs shall be transmitted to the Director, Geotechnical Engineering Bureau as each test is completed.
Jacks shall have ram travel at least equal to the theoretical elastic elongation of the stressing length plus the bond length at the maximum test load, and be sufficient to accommodate wall movements. A pressure gauge shall be used with each jack. Gauges shall be calibrated with a single jack and shall not be used with any other jack. All gauges shall be accurate enough to read 100 psi changes in pressure. For performance and creep tests, the jack used shall have two calibrated gauges; a master gauge and backup gauge. The pump shall be capable of applying each load increment in less than 60 seconds.

A load cell, which has been calibrated by an independent testing laboratory within 14 days prior to the start of work and at least annually thereafter, shall be used to measure the small changes in load during the load hold portion of the performance and creep tests. There will be no substitute for the load cell on testing of the performance and creep tests. Load cells are not required for proof tests. The Contractor shall provide the Engineer with the calibration curve for the load cell prior to testing.

For the performance and creep tests, the master gauge and backup gauge shall be connected to the same pressure hose between the pump and jack and be used to measure the applied loads. If the load measured by the master gauge and backup gauge differ by more than 10%, the jack, master gauge and backup gauge shall be recalibrated as a unit at no expense to the State.

At the completion of the test the tieback load shall be adjusted to the lock-off load and transferred to the anchorage.

The movement of the tieback tendon at each load increment shall be recorded to the nearest 0.001 in. relative to an independent, fixed reference point.

1. Performance Tests: Performance tests shall be performed by incrementally loading and unloading the tieback in accordance with Table 211-6 GTS Performance/Creep Test Load Schedule. Residual movements shall be taken at the alignment load for each cycle. Total movement measurements shall be taken at each load in each cycle.

| TABLE 211-6 GTS PERFORMANCE/CREEP TEST LOAD SCHEDULE |
|-----------------------------------------|-----------------|-----------------|
| Cycle | Load | PERFORMANCE TEST | CREEP TEST |
| | | Observation Period | Observation Period |
| 1 | AL | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.25 P | Maximum of 1 minute<sup>2</sup> | 10 minutes |
| 2 | AL | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.25 P | Maximum of 1 minute<sup>2</sup> | 10 minutes |
| | 0.50 P | Maximum of 1 minute<sup>2</sup> | 30 minutes |
| 3 | AL | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.25 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.50 P | Maximum of 1 minute<sup>2</sup> | 30 minutes |
| | 0.75 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| 4 | AL | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.25 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.50 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.75 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 1.00 P | Maximum of 1 minute<sup>2</sup> | 45 minutes |
| | 0.75 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.50 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
| | 0.25 P | Maximum of 1 minute<sup>2</sup> | Maximum of 1 minute<sup>2</sup> |
5 Temporary Tieback

<table>
<thead>
<tr>
<th>Load</th>
<th>AL</th>
<th>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>0.25 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>0.50 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>1.00 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>1.25 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>1.33 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>(Load Hold)</td>
<td>50 minutes&lt;sup&gt;4&lt;/sup&gt;</td>
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<tr>
<td>AL</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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</table>

Cycle 5 is the end of the load schedule for a temporary tieback. Adjust to the lock-off load of 0.80 P (or as specified in the contract documents).

5 Permanent Tieback

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<th>Load</th>
<th>AL</th>
<th>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>0.25 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>0.50 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>1.00 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>1.25 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>1.50 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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</tr>
<tr>
<td>(Load Hold)</td>
<td>10 minutes (or 60 minutes depending on total movement&lt;sup&gt;5&lt;/sup&gt;)</td>
<td></td>
</tr>
<tr>
<td>AL</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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</tbody>
</table>

Adjust to the lock-off load of 0.80 P (or as specified in the contract documents).

Permanent Tieback

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<thead>
<tr>
<th>Load</th>
<th>AL</th>
<th>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>0.25 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>0.50 P</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>1.00 P</td>
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<tr>
<td>AL</td>
<td>Maximum of 1 minute&lt;sup&gt;2&lt;/sup&gt;</td>
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</tbody>
</table>

Adjust to the lock-off load of 0.80 P (or as specified in the contract documents).

<sup>1</sup>P = Design Load

<sup>2</sup>AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

<sup>3</sup>Creep tests determine the long-term load carrying capacity of a grouted tieback. This test is not applicable to temporary tiebacks.

<sup>4</sup>The load hold portion of the performance test for a temporary tieback is a test load of 1.33 P, which shall be held constant for 50 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 0, ½, 1, 2, 5, 10, 30, and 50 minutes. If the total movement between 1 minute and 10 minutes is less than 0.04 in., the temporary tieback will be accepted and the test may be terminated without taking the 30 and 50 minute readings.

<sup>5</sup>The load hold portion of the performance test for a permanent tieback is a test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5,
6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 0.04 in., the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15, 20, 25, 30, 45 and 60 minutes.

The Contractor shall plot the tendon movement versus load for each load increment. He shall also plot the creep movement for the load hold as a function of the logarithm of time.

2. Creep Tests: The creep test shall be made by incrementally loading and unloading the tendon in accordance with Table 211-6 GTS Performance/Creep Test Load Schedule. At the highest load in each cycle the load shall be held constant in accordance with the observation periods. A load cell shall be used to monitor the constant load.

Residual movement measurements shall be taken at the alignment load for each cycle. Total movement readings shall be taken at each load in each cycle.

The times for reading the total movement during an observation period shall be 1 minute, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270, and 300 minutes.

The observation period shall begin when the pump starts to load the tieback from the next lower increment.

The Contractor shall plot the tendon movement and the residual movement measured in a creep test as described for the performance test. The Contractor shall also plot the creep movement for each load hold as a function of the logarithm of time.

If the creep rates are not acceptable as defined under §211-3.02 C 6. Acceptance Criteria, the Contractor shall modify his installation method and perform creep tests until two successive acceptable creep tests on two different tiebacks have been performed.

3. Proof Tests: The proof tests shall be performed by loading the tieback in accordance with Table 211-7 GTS Proof Test Load Schedule.

<table>
<thead>
<tr>
<th>TABLE 211-7 GTS PROOF TEST LOAD SCHEDULE</th>
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<tbody>
<tr>
<td>Load</td>
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<tr>
<td>AL</td>
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<tr>
<td>0.25 P</td>
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<tr>
<td>0.50 P</td>
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<tr>
<td>0.75 P</td>
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<tr>
<td>1.00 P</td>
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<tr>
<td>1.25 P</td>
</tr>
</tbody>
</table>

| Load Hold | Permanent Tieback | 1.50 P | 10 minutes (or 60 minutes depending on total movement³) |
|          | Temporary Tieback | 1.33 P | 5 minutes (or 50 minutes depending on total movement⁴) |

1. P = Design Load

2. AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

3. The load hold portion of the proof test for a permanent tieback is a test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements are recorded at 15, 20, 25, 30, 45, 60, 75, 90, 100, 120, 150, 180, 210, 240, 270, and 300 minutes.

4. Adjust to the lock-off load of 0.80 P (or as specified in the contract documents)
with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 0.04 in., the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15, 20, 25, 30, 45 and 60 minutes.

4The load hold portion of the proof test for a temporary tieback is a test load of 1.33 P, which shall be held constant for 5 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 0, ½, 2, and 5 minutes. If the total movement between ½ minute and 5 minutes exceeds 0.08 in., the test load shall be held for an additional 45 minutes. Total movements shall be recorded at 10, 15, 20, 25, 30, 40 and 50 minutes.

The Contractor shall plot the tendon movement versus load for each load increment. He shall also plot the creep movement for the load hold as a function of the logarithm of time.

4. Lift-Off Readings: Lift-off readings shall be taken and recorded directly after testing on all tiebacks. The load required to relieve the load from the tieback head shall be measured and recorded. If the lift-off load is not within 5% of the lock-off load the anchorage shall be reset and another lift-off reading taken.

5. Lift-Off Tests: Lift-off tests shall be performed on rock tiebacks only. Locations for lift-off tests shall be selected randomly by the Engineer prior to the commencement of any tieback testing. For each tieback subjected to a lift-off test, the Contractor shall leave an adequate length of tendon protruding over the anchorage to permit jacking.

   Lift-off tests shall be performed at least 24 hours but no more than 7 days after the tieback has been set to lock-off load. The results of all lift-off tests shall be recorded.

   If the lift-off load is not within 10% of the lock-off load, the anchorage shall be reset and another lift-off test performed according to the requirements in this specification.

6. Acceptance Criteria: For all grouted tiebacks:
   a. All tiebacks and components shall be free of detrimental corrosion.
   b. Lift-off readings shall show a load within 5% of the specified lock-off load.
   c. Lift-off tests shall show a load within 10% of the specified lock-off load.
   d. The total movement at the maximum test load shall exceed 80% of the theoretical elastic elongation of the unbonded length, from the alignment load to the test load.

   For performance or proof tested tiebacks with a 10 minute load hold, the tieback shall also resist the maximum test load with a creep rate that does not exceed 0.04 in. between 1 and 10 minutes.

   For performance or proof tested tiebacks with a 60 minute load hold, the tieback shall also resist the maximum test load with a creep rate that does not exceed 0.08 in. per log cycle of time.

   For creep tested tiebacks, the tieback shall also resist the maximum test load with a creep rate that does not exceed 0.08 in. per log cycle of time.

   For unacceptable tiebacks, the Contractor shall submit a written proposal containing a suggested course of action. The action to be taken will be subject to written approval by the Department. Tiebacks which do not meet the total movement criteria shall not be permitted to carry any load.

   Conditional Acceptance Criteria: Tiebacks which meet the total movement criteria but do not meet the creep rate criteria may be accepted by the Department and locked-off at a load equal to
½ \( P_f \). To determine \( P_t \) (failure load), allow the load to stabilize for 10 minutes after the tieback has failed. The load after stabilization is the failure load.

A supplemental tieback shall be installed and tested at a location approved by the Department. The combined test capacity of the tiebacks shall equal or exceed 1.5 times the original design load. That is:

\[
1.5 \, P = 1.5 \, P_t + 0.5 \, P_f
\]

Where:
- \( P \) = the design load for the original tieback
- \( P_t \) = the design load for the supplemental tieback
- \( P_f \) = the failure load for the original tieback

For tiebacks that do not meet the lift-off reading (or test) criteria, the anchorage shall be reset and another lift-off reading (or test) taken.

211-4 METHOD OF MEASUREMENT

211-4.01. Soil Nail Wall System. A SNWS will be measured in square feet of face area measured in a vertical plane between the payment lines shown in the contract documents.

211-4.02. Grouted Tieback System. A GTS will be measured by the number of grouted tiebacks installed.

211-4.03. Grouted Tieback Creep Test. A GTS Creep Test will be measured by the number of tests performed.

211-5 BASIS OF PAYMENT

211-5.01 Soil Nail Wall System. The unit bid price shall include the cost of all labor, materials, and equipment required to satisfactorily complete the work including the wall drainage network, the temporary shotcrete construction facing and preproduction verification tests, verification tests, and proof tests of the soil nails along with successful completion of quality assurance tests indicating that the material conforms to the specification. Excavation will be paid for separately to the temporary shotcrete-soil interface and to the limits shown in the contract documents. Permanent wall facing will be paid for separately.

211-5.02. Grouted Tieback System. The unit bid price shall include the cost of all labor, materials, and equipment required to satisfactorily complete the work including performance tests, proof tests, lift-off readings and lift-off tests of the tiebacks along with successful completion of quality assurance tests indicating that the material conforms to the specification. For tiebacks which do not meet all the acceptance criteria but do meet the conditional acceptance criteria, the original tieback and any required supplemental tiebacks(s) are, in sum, considered to be one tieback for payment purposes. No payment will be made for any additional wall connections required for installation of supplemental tiebacks. Permanent wall facing will be paid for separately.

211-5.03. Grouted Tieback Creep Test. The unit bid price shall include the cost of all labor, materials, and equipment required to satisfactorily complete the work.

Payment will be made under:
SECTION 212 – ROCK SLOPE REINFORCEMENT AND CATCHMENT SYSTEMS
(Last Revised January 2019)

212-1 DESCRIPTION. This work shall consist of furnishing and installing rock slope stabilization techniques or roadside protective measures in conformance with payment lines, type, size, and at the locations specified in the contract documents.

212-1.01 Definitions.

A. General. As outlined in Section 203 Excavation and Embankment, all rock slopes shall be thoroughly scaled and cleaned of unsound material and loose masses of rock. This section provides requirements for specific techniques developed to address situations where a hazardous rock slope situation still exists after stripping and scaling in order to control a rockfall within a designated rockfall catchment area.

B. Rock Fall. A rockfall is the movement of rock from a slope that is so steep the rock continues to move down slope. The movement may be by free falling, bouncing, rolling or sliding.

C. Rock Catchment Area. The rockfall catchment area is defined as the area between the edge of roadway pavement and the base of an adjacent rockslope that is used to restrict rockfall from reaching the roadway. The term catchment area is synonymous with ditch, rockfall ditch, rockfall catch ditch and rock fallout area. The catchment area width is the horizontal distance between the roadway edge of pavement and the base (toe) of a rockslope.

D. Rock Catchment Fences. Rock catchment fences are techniques to control rockfalls within the R.O.W. Rock catchment fences are wire or cable mesh draped from support columns situated to define the catchment area. The catchment fence, or impact section, attenuates the rockfall energy to capture the falling rock and maintain it within the catchment area.

E. Rock Mesh Slope Protection. Rock mesh slope protection is a technique to control rockfalls within the R.O.W. Rock mesh slope protection is the placement of wire or cable mesh on a slope face. The mesh controls the descent of falling rock, which accumulates near the base of the slope within the catchment area.

212-2 MATERIALS

212-2.01 Wire Rope Rock Catchment Fence. The rock catchment fence system, as obtained from the manufacturer, shall have a tested capability of retaining a rock impact of 155 kip-ft of kinetic energy. The result of demonstration tests shall be furnished as required by the Engineer.

A. Net Assembly. Provide a fence consisting of a net conforming to §710-06 Rock Slope Net and Wire Mesh Assemblies, Net Assembly.

Cover all nets with chain link mesh fencing material of a minimum 11 gauge, 2 in. zinc coated mesh, conforming to the requirements of §710-02 Galvanized Steel Fence Fabric.
B. Wire Ropes. Provide the following wire ropes:

1. **Net Supporting Wire Rope.** Provide net supporting wire rope conforming to §710-27 Rock Slope Wire Ropes, Net Supporting Wire Rope.

2. **Seam Rope.** Provide seam rope conforming to §710-27 Rock Slope Wire Ropes, Seam Rope for Wire Rope Rock Catchment Fence.

3. **Tieback Restraining Cables.** Provide tieback restraining cables conforming to §710-27 Rock Slope Wire Ropes, Tieback Restraining Cable.

4. **Anchor Cables.** Provide anchor cables conforming to §710-27 Rock Slope Wire Ropes, Anchor Cable.

Braking elements in the tieback restraining cable shall incorporate a protective, crushable sleeve as recommended by the manufacturer.

C. Support Columns. Fabricate the net support columns from W8 x 48 wide flange members conforming to the requirements of §715-18 Soldier Piles.

D. Miscellaneous Appurtenances. All steel bolts, nuts and washers shall conform to the requirements of §723-60 Anchor Bolts. All miscellaneous appurtenances such as wire rope clips, thimbles, bolts, etc., shall be galvanized as supplied by the manufacturer.

212-2.02 Chain Link Rock Catchment Fence.

A. **Fence Fabric.** Provide aluminum coated steel fence fabric a minimum of 6 gauge, chain link type with twist selvage edges, conforming to the requirements of §710-04 Aluminum Coated Steel Fence Fabric, except for gauge.

Vinyl coated steel fence fabric shall be 6 gauge, chain link type with twist selvage edges, conforming to the requirements of §710-03 Vinyl Coated Steel Fence Fabric, Class A Wire Diameter, except color. The color shall be black unless otherwise specified in the contract documents.

B. **Cables.** Provide galvanized guide rail cables a minimum ¾ in. in diameter, consisting of 3 strands (7 wires per strand) conforming to the requirements of §710-22 Cable Guide Railing and having a minimum tensile strength of 25 kips.

C. **Posts.** Provide No. 11 steel rebar posts conforming to the requirements of §709-01 Bar Reinforcement, Grade 420. The rebar posts shall be galvanized in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type I. Exposed cut ends shall be field repaired in accordance with §719-01 Galvanized Coatings and Repair Methods.

No. 11 steel rebar posts shall also conform to the requirements of §709-04 Epoxy-Coated bar Reinforcement, except color. The color shall be as specified on the plans or by the Engineer.

D. **Hook Bar Anchors.** Provide No. 9 stainless steel hook bar anchors conforming to the requirements of §709-13 Stainless Steel Bar Reinforcement. Hook bar anchors shall have a 180° hook with an outside diameter of 11 in.
E. **Grout.** Provide grout to fill the annular space around the No. 11 steel rebar posts, No. 9 hook bar anchors and for backfilling below the anchor angle, conforming to the requirements of §701-05 *Concrete Grouting Material.*

F. **Anchor Angles.** Provide 2 ft. long sections of anchor angles of 8 in. by 6 in. by 1 in. steel angle. The steel shall conform to the requirements of §715-01 *Structural Steel* and shall be galvanized in accordance with §719-01 *Galvanized Coatings and Repair Methods,* Type I. The anchor angle shall have two 2 in. diameter holes (for the bolts) bored through the 8 in. side. The holes shall be centered 4 in. in from each end along a line 3 in. in from the edge opposite the angle. The anchor angle shall also have three 7/8 in. diameter holes drilled on 4 in. centers along the centerline, with the middle hole located in the center of the 6 in. side for attachment of the steel turnbuckles.

G. **Resin Rock Bolt Assembly.** Provide 1 ¼ in. nominal diameter, 5 ft. long, resin rock bolt assembly conforming to the requirements of §731-03 *Rock Bolt Assembly* except resin packages of one setting time only shall be utilized for installation of the rock bolt assembly.

H. **Miscellaneous Appurtenances.**

1. **Thimbles.** Provide galvanized thimbles for ¾ in. guide rail cable conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail F of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence.*

2. **Clips.** Provide galvanized cable clips for ¾ in. guide rail cable conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail F of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence.*

3. **Turnbuckles.** Provide galvanized steel turnbuckle cable end assemblies conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail G of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence.*

4. **Cable Splices.** Provide galvanized cable splices conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail H of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence.*

5. **Wedges.** Provide wedges for cable splices and cable ends conforming to the requirements of §710-22 *Cable Guide Railing* and as shown in Detail X of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence.*

6. **Wire Ties.** Provide galvanized steel wire ties (12 gauge).

7. **U Bolts.** Provide galvanized and Epoxy-coated 3/8 in. x 2 ½ in. throat by 4 ½ in. depth “U” bolts as shown in Detail’s C1 & C2 of the Standard Sheet 212-02 *Chain Link Rock Catchment Fence* with 1/8 in. thread length to clamp ¾ in. guide rail cables to No. 11 rebar posts.

212-2.03 Wire Mesh Slope Protection.

A. **Wire Mesh.** Provide wire mesh conforming to §710-06 *Rock Slope Net and Wire Mesh Assemblies,* Wire Mesh.
B. **Cables.** Provide galvanized mesh support cables having a minimum diameter of ¾ in., 6 x 19 Independent Wire Rope Core (IWRC) construction (or equivalent), conforming to the requirements of §710-22 *Cable Guide Railing.*

C. **Anchors.** Provide galvanized ¾ in. diameter wire rope anchors conforming to the requirements of §710-22 *Cable Guide Railing.*

   Furnish anchor centralizers consisting of plastic, steel or any material not detrimental to the anchor. Do not use wood.

D. **Grout.** Provide grout conforming to the requirements of §701-05 *Concrete Grouting Material.*

E. **Miscellaneous Appurtenances.**

   1. **Seam Wire Rope.** Provide seam rope conforming to §710-27 *Rock Slope Wire Ropes,* Seam Rope for Wire Mesh Slope Protection.

   2. **Steel Rings.** Provide 1 in. x 4 in. steel rings conforming to the requirements of Federal Specification RR-C71D Type VI.

   3. **Clips.** Provide ¾ in. wire rope clips conforming to the requirements of §710-22 *Cable Guide Railing.*

   4. **Thimbles.** Provide ¾ in. thimbles conforming to the requirements of §710-22 *Cable Guide Railing.*

**212-2.04 Wire Mesh Drape.**

A. **Wire Mesh Drape.** Provide wire mesh drape conforming to the requirements of §710-06 *Rock Slope Net and Wire Mesh Assemblies,* Rock Slope Wire Mesh Drape Assembly.

B. **Cables.** Provide galvanized mesh support cables a minimum ¾ in. in diameter, consisting of 3 strands (7 wires per strand) conforming to the requirements of §710-22 *Cable Guide Railing* and having a minimum tensile strength of 25 kips.

C. **Miscellaneous Appurtenances.** Provide appurtenances, galvanized as supplied by manufacturer, as follows:

   1. **Tie Wire.** Provide 1/12 in. minimum diameter steel tie wire.

   2. **Hog Rings.** Provide 1/8 in. minimum diameter (11 gauge) hog rings or other steel fasteners.

   3. **Steel Rings.** Provide welded forged steel rings with a stock diameter of 1 in. and a maximum inside diameter of 4 in.

D. **Resin Rock Bolt Assembly.** Provide 1 ¼ in. nominal diameter, 6 ½ ft. long (min.), resin rock bolt assembly conforming to the requirements of §731-03 *Rock Bolt Assembly* except resin packages of one setting time only shall be utilized for installation of the mesh support and cable anchor rock bolts.

**212-2.05 Temporary Rock Catchment Barrier.**
A. Precast Concrete Barrier Units. Provide precast concrete barrier units consisting of three (3) components: precast concrete column supports, precast temporary concrete barriers, and precast concrete beams as detailed on the Standard Sheet 212-05 Temporary Rock Catchment Barrier.

1. Precast Concrete Column Supports. Provide precast concrete column supports conforming to the requirements of §704-05 Precast Concrete Barrier and to the dimensions and details “F”, “G”, “H”, “I”, and “N” on the Standard Sheet 212-05 Temporary Rock Catchment Barrier. Additional joint connection details shall be as shown on Standard Sheet 619-01 Temporary Concrete Barrier.

   Each column support shall have cast-in-place a 6 in. x 6 in. x ¼ in. structural steel tube to be used for support of the wire rope rock fence. The tube steel shall conform to the requirements of ASTM A500, Grade B or C, and shall conform to the dimensions and detail “N” on the Standard Sheet 212-05 Temporary Rock Catchment Barrier.

2. Precast Temporary Concrete Barriers. Provide precast temporary concrete barriers conforming to the requirements of §704-05 Precast Concrete Barrier and to the dimensions, joint connections, material details, and anchoring details shown on Standard Sheet 619-01 Temporary Concrete Barrier.

3. Precast Concrete Beams. Provide precast concrete beams conforming to the requirements of §704-05 Precast Concrete Barrier and to the dimensions and details “K”, and “M” shown on the Standard Sheet 212-05 Temporary Rock Catchment Barrier.

The Engineer will inspect all precast concrete barrier unit components upon delivery to the project site for conformance to specifications. Any barrier unit component having damage and/or defects in the concrete and/or joint connections will be rejected.

The precast concrete barrier units shall form a smooth and continuous barrier when joined together. Any sections damaged or misaligned while in service shall be corrected or replaced.

B. Net Support Columns. Fabricate the net support columns from W5 x 16 wide flange members conforming to the requirements of §715-18 Soldier Piles

   Each support column shall have four (4) pairs (eight holes) of 1 in. diameter holes drilled on the side facing the rock slope. Two (2) holes shall be situated 3 in. from the top of the post and the remaining three (3) pairs spaced equally approximately 40 in. apart.

   After any required drilling, welding and/or cutting, all support columns and related hardware shall be hot dipped galvanized in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type I.


D. Wire Rope Netting. Provide wire rope netting conforming to §710-06 Rock Slope Net and Wire Mesh Assemblies, Net Assembly.

   Two (2) aluminum stop sleeves shall be used at all locations where two individual wire ropes are joined together.

   The 8 in. x 8 in. mesh size shall be fabricated using high strength, hot dipped, galvanized steel clips, which are attached so that they are non-moveable. Nets damaged during clipping shall be rejected by the Engineer.

E. Chain Link Fence Fabric. Provide a minimum of 9 gauge chain link fence fabric conforming to the requirements of §710-02 Galvanized Steel Fence Fabric. The galvanized chain link fence fabric
shall be 12 ft. high and have a 2 in. mesh size. The chain link fence fabric shall be continuous between wire rope net panels.

**F. Synthetic Fabric Layer.** Provide a synthetic fabric, 10 ½ ft. in height conforming to the requirements of §737-01A Geotextile Bedding.

**G. Cushion Sand.** Provide sand conforming to the requirements of §703-06 Cushion Sand.

**H. Miscellaneous Material.** Provide miscellaneous hardware such as shackles, thimbles, wire clips, bolts, etc. which shall be hot dipped galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods, Type I.

**212-2.06 Move Temporary Rock Catchment Barrier.** None Specified.

**212-3 CONSTRUCTION DETAILS**

**212-3.01 Wire Rope Rock Catchment Fence.** Assemble the wire rope rock catchment fence as detailed on the Standard Sheet 212-01 Wire Rope Rock Catchment Fence.

Submit to the Engineer for approval not less than two weeks prior to the installation of the wire rope rock catchment fence. Do not begin work prior to approval. Provide the following:

- Proposed start date, completion date and detailed construction sequence.
- Proposed anchor drilling method and equipment including hole diameter, method of keeping holes open, and hole clean out procedures.
- Proposed anchor installation procedure including grout placement procedures, grouting equipment, and the procedure for setting the wire rope anchor centralizers.
- Method of verifying anchor capacity and equipment setup including details of the jacking frame and appurtenant bracing. Include the calibration data for the stressing device. The calibration shall be performed by an independent testing laboratory within 60 calendar days of the submittal date.

Install grouted wire rope anchors with accompanying centralizers at the top of the rock slope on 12 ft. centers or as indicated by Engineer. Mix grout per manufacturer’s instructions. Wait a minimum of 7 days after grouting before applying any load to the anchors. Proof test each anchor in accordance with §212-3.03 A. Anchor Testing.

Fasten all net braiding with high strength, corrosion resistant clips or other fasteners to produce a permanent, non-movable joint. Damage to the wire rope resulting from the installation of the clips, insofar as it affects the integrity of the system, in the opinion of the Engineer, shall be cause for rejection of the net panel.

Cut the chain link material to fit each wire rope netting panel. Attach the chain link mesh fencing material to the inside face of the wire rope nets with clips to extend a minimum of 3 ft. beyond the bottom of the fence.

Provide and install one braking element per top and bottom net supporting rope per 20 ft. net section. Position the braking element not more than 3 ft. from the column.

Use seam ropes to fasten adjacent wire rope nets and the nets to the net support wire ropes, with at least 1 wrap per 16 in.

The column spacing shall be 20 ft.

Install a tie-back restraining cable to extend from the top of each column in a direction perpendicular to the length of the fence and on the slope side of the fence. Install a braking element in each cable not more than 3 ft. from the column.

For a fence whose length is 120 ft. or less, both end columns shall have a lateral restraining cable without the braking element. This cable shall extend from the top of the column at an angle of 60° from
the vertical to the ground. For a fence which is longer, install lateral restraining cables at every multiple of 120 ft., or approximately midway for a fence less than 240 ft.

Paint the fence installation where specified, with the appropriate material and color as directed by the Engineer.

212-3.02 Chain Link Rock Catchment Fence. Assemble the chain link rock catchment fence as detailed on the Standard Sheet 212-02 Chain Link Rock Catchment Fence.

Install galvanized No. 11 steel rebar posts in 2 in. diameter vertical holes drilled to a minimum depth of 2 ft. into rock. Post spacing shall be 8 ft. Pour a sufficient amount of concrete grouting material into the hole before inserting the post to allow overflow after insertion.

Install anchor angles for terminal sections. The location of the anchor angles shall be in line with the corresponding fence section and shall be determined by the angle (60° minimum) between the top longitudinal cable and the end post. The angle between any longitudinal cable and the end post shall not exceed 90°. Drill bolt holes for anchor angles into the rock spaced 16 in. on-center to a depth of 4 ft. The bolt hole diameter shall be compatible with the bolt/drill hole/resin cartridge diameter, as recommended by the bolt manufacturer, but in no case shall the bolt hole diameter exceed the resin cartridge diameter by more than 3/8 in. Install the anchor angle within 90°± 15° to the axis of the rock bolt and in intimate contact with the rock surface for its entire contact area. Acceptable methods of leveling the rock surface include the following:

a) Chipping the rock surface.
b) Applying a special mix supplied by the bolt manufacturer for leveling purposes.
c) A combination of chipping and leveling.

Clean out the bolt hole to its full depth with air or water. Place the appropriate amount of resin in the hole. Insert the bolt into the hole and rotate at approximately 100 rpm while pushing the bolt down through the resin cartridges to the bottom of the hole by a means approved by the Engineer. Rotate the bolt in this position for 30 to 60 seconds to insure mixing of the resin in the hole. Do not rotate the bolt longer than the setting time of the resin. Leave the bolts undisturbed in the hole for the time required for the resin to harden. Place the anchor angle over the bolts on the prepared surface and add the appurtenances. Tension the bolts to 40 kips by means of hollow-ram hydraulic jack, or as ordered by the Engineer. Support the base of the jack at 90°± 2° to the axis of the bolt.

If a failure of the bolt or anchorage occurs, a determination of the cause of failure will be made by a Departmental Engineering Geologist. Correct, as ordered by the Engineer, at no cost to the State, failures attributable to causes other than failure of the rock in the anchorage zone.

The State reserves the right to sample and test delivered materials.

Install No. 9 stainless steel hook bar anchors on the uphill side of the fence, one hook bar anchor at each post located in a direction normal to the fence alignment. The location of the hook anchor on the ground surface shall be determined by the angle (60°± 5°) between the tie-back cable and the post at the top longitudinal cable. Construct hook bar anchorages according to depth of overburden.

Install No. 9 stainless steel hook bar anchors at intermediate fence sections. The location of the hook bar anchors shall be in line with the corresponding fence section and shall be determined by the angle between the longitudinal cables and the intermediate anchorage post. This angle shall be between a minimum of 60°± 5° and a maximum of 90°. Construct hook bar anchorages according to depth of overburden.

Secure longitudinal cables to anchor angles at terminal sections with steel turnbuckle cable end assemblies. Secure longitudinal cables at intermediate fence sections to hook bar anchors with one (1) thimble, and four (4) cable clips per cable loop. The maximum distance between terminal sections, and/or intermediate anchorage sections, shall be 200 ft.

Secure ¾ in. longitudinal guide rail cables to rebar posts with “U” bolts so as to have minimum sag without bending posts. Cable splices shall be staggered a minimum of 20 ft. on adjacent cables. Splices shall be spaced a minimum of 100 ft. on the same cable.

Recommended installation sequence:
a) Start with lowest longitudinal cable working from one terminal anchorage toward another or toward an intermediate anchorage, if used.
b) Draw cable taut and secure with “U” bolt to posts.
c) Complete tightening entire length of lower cable between anchorages before starting next higher cable.

Install aluminum fence fabric on uphill side of posts. Attach fence fabric to longitudinal cables with 12 gauge galvanized steel wire ties at 1 ft. intervals. Fence fabric splices shall be overlapped a minimum of four chain link rows. Attach fabric sections by tying both ends of the overlap at 1 ft. intervals, or by a method approved by the Engineer.

Install vinyl coated fence fabric on roadway side of posts. Attach fence fabric to longitudinal cables with 9 gauge vinyl coated steel wire ties at 1 ft. intervals. Fence fabric splices shall be overlapped a minimum of four chain link rows. Attach fabric sections by tying both ends of the overlap at 1 ft. intervals, or by a method approved by the Engineer.

Bottom of fence fabric shall be in contact with the ground surface. Add fence fabric material as necessary. Added material shall be overlapped a minimum of four chain link rows. Tie both ends of the overlap at 1 ft. intervals, or as approved by the Engineer.

Attach tie-back cables on uphill side of rebar posts after longitudinal cables have been tightened and chain link fence fabric has been installed. Tie-back cables shall have a maximum sag of ¾ in. measured at the center.

212-3.03 Wire Mesh Slope Protection. Assemble the wire mesh slope protection as detailed on the Standard Sheet 212-03 Wire Mesh Slope Protection.

Design the grouted wire rope anchors so that the design load (P) is at least equal to 30 kips.

Submit shop drawings to the Engineer for approval not less than two weeks prior to the installation of the wire mesh slope protection. Do not begin work prior to approval. Provide drawings including the following:

   a) Proposed start date, completion date and detailed construction sequence.
   b) Details of the wire mesh and anchor layout on the existing slope.
   c) Proposed anchor drilling method and equipment including hole diameter, method of keeping holes open, and hole clean out procedures.
   d) Proposed anchor installation procedure including grout placement procedures, grouting equipment, and the procedure for setting the wire rope anchor centralizers.
   e) Method of verifying anchor capacity and equipment setup including details of the jacking frame and appurtenant bracing. Include the calibration data for the stressing device. The calibration shall be performed by an independent testing laboratory within 60 calendar days of the submittal date.

Install grouted wire rope anchors with accompanying centralizers at the top of the rock slope on 12 ft. centers or as indicated by Engineer. Mix grout per manufacturer’s instructions. Wait a minimum of 7 days after grouting before applying any load to the anchors. Proof test each anchor in accordance with §212-3.03 A. Anchor Testing.

Connect vertical wire rope tag lines to the anchors. Connect the horizontal support cable(s) to the vertical tag lines with steel rings as shown on the attached drawing for this specification. Do not draw cable taut. Maintain a minimum cable sag of ¾ in. on the horizontal support cable between vertical tag lines.

Attach the mesh to the horizontal support cable by a continuous weave through each of the mesh openings with galvanized 5/16 in. seam wire rope, as shown on the attached drawing for this specification. Install the wire mesh in vertical strips. Overlay horizontal and vertical laps a minimum of 1 ft. and connect with a continuous weave through each of the mesh openings with galvanized 5/16 in. seam wire rope along the edge of the upper mesh strip. The mesh shall be installed in such a manner that the end of a roll curls into the rock face.

Install the wire mesh to cover the specified area of rock face.
A. Anchor Testing. Proof test each anchor. Perform the proof test by incrementally loading and unloading the anchors to 1.5 times the design load (P) in accordance with Table 212-1 Wire Mesh Slope Protection Proof Test Load Schedule. Record the anchor movements to the nearest 0.025 mm at each load increment.

<table>
<thead>
<tr>
<th>Load¹</th>
<th>Observation Period</th>
</tr>
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<tbody>
<tr>
<td>AL</td>
<td>Minimum of 1 minute²</td>
</tr>
<tr>
<td>0.25 P</td>
<td>Minimum of 1 minute²</td>
</tr>
<tr>
<td>0.50 P</td>
<td>Minimum of 1 minute²</td>
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<tr>
<td>1.00 P</td>
<td>Minimum of 1 minute²</td>
</tr>
<tr>
<td>1.25 P</td>
<td>Minimum of 1 minute²</td>
</tr>
<tr>
<td>1.50 P (Load Hold)²</td>
<td>10 minutes (or 60 minutes depending on total movement³)</td>
</tr>
</tbody>
</table>

¹P = Design Load  
AL = Alignment Load. The AL necessary to maintain position of the stressing and testing equipment shall not exceed 0.05 P. Set dial gauges to “zero” after the alignment load has been applied.

²Hold each load increment, except for the 1.5 P load, until the deflection stabilizes.

³The load hold portion of the proof test is a maximum test load of 1.50 P, which shall be held constant for 10 minutes. The load hold time shall start when the pump begins to load the anchor from the 1.25 P load to the test load. A load cell shall be used to monitor the constant load. Total movements with respect to an independent fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 1/24 in., the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15, 20, 25, 30, 45 and 60 minutes.

No part of the temporary yoke or load frame shall bear within 3 ft. of the anchor.  
Plot the movement versus load for each increment.  
An anchor will be accepted by the Engineer if the creep rate at 1.5P does not exceed 1/24 in. between the 1 and 10 minute readings or for a load hold time of 60 minutes, the creep rate does not exceed 1/12 in. per log cycle of time. If an anchor fails the proof test, install a new anchor at no cost to the State.

Install untensioned resin rock bolts at the top of the rockslope on 50 ft. centers (maximum) or as shown in the contract documents. Proof test the first rock bolt per resin lot number to 20 kips in accordance with §212-3.03 A. Anchor Testing.  
Place ¾ in. diameter guide rail cable horizontally across the top of the rock slope, secured by 1 ¼ in. diameter resin rock bolts. Maintain a minimum cable sag of 2 ft. to 3 ft. between rock bolts. Do not draw cable taut. Splices of the guide rail cable will not be allowed.  
Fold the mesh over or under the guide rail cable a minimum of 1 ft. and connect the horizontal lap with galvanized tie wire with a continuous weave through each of the mesh openings.  
Install the wire mesh in vertical strips, each lapped over the other by a minimum of 1 ft. Connect the adjacent vertical strips by either a continuous weave of galvanized tie wire along the edge of the outer
mesh strips only, or with hog rings or metal ties on a 6 in. staggered pattern along the edges of both panels. When used, overlay horizontal laps a minimum of 1 ft. and connect with a continuous weave of galvanized tie wire along the edge of the upper mesh strip.

Install the wire mesh to cover the area of rock face identified in the contract documents.

Repair all damaged galvanized surfaces in accordance with §719-01 Galvanized Coatings and Repair Methods.

**212-3.05 Temporary Rock Catchment Barrier.** Assemble and maintain the temporary rock catchment barrier as detailed on the Standard Sheet 212-05 Temporary Rock Catchment Barrier.

**A. Precast Concrete Barrier Units.** Each run, or bay, of precast concrete barrier units (precast concrete column support, precast temporary concrete barrier and precast concrete beam) shall be fastened together to form a continuous chain. After placement, each successive unit shall be moved longitudinally to remove any slack in the connecting joint. The units at each end of a run or bay shall be connected as shown on Standard Sheet 619-01 Temporary Concrete Barrier. To reduce movement of the barrier in areas where limited deflection is desired, one of the anchoring methods shown on Standard Sheet 619-01 Temporary Concrete Barrier shall be used. Where shown in the contract documents, the ends of the barrier run shall be fitted with an impact attenuation device or a tapered end section and flared back.

The empty space within each concrete barrier unit shall be filled with sand for the full height (32 in.) of the unit. The back of the concrete barrier units shall also be covered with sand to the full height of the unit. The sand shall then be laid back at the angle of repose of the material to a minimum sand thickness of 18 in. as shown in detail “E” on Standard Sheet 212-9 Temporary Rock Catchment Barrier. The cost of installing and removing the sand, including the final cleaning of the pavement and shoulder, shall be included in the bid price for this Item.

The Contractor shall provide and maintain delineation of temporary barriers. This delineation shall make the barrier visible to approaching traffic, as well as to traffic which is adjacent to the barrier. The Contractor shall have the choice of using one or more of the following: warning lights, delineators, pavement marking, reflective tape placed on the barrier, reflective paint, or any other device subject to the approval of the Engineer. The delineation devices shall be maintained dirt and snow free, and be visible throughout the term of the contract including shutdown periods.

**B. Net Support Columns.** The W5 x 16 posts shall be installed in the 6 in. x 6 in. x ¼ in. structural steel tubes cast in the precast concrete column support units. The columns shall be inserted flush with the bottom of the precast concrete column supports.

**C. Net Support and Lateral Anchor Ropes.** The 5/8 in. net support wire ropes shall be installed as shown in detail “B” on Standard Sheet 212-05 Temporary Rock Catchment Barrier. The net support wire rope shall have maximum sag of 2 in. At both end sections and at every 125 ft. section of temporary catchment barrier (five precast concrete barrier units) install lateral anchors as shown in detail “C” on Standard Sheet 212-05 Temporary Rock Catchment Barrier. The wire rope loop at a ¾ in. shackle connection shall be secured with three (3) wire rope clips as shown in detail “J” on Standard Sheet 212-05 Temporary Rock Catchment Barrier.

**D. Rock Catchment Fence Fabric.** The rock catchment fence fabric (wire rope net, chain link fence fabric and synthetic fabric) shall be attached to the support rope after the concrete barrier units have been installed.

The wire rope net panels shall be attached to the support ropes with ¾ in. shackles spaced approximately 3 ft. apart. The chain link fence fabric, 12 ft. in height, shall be attached to the wire rope net with hog rings or twist ties. The area between two adjacent wire rope net panels shall be
covered with chain link fence fabric. The layer of synthetic fabric, with a minimum height of 10 ½ ft., shall be attached to the chain link fence.

212-3.06 Move Temporary Rock Catchment Barrier. Move and reset the temporary rock catchment barrier in accordance with the requirements of §212-3.05 Temporary Rock Catchment Barrier.

212-4 METHOD OF MEASUREMENT

212-4.01 Wire Rope Rock Catchment Fence. Wire rope rock catchment fence will be measured as the number of linear feet of fencing, measured from center-to-center of end posts.

212-4.02 Chain Link Rock Catchment Fence. Chain link rock catchment fence will be measured as the number of linear feet of fence, measured along the top of the fence between the terminal posts. An allowance of 10 linear feet will be added for each terminal section anchorage and for each intermediate section anchorage installed.

212-4.03 Wire Mesh Slope Protection. Wire mesh slope protection will be measured as the number of square feet of rock face satisfactorily covered. No measurement will be made of wire mesh used in any overlap.

212-4.04 Wire Mesh Drape. Wire mesh drape will be measured as the number of square feet of rock face satisfactorily covered. No measurement will be made of wire mesh used in any overlap.

212-4.05 Temporary Rock Catchment Barrier. Temporary rock catchment barrier will be measured as the number of linear feet of barrier, measured along the centerline of the uppermost concrete barrier surface, from one end anchor to the other.

212-4.06 Move Temporary Rock Catchment Barrier. Moving temporary rock catchment barrier will be measured as the number of linear feet of barrier moved, measured along the centerline of the uppermost concrete barrier surface, from one end anchor to the other.

212-5 BASIS OF PAYMENT

212-5.01 Wire Rope Rock Catchment Fence. The unit price bid per linear feet for wire rope rock catchment fence shall include the costs of furnishing all labor, material and equipment necessary to complete the work.

212-5.02 Chain Link Rock Catchment Fence. The unit price bid per linear feet for chain link rock catchment fence shall include the costs of furnishing all labor, material and equipment necessary to complete the work.

212-5.03 Wire Mesh Slope Protection. The unit price bid per square feet for wire mesh slope protection shall include the costs of furnishing all labor, material and equipment necessary to complete the work, including anchor testing and disposal of any material removed from the slope.

212-5.04 Wire Mesh Drape. The unit price bid per square feet for wire mesh drape shall include the costs of furnishing all labor, material and equipment necessary to complete the work, including anchor testing and disposal of any material removed from the slope.
212-5.05 Temporary Rock Catchment Barrier. The unit price bid per linear feet for temporary rock catchment barrier shall include the costs of furnishing all labor, material and equipment necessary to erect, maintain, and remove the required barrier, including any required connection devices, end treatments, delineation or guiding devices, and devices for pinning and connecting temporary precast concrete barrier units.

After placement, 90% of the item unit price will be paid. The remaining 10% will be paid when the rock catchment barrier has been removed.

212-5.06 Move Temporary Rock Catchment Barrier. The unit price bid per linear feet for moving temporary rock catchment barrier shall include the costs of furnishing all labor, material and equipment necessary to remove, transport, erect, and maintain the required barrier, including any required connection devices, end treatments, delineation or guiding devices, and devices for pinning and connecting temporary precast concrete barrier units.

Movements necessary to maintain, realign, or replace damaged units will not be considered as moving temporary rock catchment barrier and shall be done at no additional cost to the State.

Payment will be made under:

<table>
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<th>Item No.</th>
<th>Item Pay</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
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<td>Wire Rope Rock Catchment Fence (Medium Impact – 6 ft.)</td>
<td>Feet</td>
</tr>
<tr>
<td>212.0108</td>
<td>Wire Rope Rock Catchment Fence (Medium Impact – 8 ft.)</td>
<td>Feet</td>
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<tr>
<td>212.0110</td>
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<td>212.0112</td>
<td>Wire Rope Rock Catchment Fence (Medium Impact – 12 ft.)</td>
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<td>Vinyl Coated Chain Link Rock Catchment Fence</td>
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<td>Wire Mesh Drape Square</td>
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SECTIONS 213 THRU 299 (VACANT)
Section 300
BASES AND SUBBASES

SECTION 301 (VACANT)

SECTION 302 - BITUMINOUS STABILIZED COURSE

302-1 DESCRIPTION. This work shall consist of furnishing and placing a course of bituminous stabilized granular material and stabilized reclaimed asphalt pavement shoulder in conformance with this specification, the payment lines, and typical sections shown on the plans or as specified by the Engineer.

302-2 MATERIALS

302-2.01 General. The Contractor has the following options in furnishing a bituminous stabilized course:

Option A. Furnish a granular material conforming to the requirements of Option A under §302-2.03, mixed with an asphalt emulsion conforming to §702-3201. Requests to use any asphalt emulsion other than that specified must be approved by the Director, Geotechnical Engineering Bureau. The written request must state the type of asphalt emulsion for the proposed use and be accompanied by a sample (one quart minimum) of such. The Geotechnical Engineering Bureau will require at least fourteen days to act upon the request, after receipt of the request and the sample.

Option B. Furnish a 3/4, 1 or 1 1/2 inch hot mix asphalt (HMA), mixed and placed in conformance with the Materials and Construction Details specified in Section 402, Hot Mix Asphalt (HMA) Pavements, except as modified herein.

Option C. Furnish a granular material conforming to the requirements of Option C under §302-2.03, mixed with the appropriate P.G. Binder specified in the contract and placed in accordance with the requirements of Section 402 except as modified herein. The amount of P.G. Binder for this option will be as ordered by the Engineer, but shall range between 6 and 8 percent by weight. Unless otherwise indicated by a Special Note in the Proposal, this option will be permitted only in Nassau and Suffolk Counties.

Before any Bituminous Stabilized Course is prepared, the Contractor shall take one of the following two actions:

- Notify the Engineer in writing as to which option is selected to furnish material under. Only this option will then apply for the entire project unless written approval is received from the Engineer.
- Submit to the Engineer for approval, a plan of the project delineating the areas where each option will apply. Exceptions to the approved plan during the course of the work shall be subject to advance written approval by the Engineer.

302-2.02 Tests and Control Methods. Materials tests and quality control methods pertaining to the work of this Section will be performed in conformance with the procedures contained in the appropriate Department publications which are current on the date of advertisement for bids. These publications are available upon request to the Regional Director or the Director, Geotechnical Engineering Bureau.
302-2.03 **Granular Material Requirements for Options A and C.** All borrow sources of granular materials for Options A and C shall be managed in accordance with the applicable provisions of Section 203, *Borrow*.

**A. Gradation Requirements.** The material for Options A and C shall conform to Table 302-1.

**B. Soundness.** Granular materials will be accepted on the basis of a Magnesium Sulfate Soundness Loss after 4 cycles of 20 percent or less, unless other values are specified by a Special Note in the Proposal.

<table>
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<tr>
<th>Sieve Option</th>
<th>2 in</th>
<th>1 in</th>
<th>1/2 in</th>
<th>1/4 in</th>
<th># 10</th>
<th># 40</th>
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<td>55-75</td>
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<td>4-12</td>
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**C. Plasticity Index.** The plasticity index shall not exceed 5.0 for the granular material unless otherwise stated in the Proposal by a Special Note.

302-3 **CONSTRUCTION DETAILS**

302-3.01 **Weather Limitations for Option A.** This work will not be permitted on a subbase or subgrade containing frost, nor when the temperature of the surface on which the mixture is to be placed is below 45°F. All material placed under this section during any calendar year shall be mixed after March 1 of that year. No material shall be placed from the last Saturday of September to May 15, except with written permission of and under such special limitations and conditions as may be imposed by the Deputy Chief Engineer (Technical Services).

302-3.02 **Equipment for Mixing Option A.** All equipment for this work shall be subject to approval of the Engineer at all times. No work under this section will be permitted until all equipment and the processing facilities are established, inspected and approved.

Mixing shall be done with a rotating paddle shaft pugmill, providing suitable pressure-kneading action in mixing. Mixing by blading, shoveling and/or scooping will not be permitted.

The materials shall be mixed either at a central twin shaft pugmill mixing plant by the plant mix method, or on the roadbed (or some other area approved by the Engineer) by a traveling twin shaft pugmill, whichever equipment the Contractor elects to use.

The mixer shall be either a continuous or a batch type pugmill, designed to accurately proportion either by volume or by weight, so that when the granular material and bituminous material are incorporated in the mix, a thorough and uniform coating of the granular material will result. The pugmill mixer shall be provided with weighing, volumetric or other gauging equipment which shall be capable of providing accurate control at all times of the amount of granular material entering the mixer per time interval. The mixer shall be equipped to mechanically interlock the bituminous feed with the granular material feed, such that uniformity of the mixture is assured at all times. A water pump with meter shall be available to add water to the granular material, just prior to the addition of the bituminous material.

The mixer shall be equipped with a positive displacement meter for totalizing the quantity of bituminous material applied to the mixing chamber. A by-pass valve shall be placed on the bituminous line between the positive displacement meter and the spray bar in the pugmill to permit determination of the accuracy of the positive displacement meter. The Contractor shall furnish a clean 55 gallon drum having one end completely open, and a length of flexible hose to permit filling from the by-pass valve on the bituminous line.
Traveling pugmill mixing equipment shall not be operated at speeds greater than those recommended by the manufacturer for the depth of treatment and quantity of material used.

Where the materials are mixed at a central twin shaft pugmill mixing plant, the pugmill mixing chamber shall extend at least 4 feet beyond the last point where the granular material, binder, and water are fed into the mixer, so that all materials will be completely and thoroughly mixed in the pugmill for a distance of at least 4 feet. The pugmill paddles shall be of a type adjustable for angular position on the shaft, and shall be reversible to allow retardation of the flow of the mixer, in order to control the mixing time. A dam or baffle, if approved in writing by the Director, Geotechnical Engineering Bureau may be used for the purpose of retarding flow. A mechanically operated discharge hopper of at least 1 cubic yard capacity shall be provided. Sufficient clearance for a ten wheel dump truck shall be provided beneath the discharge hopper to permit calibration.

302-3.03 Stockpiling and Sampling for Option A. Before mixing with the bituminous material, the granular material shall be stockpiled, sampled and tested for approval as stipulated in §302-2.02.

302-3.04 Mixing for Option A. The proportion of bituminous material that shall be mixed with the granular material will range between 16 and 19 gallons per cubic yard, loose (uncompacted) measure. The actual proportion within this range, however, shall not be less than that determined by the Geotechnical Engineering Bureau and specified by the Engineer after the stockpiled granular material is sampled and tested. In computing the rate of application, the loose measure volume shall be determined by level filling a truck, having a minimum capacity of 8 cubic yards, with granular material. No mixing will be allowed until the temperature of the granular material is 45°F or higher.

The moisture content of the granular material, based on the material passing 3/4 inch sieve, just prior to the addition of the bituminous material, shall be in the range of 4 to 8 percent. The acceptable moisture content within this range shall be determined by the Engineer.

All granular material removed from stockpiles for introduction into continuous twin shaft or traveling twin shaft pugmill mixers shall be by side excavation for the full height of the stockpile unless otherwise approved in writing by the Director, Geotechnical Engineering Bureau.

If mixed in a traveling plant, the method of transporting and introducing granular material from approved stockpiles into the mixer shall be as approved by the Engineer.

The application temperature of the bituminous material shall be designated by the Engineer and be within the range of 130°F to 170°F.

After the granular material and bituminous material have been introduced into the pugmill, the mixing shall continue for a length of time necessary to uniformly coat the particles and to obtain a homogeneous mixture.

The discharge gates in a central plant shall not remain open during production of the stabilized mixture and shall only be opened in order to empty the hopper after the hopper becomes full. The discharged mixture may be immediately transported directly to the grade or stockpiles for later use.

The material shall be transported to the stockpile by dump truck haul. If the Contractor wishes to utilize a method other than dump truck haul to construct stockpiles, a request shall be submitted to the Director, Geotechnical Engineering Bureau. The request shall include the proposed method and type of equipment to be used.

Approval, if granted, will be based on the opinion of the Director, Geotechnical Engineering Bureau as to the capabilities of the proposal to provide a stockpile of uniformly mixed, uncontaminated material. If granted, such a waiver will remain in force only so long as all conditions for which the waiver is granted remain unchanged and a satisfactory material results.

302-3.05 Transporting, Spreading, Compacting and Finishing of Option A. If a central mixing plant is used, the mixture shall be transported from the mixing plant or stockpiles to the point of use in pneumatic tired vehicles, having tight bodies previously cleaned of all other materials. Approved mechanical spreading equipment shall be used for placing.
The mixture shall be spread in a thickness sufficient to produce the final compacted thickness shown on the plans. The maximum compacted thickness of any layer shall not exceed 4 inches.

After spreading, the mixture shall not be compacted until properly cured. Adequate curing shall be the responsibility of the Contractor, who shall take into account all factors, including weather and time of the year. Material that cannot be properly and adequately compacted to a stable condition shall be removed and replaced at no expense to the State. Compaction of the course shall be in accordance with the applicable provisions of §402-3.07, Compaction.

Successive layers shall not be placed until the underlying layer has been satisfactorily compacted and approved by the Engineer.

302-3.06 Traffic. The movement of highway traffic and construction equipment over this course may be permitted at locations designated by and in a manner under such restrictions as are ordered by the Engineer. Any damage occurring to the course as a result of traffic shall be repaired at no expense to the State as ordered by the Engineer.

302-3.07 Care of Adjoining Pavement. Where this course constitutes a base course for a shoulder, the Contractor shall organize the work and conduct the various operations so as to keep the surface of the adjacent pavement clean at all times, or shall bear the full expense of cleaning the pavement as ordered by the Engineer.

302-3.08 Tolerance. Where used as a base course supporting other pavement courses, the final surface elevation of this course shall not vary more than 1/4 inch above or below the design grade elevation at any location.

Where used as a shoulder base course, the surface elevation of this course shall not vary more than 1/4 inch above or below, true grade at any location.

302-3.09 Maintenance. The Contractor shall be required to maintain the bituminous stabilized course in good condition and in a manner satisfactory to the Engineer from the time work is begun until all work has been completed and accepted. Maintenance by the Contractor shall include immediate repairs of any defects, regardless of cause, that may occur.

302-3.10 Repairs. Repairs to the bituminous stabilized course shall be made in a manner that will assure restoration of a uniform surface and durability of the part repaired. A stabilized course that is either faulty, damaged or with low areas shall be repaired by replacing the stabilized course material to the full depth of treatment. When the extent of damage is essentially at the surface of the course and where the areas are low, the Contractor may elect to repair the course with a surface application of an approved, suitable, top course bituminous concrete mix, in lieu of a full depth material replacement.

302-4 METHOD OF MEASUREMENT. The quantity of Bituminous Stabilized Course to be measured for payment, will be the number of cubic yards of compacted material computed from the payment lines shown on the plans, the specifications, or as ordered by the Engineer.

302-5 BASIS OF PAYMENT. The unit price bid per cubic yard shall include the cost of furnishing all labor, materials and equipment, including bituminous material and water necessary to complete the work.

Any work by the Contractor required for the maintenance or repair of bituminous stabilized course prior to acceptance of the contract, shall be done at the Contractor's expense.

Payment will be made under:

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<td>Cubic Yard</td>
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SECTION 303 (VACANT)

SECTION 304 - SUBBASE COURSE

304-1 DESCRIPTION

304-1.01 General. The work consists of furnishing, placing and compacting a subbase course of the specified type in conformity with the lines, grades, thicknesses and typical sections shown in the contract documents.

304-1.02 Optional Type. When the Optional Type subbase item is specified, select any of the four (4) options as follows:

Option A. Subbase construction consisting of two (2) separate layers of Type 4 and Type 3 Subbase Course.

Option B. Subbase construction consisting of a single layer of Type 1 Subbase Course.

Option C. Subbase construction consisting of a single layer of Type 2 Subbase Course.

Option D. Subbase construction consisting of a single layer of Type 4 Subbase Course.

304-1.03 Definitions. Deleterious: Any material that does not consist of concrete, asphalt, glass, brick, stone, sand, gravel, blast furnace slag, or other materials deemed acceptable, when these materials are used in subbase in conformance with the specification requirements, OR any material which will adversely affect the performance of the product either during handling, during construction, or in its final application.

304-2 MATERIALS. Provide subbase material meeting the requirements of §733-04 Subbase Course.

Provide a subbase material meeting the specification requirements and is within the Contractor’s capabilities to place and fine grade to the required tolerances. Should the subbase course become unstable at any time prior to the placement of the overlying course, correct the unstable condition at no additional cost to the State. Perform any required modification prior to placing the material on the grade.

RAP will not be allowed as an acceptable alternate to Types 1, 3 and 4 at intersection locations or in areas with a high percentage of truck traffic as shown in the contract documents, unless Portland CementConcrete pavement is to be installed as part of the pavement structure. A high percentage of trucks is defined to be 10% or more. For interstates and other freeways, a DDHV of 250 vph is used to indicate a high percentage of trucks.

304-3 CONSTRUCTION DETAILS

304-3.01 General. Notify the Engineer in writing of which placement option, material option (if applicable) and/or material type is proposed for use, at least 14 calendar days prior to performing the work. If it is proposed that more than one option or type is to be used, submit a plan to the Engineer describing where each option or type is proposed for use. This plan must be approved by the Engineer prior to incorporating it into the project. The State reserves the right to disapprove the use of more than one option on a project. Use uniform subbase types and materials within the limits of the roadbed as defined in §101-02 Definition of Terms.
A. **Winter Earthwork.** For Contractors choosing to proceed with earthwork construction operations requiring soil compaction from November 1st thru April 1st, provide the Engineer with a Winter Earthwork submittal, with a copy to the Regional Geotechnical Engineer, in accordance with §203-3.01 A. *Winter Earthwork Submittal.* In all work incorporated into the final product, the Contractor shall not place material that is frozen, or place fill material on frozen ground.

Winter earthwork restrictions for subbase material are such that construction operations may only proceed if the air temperature, ground temperature, and material temperature is above 32° F. Therefore, the Winter Earthwork submittal shall provide details of how standard subbase material will be placed utilizing the modified methods and procedures to adjust for the weather influence on the compaction operations.

304-3.02 Placement

- Place the upper course material on the grade in a manner to minimize segregation, using equipment and procedures approved by the Engineer. Do not perform uncontrolled spreading from piles dumped on the grade.
- The maximum compacted layer thickness shall be as shown in the contract documents. In confined areas, the maximum compacted layer thickness is 6 in. The minimum loose lift thickness is 1.5 times the maximum particle size.
- Place Type 1 with a minimum compacted layer thickness of 6 in.
- Do not place Type 3 material within 4 in. of the bottom of a pavement course.
- Do not place materials blended with glass in contact with synthetic liners, geogrids, geotextiles or other geosynthetics. Ensure that glass incorporated into subbase is thoroughly mixed so that glass constitutes no more than 30 percent by weight anywhere in the subbase.
- When placing material under Option A, place and compact each material in a separate lift.

304-3.03 Compaction. When the moisture content is within the limits for proper compaction, compact the material in accordance with the requirements of §203-3.03 C. *Compaction.* Density tests are not required for the acceptance of these courses.

If a subbase course is disturbed by frost action prior to paving, re-compact the subbase.

304-3.04 Traffic and Contamination. The movement of highway traffic over the final surface of the subbase may be permitted at locations designated by, and under such restrictions as shown in the contract documents, provided such movements take place prior to the final finishing of this course to the specified tolerance. Do not allow highway traffic to move over subbase containing glass. The movement of construction equipment on this course may be permitted at locations designated by and under such restrictions as ordered by the Engineer. At locations where permission is granted for such movement, place and maintain the temporary surface of the course, upon which the construction traffic is running, at least 2 in. above the final surface of the course. Just prior to paving and after all construction traffic not required for the removal has ceased, remove the 2 in. protective layer, and prepare and compact the exposed surface of the course to the specified tolerance.

No payment will be made for furnishing, placing, maintaining, removing and disposing of the 2 in. thick protective layer. Include the cost thereof in the price bid for Subbase Course.

If the subbase is damaged or mixed with the subgrade or any other material due to the Contractor’s operation, remove such material and replace it with the appropriate subbase material at no additional cost to the State.

304-3.05 Tolerance. Place Types 1, 2 or 4 so that after compaction the top surface of the course does not extend more than ¼ in. above nor more than ¼ in. below true grade for the course at any location. Place Type 3 course so that the finished surface does not extend above the true grade and surface for this course at any location.
304-4 METHOD OF MEASUREMENT

304-4.01 Subbase Course. The quantity is the number of cubic yards of material, computed from payment lines shown in the contract documents.

304-5 BASIS OF PAYMENT

304-5.01 Subbase Course. The unit price bid for this work includes the cost of furnishing all labor, material and equipment necessary to complete the work. Include the cost of adding water in the price bid unless the item for applying water is included in the contract. No direct payment will be made for losses of material resulting from compaction, foundation settlement, erosion, or any other cause. No deductions will be made for the volumes occupied by manholes, catch basins and other such objects.

No additional payment will be made for the protective layer, as stated in 304-3.04.

Progress payments will be made after the subbase course has been properly placed and compacted. Payment will be made at the unit price bid for 75% of the quantity. The balance of the quantity will be paid for after the final finishing to the required tolerance and just prior to the placing of the next course.

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SECTIONS 305 AND 306 (VACANT)

SECTION 307 - HYDRATED LIME STABILIZED SUBGRADE

307-1 DESCRIPTION. Hydrated lime stabilized subgrade shall consist of the in-place subgrade soil mixed uniformly with hydrated lime and moistened, compacted and cured in accordance with these specifications, the plans and as specified by the Engineer.

307-2 MATERIALS

307-2.01 Lime Stabilization. Materials for lime stabilization shall meet the requirements of the following:

Water                                     712-01
Hydrated Lime                             712-04

Hydrated lime which has slaked prior to mixing, for any reason, shall not be incorporated in the work.

307-2.02 Surface Treatment. When a surface treatment is required to protect the completed lime stabilized course as specified in §307-3.11, the materials for surface treatment shall meet the following requirements:

Asphalt Emulsion - (RS-2)                   702-3101
Coarse Aggregate - 1A size                  703-02
307-3  CONSTRUCTION DETAILS

307-3.01  Equipment. No work will be permitted until all necessary equipment is on hand, inspected and approved by the Engineer.

A. Scarifiers. A grader-scarifier, heavy disc harrow, heavy plow or rotary pulverizing mixer shall be used for the initial scarification of the soil. The equipment shall be capable of scarifying the soil to the full depth of stabilized treatment.

B. Mixers. A rotary pulverizing mixer or heavy plow shall be used for all mixing of the hydrated lime with the subgrade soil. The use of a heavy plow will be permitted only if the rotary pulverizing mixer is not capable of adequately mixing the lime-soil mixture to the full depth of treatment. Rotary mixers shall be equivalent to the Seaman Duo-Stabilizer Model DS730 or the Brothers Master Mixer Model LSPRM84A.

C. Lime Spreaders. Spreading equipment shall be capable of uniformly distributing the lime without excess loss and at a specified rate.

D. Compactors. Compaction equipment shall be selected as specified in Section 203, Compaction.

E. Shaping. Shaping of the stabilized course shall be accomplished with a motor-grader or equivalent equipment capable of shaping the surface to the required tolerances specified.

F. Finish Rolling. A smooth steel wheel tandem roller weighing between 8 to 10 tons shall be used for the finish rolling.

G. Water Equipment. Water shall be added to the soil with a pressure distributor or other suitable equipment capable of uniformly distributing the required amount.

307-3.02  Weather Limitations. Lime stabilization of the subgrade shall not be done when the subgrade temperature is below 40°F, nor in the period from October 15 to May 15, except by written permission of and under such special limitations as set forth by the Deputy Chief Engineer (Technical Services). The hydrated lime shall not be mixed with frozen subgrade soil or when the subgrade contains frost. Lime shall not be applied when wind conditions, as determined by the Engineer, are such that blowing lime becomes objectionable or hazardous to traffic, workers, and adjacent property owners.

307-3.03  Protection and Safety. Before lime is spread, the Contractor shall take necessary precautions and provide necessary equipment to protect all personnel and adjacent properties from lime dust created by the lime application and mixing operations. Safety goggles and lightweight filter masks shall be provided by the Contractor to all working personnel and shall be worn at all times during these operations.

307-3.04  Preparation of Foundation. Prior to the addition of any lime to the subgrade, the area to be stabilized shall be graded and shaped in close conformity to the typical sections, lines and grades as shown on the plans or as specified by the Engineer. Where the depth of lime stabilization exceeds 6 inches, the subgrade soil in excess of the 6 inches depth shall be removed, placed in windrows and processed as an additional lift.

307-3.05  Scarifying. The subgrade soil shall be scarified 6 inches deep to the width required for stabilization. The scarified material shall be partially pulverized by making one pass through the area with a pulverizing rotary mixer. The pulverizing portion of the scarifying operation may be deleted in some
areas, where, as determined by the Engineer, the subgrade soils are excessively wet and sticky so that pulverizing with a rotary mixer is impractical.

307-3.06 Application of Lime. The hydrated lime shall be applied to the scarified material by an approved method and at the rate stipulated in the plans or as specified by the Engineer. A lime slurry, applied by an approved method and suitable equipment, will be permitted. Spreading equipment shall uniformly distribute the lime without excess loss. No equipment except that used for spreading and mixing shall be permitted to pass over the spread lime until it is mixed. The Engineer may require the spread lime to be sprinkled with water to reduce dusting.

307-3.07 Primary Mixing. After the required amount of lime has been uniformly spread, it shall be mixed into the subgrade to the full depth of treatment using a traveling rotary mixing machine or heavy plow. A minimum of three passes will be required to assure uniform incorporation of the hydrated lime. Water shall be added at the rate of up to 500 gallons/ton of lime as required for the proper consistency.

The primary mixing operation shall be completed within four hours after application of the lime. At this time, all of the lime shall be thoroughly and uniformly incorporated into the subgrade to the full depth of treatment in such a manner that the result is a homogeneous, friable mixture of subgrade soil and lime, free from clods or lumps exceeding 2 inches in size. Where the required depth of stabilization exceeds 6 inches, the windrowed material in excess of the 6 inches depth shall be spread to the required lift thickness and processed, by the addition of lime and primary mixing, as specified for the first layer. Each additional layer, where required, shall be processed similarly.

Immediately after the primary mixing operations are completed for the full depth of treatment, the surface of the subgrade shall be shaped and lightly sealed with a pneumatic tired or smooth steel wheel roller. The surface shall be crowned so as to properly shed water if rain occurs.

307-3.08 Curing. Following primary mixing operations, the stabilized course shall be allowed to cure for at least 24 hours plus any additional time required for the lime to properly react with the subgrade soil. Curing periods in excess of 24 hours shall be as determined and specified by the Engineer. During the curing period, the surface of the material shall be kept moist to prevent drying and cracking, and maintained in a properly sealed and crowned condition as specified by the Engineer.

307-3.09 Secondary Mixing. Immediately after the completion of the curing period, the stabilized course shall again be completely mixed and pulverized to the full depth of stabilization by a rotary pulverizing mixer. Secondary mixing shall continue for at least three passes or until, as determined by the Engineer, the material is properly mixed and blended. Adjustments in water content shall be made during the secondary mixing operation to obtain the proper moisture content required for compaction.

307-3.10 Compaction, Shaping and Finishing. Compaction of the mixture shall begin immediately after completion of the secondary mixing operations and after the proper moisture content for compaction has been obtained. Compaction shall be in accordance with the requirements of Section 203, Compaction. After compaction and shaping, the surface of the course shall be finished-rolled by a smooth steel wheel tandem roller weighing between 8 to 10 tons. The secondary mixing, compaction, shaping and finishing operations shall be completed within eight hours after the start of the secondary mixing.

The surface of the finished stabilized subgrade course shall not extend above design grade at any location.

The thickness of the complete hydrated lime stabilized subgrade will be determined from measurements made in test holes located at random intervals not to exceed 500 feet. The measured thickness shall not deviate from that shown on the plans or specified by the Engineer, by more than plus 1 1/2 inches or minus 1 inch. Areas of hydrated lime stabilized subgrade not meeting the specified thickness requirements shall be reconstructed.
The subbase course material shall be placed and compacted within two days after the lime stabilized subgrade course has been compacted, shaped and finished at that location. The surface of the treated subgrade shall be kept continuously moist up to the time of subbase material placement.

307-3.11 Surface Treatment Option. The Contractor may elect to defer placement of the subbase materials up to two weeks by placing a bituminous membrane, cationic asphalt emulsion, over the treated subgrade. The bituminous membrane must be placed within two days after the stabilized subgrade has been compacted and finished. The stabilized subgrade must be kept continuously moist prior to application of the bituminous membrane. The bituminous material shall be applied at a uniform rate of 0.2 gal/sy of treated subgrade. Where traffic is to operate on the treated subgrade, the bituminous membrane shall be chipped with a uniform coating of Size 1A aggregate applied at a rate of 15 lb/sy of treated subgrade.

307-4 METHOD OF MEASUREMENT

307-4.01 Hydrated Lime Stabilized Subgrade. The quantity of hydrated lime stabilized subgrade to be paid for will be the number of cubic yards of lime stabilized subgrade computed within the payment lines shown on the plans or otherwise specified in writing by the Engineer.

307-4.02 Furnishing and Applying Hydrated Lime. The quantity of hydrated lime to be paid for will be the number of tons of hydrated lime furnished and applied. Lime that has slaked prior to application and additional lime applied because of reduced lime content resulting from excessive thickness of the lime stabilized layer will not be measured for payment.

307-5 BASIS OF PAYMENT

307-5.01 Hydrated Lime Stabilized Subgrade. The unit price bid per cubic yard shall include the cost of furnishing all labor, equipment and materials necessary to complete the work, except that furnishing and applying water and hydrated lime will be paid for separately. No payment will be made for the asphalt emulsion or 1A stone chips, nor for any maintenance, repairs or reconstruction of the stabilized subgrade made before acceptance, nor for any losses of material which may result from compaction, erosion or any other causes.

307-5.02 Furnishing and Applying Hydrated Lime. The unit price bid for hydrated lime shall include the cost of all material, labor and equipment necessary to furnish, store, handle and apply hydrated lime in accordance with these specifications.

Payment will be made under:

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<th>Item No.</th>
<th>Item</th>
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<td>307.02</td>
<td>Furnishing and Applying Hydrated Lime</td>
<td>Ton</td>
</tr>
</tbody>
</table>

SECTION 308 - SOIL CEMENT COURSE

308-1 DESCRIPTION. This work shall consist of furnishing and placing a course of Portland cement stabilized soil in accordance with these specifications and in reasonably close conformance to the lines, grades, and typical sections shown on the plans or as ordered by the Engineer.

308-2 MATERIALS. Materials used for this item shall conform to the following Sections of these Specifications:
Portland Cement, Type 2  701-01  
Asphalt Emulsion (RS-2)  702-3101  
Coarse Aggregate - 1A size  703-02  
Water  712-01  
Calcium Chloride  712-02  

Soil shall be graded from coarse to fine, free of topsoil, organic matter, and substances deleterious to the normal hardening of the soil cement mixture, and shall be subject to the approval of the Engineer at all times. The soil will be sampled by the Engineer prior to use and submitted to the Geotechnical Engineering Bureau to determine both its suitability and the cement content to be used. Frozen soil or soil containing frost shall not be used.

The soil material shall be stockpiled, sampled and tested before mixing in conformance with material tests and quality control methods contained in the appropriate Department publications which are current on the date of advertisement for bids. These publications are available upon request to the Regional Director or the Director, Geotechnical Engineering Bureau.

308-3 CONSTRUCTION DETAILS

308-3.01 Equipment. No work under this item will be permitted until all equipment and facilities involved are established, inspected and approved by the Engineer.

The materials shall be mixed in a central twin-shaft pugmill mixing plant or mixed on the roadbed by a traveling pugmill, whichever equipment the Contractor elects to use. Traveling pugmill mixing equipment shall not be operated at speeds greater than those recommended by the manufacturer for the depth of treatment and quantity of materials to be mixed.

Where the materials are mixed in a central twin-shaft pugmill mixing plant, the mixing area of the pugmill shall extend at least 4 feet beyond the last point where the soil, cement, or water are fed into the mixer, so that all materials will be completely and thoroughly mixed in the pugmill for a distance of at least 4 feet. The paddles of the pugmill shall be adjustable for angular position on the shaft, and shall be reversible to retard the flow of mixture in order to control the mixing time. Where the materials are mixed at a central twin-shaft mixing plant, a hydraulically or mechanically operated discharge hopper of at least 1 cubic yard capacity shall be provided. Sufficient clearance for a ten-wheel dump truck shall be provided underneath the hopper.

The central mixer shall be either a continuous or batch type pugmill, and shall be designed to accurately proportion the mix either by volume or by weight. The pugmill mixer shall be provided with weighing, volumetric or other gauging equipment, which shall be capable of providing accurate control at all times of the amounts of soil and cement entering the mixer per time interval. The mixer shall be equipped with a method of mechanically interlocking the cement feed with the soil feed so that uniformity of the mixture will be assured at all times. A water pump and meter arrangement shall be available for addition of water to the soil and cement. The water supply line shall have a 90° T connection with a valve immediately downstream of the flow meter for calibration purposes. The meter shall be calibrated at least once a year under the direction of Department personnel.

A smooth steel wheel roller and a self-propelled pneumatic tired or self-propelled vibratory compactor shall be used for compaction. The minimum number of passes shall be determined by the Engineer, after field tests, and shall be such as to produce the specified minimum density for the full depth of the course. Cleated or tracked equipment will not be permitted on the soil cement course. In areas inaccessible to pneumatic tired compactors, or where maneuvering space is limited, impact rammers and/or vibratory equipment may be used provided the required density is obtained.

Equipment suitable for storing, handling, weighing, measuring, proportioning, controlling and applying or spreading the cement shall be used.
Equipment suitable for accurately metering, controlling and applying the water shall be used. If a pugmill mixer is used, all necessary water for mixing shall be added in the pugmill. If a rotary mixer is permitted and used, water for mixing shall be added through a spray bar in the mixing chamber.

308-3.02 Weather Limitations. Soil Cement Course shall not be placed between October 15 and May 15 nor when the air temperature in the shade is 40°F or lower. Soil cement course shall not be placed upon a frozen surface.

308-3.03 Preparation of Foundation. Before soil cement operations are begun, the area upon which the soil cement course is to be placed shall be graded, shaped, and compacted as required in conformance with the grades, lines, thicknesses and typical sections shown on the plans or as ordered by the Engineer.

The subgrade and any preceding course shall be compact and suitable to support the construction and compaction equipment without settlement or displacement. Soft or yielding subgrade shall be corrected and made stable before the soil cement course is placed.

308-3.04 Application of Calcium Chloride and Cement. Where required by a Special Note in the Proposal, the specified quantity of calcium chloride ordered by the Engineer in flake form shall be uniformly added to the soil before adding the cement.

Portland cement, in the amount ordered by the Engineer, shall be added uniformly to the soil material. The amount of cement ordered by the Engineer will range generally between 8 percent and 10 percent by weight.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform mixture of soil and cement during mixing operations and shall not exceed the optimum moisture content for the soil cement mixture, as determined by the Engineer.

Where a traveling pugmill mixer is used, cement that has been displaced or removed from the windrow regardless of cause, shall be replaced before mixing is started, at the Contractor's expense.

308-3.05 Mixing and Spreading. Immediately prior to mixing, the soil shall have a minimum temperature of 40°F. After the cement has been applied to the soil, it shall be immediately mixed with the soil. Mixing shall continue until the cement has been thoroughly blended with the soil to prevent the formation of cement balls when the water is applied. Immediately after the soil and cement have been thoroughly mixed, the full amount of water shall be applied uniformly and mixing shall be continued until an intimate and homogeneous blend of soil, cement and water has been obtained.

When water application and mixing have been completed, the percentage of moisture in the mixture based on oven-dry weights, shall not be below, nor more than 2 percent above, the specified optimum moisture content determined by the Engineer.

In order to minimize segregation of the mix, the discharge gates shall be kept closed until the hopper is filled to at least one-half of its capacity. After the hopper is emptied, the gates shall be closed until the hopper is refilled. The material shall then be discharged into clean trucks and transported directly to the grade.

The soil cement shall be spread on an accepted subgrade or preceding course immediately after mixing. If mixed in a central plant, approved mechanical spreading equipment shall be used and not more than 30 minutes shall elapse between the time of mixing the cement and the start of the compaction operation.

In case of rain between the time of adding cement and final finishing, the Engineer shall be the sole judge of what areas involved are satisfactory and what areas are not acceptable. Areas not acceptable to the Engineer shall be removed to the full depth of the soil cement course and properly replaced at the Contractor's expense for all labor, materials and equipment involved.

308-3.06 Compaction. Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth on the subbase course. As an immediate continuation of mixing operations, and after an
initial breakdown pass with a smooth steel wheel roller, the loose mixture then shall be uniformly compacted, by a self-propelled pneumatic tired or self propelled vibratory compactor, to the specified density. All areas and portions of this course shall be thoroughly and uniformly compacted for the full thickness of the course to a minimum dry density of 95 percent of the maximum density. During compaction, water shall be applied to the surface as determined and ordered by the Engineer, to maintain the optimum moisture content.

308-3.07 Finishing. During the compaction operations, shaping will be required to obtain the required surface and cross-section. During shaping operations it may be necessary to lightly scarify and broom-drag the surface in order to remove ridges or depressions in excess of the permitted tolerance. The resulting surface shall then be rolled with a smooth steel wheel roller, weighing not less than 10 tons, or pneumatic tire rollers, or both. The final rolling shall be done by a smooth steel wheel roller. Several applications of water may be required to keep the surface at the proper moisture content, as ordered by the Engineer, during the finishing operation. Water shall be applied by the pressure spray bar method. Compaction and finishing shall be done in such a manner as to produce, in not longer than 2 1/2 hours after completion of mixing, a smooth, dense surface, free of surface compaction planes, cracks, ridges or loose material. Immediately after rolling, the surface of the course shall be tested for trueness, transversely and longitudinally. The finished surface of the course shall not extend above, nor be greater than 1/2 inch below, true grade and surface at any location. Surface finishing shall be completed in daylight hours.

Any portion of this course which has a density less than that specified shall be corrected or removed and replaced to its full depth to meet these specifications, at the Contractor's expense.

308-3.08 Construction Joints. At the end of each day's construction, a straight transverse and/or longitudinal construction joint shall be formed by cutting back into the completed work to form a true vertical face, which shall be properly maintained until the abutting section is completed.

308-3.09 Curing and Surface Treatment. After the soil cement course has been finished as specified herein, it shall be continually protected against drying by the application of water, until the bituminous seal is applied. At least 48 hours shall elapse between the completion of the finishing operations and the application of the bituminous seal.

At the time the bituminous seal is applied, the soil cement surface shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. Water shall be applied in sufficient quantity to fill the surface voids of the soil cement immediately before the bituminous seal is applied. The bituminous seal shall be uniformly applied to the surface of the completed soil cement at the rate of approximately 0.15 to 0.30 gal/sy with approved heating and distributing equipment. The exact rate and temperature of application to give complete coverage without excessive run-off will be as determined and ordered by the Engineer. No traffic, nor placement of an overlying course, will be permitted over the soil cement course within 5 days from the application of the bituminous seal. Where this course is utilized for maintaining traffic, the application of the bituminous material shall be immediately followed by the application of approved cover aggregate of 1A size at the rate of 20 to 30 lb/sy. The aggregate will be broomed and rolled as ordered by the Engineer.

When the air temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the soil cement for 7 days after its construction and until it has hardened to the satisfaction of the Engineer.

308-3.10 Traffic. No traffic or hauling equipment other than that necessary for sealing, chipping or for placing the next course will be permitted over this course, unless specifically permitted by a Special Note in the Proposal.
308-3.11 Maintenance. The Contractor shall be required, within the limits of the contract, to maintain the soil cement in good condition and in a manner satisfactory to the Engineer from the time he first starts work until all work has been completed and accepted. Maintenance by the Contractor shall include immediate repairs of any defects, regardless of cause, that may occur. This work shall be done by the Contractor at its own expense, and repeated as often as may be necessary to keep the course continuously intact. Repairs are to be made in a manner to insure restoration of a uniform surface and durability of the part repaired. Faulty and damaged work, regardless of cause, shall be replaced for the full depth of the course by the Contractor at its own expense. Any low areas, regardless of cause, shall be remedied by replacing the material for the full depth of the course and not by adding a thin layer of soil cement to the completed work.

308-4 METHOD OF MEASUREMENT. The quantity to be paid for under this item will be the number of cubic yards of material computed within the payment lines shown on the plans or otherwise ordered in writing by the Engineer, and completed in accordance with the plans and specifications. The thickness of the surface treatment will not be included in the volume measured for payment.

308-5 BASIS OF PAYMENT. The unit bid price per cubic yard for this item will include the cost of furnishing all labor, equipment and materials necessary to complete the work, except that furnishing Portland cement, calcium chloride (where required), bituminous material, water equipment and applying water, will be paid for separately under their respective items.

No direct payment will be made for any maintenance, repairs and replacements made before acceptance, nor for any losses of material which may result from shrinkage, compaction, foundation settlement, waste, overflow, erosion, leakage or any other causes: the cost of such will be included in the price bid for this item.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>308.01</td>
<td>Soil Cement Course</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

SECTIONS 309 THRU 399 (VACANT)
Section 400
HOT MIX ASPHALT

SECTION 401 - PLANT PRODUCTION
(Last Revised January, 2020)

401-1 DESCRIPTION. The contractor is responsible for Quality Control (QC). QC is defined as all activities required to produce HMA that meets all specification requirements. The contractor shall incorporate a Quality Control system for all plant production of hot mix asphalt (HMA) and assume responsibilities for all QC activities at the production facilities.

The contractor shall produce the HMA according to the specifications herein and provide production documentation. Quality Adjustment Factors (QAFs) will be used to assess HMA production quality and these factors will be applied to calculate a quality payment adjustment.

The Department is responsible for Quality Assurance (QA). QA is defined as all activities performed by the Department to assure that HMA production meets the specification requirements. The Department will determine quality payment adjustments for each day’s production using a daily QAF obtained from the calculations of the average absolute values for volumetric and non-volumetric mixes in accordance with Materials Procedure (MP) 401, Quality Control and Quality Assurance Procedures for Quality Control Hot Mix Asphalt Production. The daily QAFs measure production variation from the mean of the specification limits.

401-2 MATERIALS. The provisions of §402-2, Materials, apply and are as modified herein. Produce HMA in accordance with the requirements outlined in this specification, including all applicable Test Methods and Materials Procedures. HMA mixture designs must be accepted by the Department prior to any HMA production.

The Department reserves the right to suspend any mixture design when the mixture produces unacceptable paving results or exhibits properties that will affect the anticipated pavement performance.

401-2.01 Hot Mix Asphalt Designs. Formulate and submit a HMA design to the Regional Materials Engineer (RME) that satisfies all design criteria outlined in MM 5.16, Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures. When the submitted HMA design is assigned verification status, the design must be verified during production. Notify the RME at least 24 hours prior to the start of verification status production. When producing under verification status, make necessary adjustments to control the process. Apply daily QAFs to both verification and production status mix designs. Mixtures produced under verification status are allowed for use on State projects.

For any HMA permeable base and shim mixtures required by the contract documents, formulate and submit to the RME a job mix formula that satisfies the General Limits imposed by Table 401-1, Composition of Hot Mix Asphalt Mixtures.

401-2.02 Aggregates. Aggregate must be from a source approved by the Department. Use fine aggregate that consists of materials conforming to the requirements of §703-01, Fine Aggregate. In addition, fine aggregate may consist of screenings, free from deleterious materials and manufactured from sources of stone, gravel, or slag meeting the requirements of §703-02, Coarse Aggregate.

Use coarse aggregate that consists either of crushed stone, crushed gravel, or crushed slag conforming to the requirements of §703-02, Coarse Aggregate and MM 5.16.

Use slag aggregate on State projects only when an alternate pay item which takes the mix yield differential into account is included on the plans or in the itemized proposal.
When coarse aggregates for the mixture are from more than one source or of more than one type of material, proportion and blend them to provide a uniform mixture.

### TABLE 401-1 COMPOSITION OF HOT MIX ASPHALT MIXTURES

<table>
<thead>
<tr>
<th>Mixture Requirements</th>
<th>Permeable Base</th>
<th>Shim</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type 2</td>
<td>Type 5</td>
</tr>
<tr>
<td>Screen Sizes G</td>
<td>General Limits</td>
<td>Job Mix Tolerance</td>
</tr>
<tr>
<td></td>
<td>% Passing¹</td>
<td>% Passing¹</td>
</tr>
<tr>
<td>2 in</td>
<td>100</td>
<td>---</td>
</tr>
<tr>
<td>1 ½ in</td>
<td>75 – 100</td>
<td>±7</td>
</tr>
<tr>
<td>1 in</td>
<td>55 – 80</td>
<td>±8</td>
</tr>
<tr>
<td>½ in</td>
<td>23 – 42</td>
<td>±7</td>
</tr>
<tr>
<td>¼ in</td>
<td>5 – 20</td>
<td>±6</td>
</tr>
<tr>
<td>1/8 in</td>
<td>2 – 15</td>
<td>±4</td>
</tr>
<tr>
<td>No. 20</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>No. 40</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>No. 80</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>No. 200</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Asphalt Content, %²³</td>
<td>2.5 – 4.5</td>
<td>NA</td>
</tr>
<tr>
<td>Mixing and Compaction Temperature Range °F</td>
<td>225 – 300</td>
<td>250 – 325</td>
</tr>
</tbody>
</table>

NOTES:
1. All aggregate percentages are based on the total weight of the aggregates.
2. The asphalt content is based on the total weight of the mix. When using slag aggregates in the mix, the asphalt content shall be increased accordingly, a minimum of 25 percent for an all slag mix.
3. Use the PG binder listed in the proposal or as designated by the Regional Materials Engineer following the guidance specified in the Comprehensive Pavement Design Manual, Chapter 6, Section 6.2.5 – Performance Graded Binder Selection.

A. **Coarse Aggregate Type F1 Conditions.** Use one of the following types of coarse aggregate:

1. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonated materials.
2. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:
   
a. 12.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 90.0% of plus 3/8 inch particles must be non-carbonate.
   b. 9.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must
comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 90.0% of plus No. 4 particles must be non-carbonate.

c. 6.3 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus No. 8 particles must comprise a minimum of 30.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 90.0% of plus No. 4 particles must be non-carbonate.

**B. Coarse Aggregate Type F2 Conditions.** Use one of the following types of coarse aggregate.

1. Limestone, dolomite, or a blend of the two having an acid-insoluble residue content of not less than 20.0%.
2. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
3. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:

   a. 12.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus 3/8 inch particles must be noncarbonate.
   b. 9.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be noncarbonate.
   c. 6.3 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus No. 8 particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be non-carbonate.

**C. Coarse Aggregate Type F3 Conditions.** Use one of the following types of coarse aggregate.

1. Limestone or a blend of limestone and dolomite having an acid-insoluble residue content of not less than 20.0%.
2. Dolomite.
3. Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
4. Gravel, or a natural or manufactured blend of the following types of materials: limestone, dolomite, gravel, sandstone, granite, chert, traprock, ore tailings, slag or other similar materials, meeting the following requirements:

   a. 12.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus 3/8 inch particles must be noncarbonate.
   b. 9.5 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus 1/8 inch particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be noncarbonate.
   c. 6.3 Nominal Maximum Size Aggregate Mixes. Noncarbonate plus No. 8 particles must comprise a minimum of 10.0% of the total aggregate (by weight with adjustments to equivalent volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be non-carbonate.
volumes for materials of different specific gravities). A minimum of 20.0% of plus No. 4 particles must be non-carbonate.

D. Coarse Aggregate Type F9 Conditions. Use coarse aggregate meeting the requirements of §703-02, Coarse Aggregate.

401-2.03 Mineral Filler. Use mineral filler conforming to the requirements of §703-08, Mineral Filler.

401-2.04 Performance-Graded Binder. Use the Performance-Graded Binder (PG Binder) in the production of these mixtures that meets Section 702 – Bituminous Materials.

Initial acceptance of the PG Binder is based on the primary source appearing on the Department’s Approved List for Bituminous Material Primary Sources, A. Performance-Graded Binders for Paving. Acceptance of the PG Binder is contingent upon satisfactory test results from samples taken, as required by the Department’s procedural directives, at the location where the material is incorporated into the work. A primary source is defined as a firm that samples, tests, and certifies by Production Lot that the PG Binder is in conformance with the specifications. The procedural directives for sampling, testing, and certifying the PG Binder, and for achieving and maintaining approved list status, are available from the Materials Bureau.

The temperature of PG Binder delivered to the HMA Production Facility shall not exceed 350°F, unless the PG Binder supplier recommends it.

401-2.05 Reclaimed Asphalt Pavement. Reclaimed Asphalt Pavement (RAP) shall meet the requirements of MM 5.16.

401-3 CONSTRUCTION DETAILS.

401-3.01 Quality Control. Perform all sampling and testing in accordance with Materials Procedure 401. Document all QC test results and records in a legible manner and provide them to the State at the end of each production season or when requested by the RME. HMA produced without the required sampling, testing and documentation may be rejected.

401-3.02 Production Facility Laboratory. Maintain an approved production facility site laboratory to perform all required HMA sampling and testing according to MP 401.

401-3.03 Plant Lots and Sublots. Determine plant lots and sublots on a daily basis in accordance with MP 401.

401-3.04 Quality Control Sampling and Testing. Obtain and test QC samples as outlined in MP 401.

401-3.05 Production Control. Produce HMA according to MP 401. Make necessary process control adjustments during production according to MP 401.

401-3.06 Production Quantities. Whenever production is made for the Department, notify the Regional Materials office by 3:00 p.m. the business day before the day of production.

Maintain a record of each day’s production quantity for each mix design supplied to the project site daily. Retain these records at the production facility. These records must be available to the Department’s representative for review. Ship all production quantities as outlined in §401-3.07 Documentation.

401-3.07 Documentation. Record all QC test data for each plant on the appropriate forms provided by the Department according to MP 401. Also, keep a copy of the plant automation printout at the plant.
facility for each mix type produced and make them available for review at all times. Transmit a summary of all test data weekly to the RME.

Provide a delivery ticket indicating the total quantity in tons being delivered with each delivery vehicle supplying HMA. The method of determining the delivered quantity is subject to the approval of the RME. Make one legible copy of the delivery ticket available to the Department’s paving inspector prior to the placement of the mixture showing the following minimum information:

- Ticket number
- Plant identification
- Contract number
- Site Manager Mix ID (as outlined in MP 401)
- Mix Code (as outlined in MP 401)
- Quantity of material in vehicle
- Date and Time

The quality assurance technician (QAT) will determine the quality adjustment factor (QAF) for each day’s production in accordance with MP 401.

The Engineer will use the Daily QAF to calculate the payment adjustment for each day’s production according to §402-4 Method of Measurement.

401-3.08 HMA Mixing Plant. HMA mixing plants must meet the requirements in MP 401.

401-3.09 Hot Mix Asphalt Holding Bins. HMA mixtures may be held in holding bins which meet the requirements in MP 401.

401-3.10 Evaluation of Lots Represented by 0.85 QAF. When any material results in a QAF of 0.85, the Engineer will evaluate the subject material to determine if it will be left in place. The Engineer may require the Contractor to core the pavement to determine if the in-place density is acceptable at no additional cost to the State. When cores are required, the Engineer will divide the pavement area being evaluated into 4 sublots in accordance with the requirements of §402-3.08, Pavement Density Samples. The material will be left in-place when either of the following sets of conditions is met.

- The calculated plant air voids used for payment are greater than 5.5% and less than or equal to 7.0%, the asphalt content, based on automation, is within 0.2% of the production target, the Contractor achieved field density of 92% to 97%, and there are no defects such as, but not limited to, cracking, raveling, rutting, shoving, or bleeding.
- The calculated plant air voids used for payment are greater than or equal to 1% and less than 1.5%, the validated QC and QA plant air void test results, according to MP 401, average 1.5% to 5.5%, the asphalt content, based on automation, is within 0.2% of the production target, the contractor achieved field density of 92% to 97%, and there are no defects such as, but not limited to, cracking, raveling, rutting, shoving, or bleeding.

If the material does not meet the above conditions or it is unknown, such as for mixes accepted based on gradation or if QA testing was not required, the Engineer will determine if the material in question may remain in-place considering, but not limited to, the following:

- Type of material produced
- The layer in which the material was placed
- The location and traffic volume
- Laboratory test results
- Field test results, such as density
401-4 METHOD OF MEASUREMENT. The quantity will be the number of tons delivered as determined from the automated proportioning system, the delivery vehicle weigh system, or the HMA holding bin weigh system. The measurement or calculation will be the quantity based on the measured amount and reported to the nearest 0.01 of a ton.

SECTION 402 - HOT MIX ASPHALT (HMA) PAVEMENTS
(Last Revised January, 2020)

402-1 DESCRIPTION. These specifications apply to all plant mixed Hot Mix Asphalt (HMA) produced at a production facility under Section 401 Plant Production, irrespective of aggregate gradation, type, and amount of HMA material or use.

This work will consist of providing, placing, and performing density monitoring of one or more courses of HMA pavement constructed on the prepared foundation in accordance with the contract documents or as directed by the Engineer.

402-2 MATERIALS

402-2.01 General. Use aggregate and PG binder from suppliers listed in the Department’s Approved List for Fine and Coarse Aggregates and Performance Graded (PG) Binders for Hot Mix Asphalt (HMA) Paving respectively. Use of mineral filler or any other materials for the production of HMA will be accepted in accordance with the State’s written instructions.

A PG Binder grade and the Design Estimated Traffic in 80 kN ESALs will be specified by Special Note in the contract documents.

402-2.02 Composition of Mixtures. Supply HMA mixture meeting the requirements of §401-2 of the Standard Specifications and the mixture design procedure as written in Materials Method (MM) 5.16, Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures.

The Contractor will be responsible for the quality and performance of the mixture created from approved components. The Department reserves the right to take samples at any time and location to ensure the materials incorporated into the work are in conformity with the contract documents.

402-3 CONSTRUCTION DETAILS. The Engineer will conduct a pre-paving meeting prior to any HMA placement. The attendance at this meeting will include Regional Materials Engineer, Paving Superintendent, Chief Inspector or Paving Inspector(s), HMA plant representative, density gauge operator, depending on the compaction method used, and work zone traffic control (WZTC) competent person. Be prepared to discuss the operation necessary to complete the work successfully. Participants will review all aspects of the requirements including, but not limited to, the following:

- HMA mixture delivery temperature
- Equipment and setup
- Mix codes to assure correct mixture is delivered
- Gauge operator certification
- Proper construction practice to provide quality product
- WZTC Activities
Provide a certified density gauge operator to monitor pavement density using a density gauge for 50 Series, 60 Series, and 70 Series compaction methods with a current Density Gauge Inspector Certification from the Associated General Contractors, New York State, or its equivalent, as determined by the Director, Materials Bureau.

Do not place HMA mixture on any wet surface. Wet surface is defined as one that is moistened, covered, or soaked with water.

402-3.01 Temperature and Seasonal Limitations.

A. Surface Temperature.

1. Surface Temperature. Place HMA mixture only when the pavement surface temperature is equal to or greater than those specified in Table 402-1 Temperature Requirements.

<table>
<thead>
<tr>
<th>Nominal Compacted Lift Thickness</th>
<th>Surface Temperature Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1 in</td>
<td>50°F</td>
</tr>
<tr>
<td>1 in &lt; Thickness ≤ 3 in</td>
<td>45°F</td>
</tr>
<tr>
<td>&gt; 3 in</td>
<td>40°F</td>
</tr>
</tbody>
</table>

2. Temperature Measurement. Furnish a surface thermometer capable of reading surface temperature to nearest 1° F for the exclusive use of the Engineer. The Engineer will measure pavement surface temperatures on the surface where the mixture is to be placed. The controlling temperature will be the average of three readings taken at locations 25 feet apart utilizing a surface thermometer covered by insulation for 10 minutes or until a constant temperature is reached. Infra Red (IR) temperature guns may be used in lieu of surface thermometer. When IR gun is used and if there is a dispute with the value obtained, the Engineer will determine the temperature using the surface thermometer.

B. Seasonal Limits. Place HMA Top Course on mainline and shoulders between April 1 and November 30 for the counties of Dutchess, Orange, Putnam, Rockland, Westchester, Nassau, Suffolk, and the City of New York. For all other counties, place HMA Top Course between April 15 and October 31. When placing Top Course HMA outside the seasonal limitations, provide a limited warranty against defects in such work. Perform the warranty work in accordance with Materials Procedure (MP) 402-01, Warranty Requirements for Hot Mix Asphalt (HMA) Top Course. Unless specified elsewhere in this specification or contract documents, these seasonal limits do not apply for any other HMA course placement.

C. Temporary HMA Placements. HMA mixture placement for temporary detours, which are not and will not become part of the permanent pavement, are not subject to the temperature and seasonal limitations, but must be approved by the Engineer when placed outside temperature and seasonal limits. Repair any damaged areas deemed necessary by the Engineer on the temporary HMA placements within one work day after the notification.

D. Miscellaneous HMA Placements. The Engineer may allow the placement of HMA mixtures for curbs, driveways, sidewalks, gutters, and other incidental construction below the minimum temperature and outside the seasonal limits to expedite the completion of the work.
E. Scheduling HMA Placement. Schedule paving operations such that all HMA mixture placements are completed within the temperature and seasonal limitations, provide safe and adequate work zone traffic control, and protect previously laid courses. Such scheduling will include expediting construction operations to permit paving within the seasonal limitations or by limiting the length of work so that it can be completed before the seasonal shut-down. Should paving operations not be completed within temperature and seasonal limitations, provide all temporary materials and work necessary such as shimming of castings and protrusions, drainage of the roadway, providing acceptable rideability, and other work needed for the adequate work zone traffic control at no additional cost to the State.

If the approved schedule indicates that Base or Binder course, which will be permanently incorporated into the work, is to be left open to traffic over the winter, apply joint adhesive to all the joints in accordance with Section 418 Asphalt Pavement Joint Adhesive.

If the top course is not placed within the seasonal limits as scheduled, apply joint adhesive on top of the exposed joints in the Binder course at least 4 inches centered on the exposed joint at no additional cost to the State.

Repair any damage to the Base or Binder course left over the winter prior to placing subsequent course(s) at no additional expense to the State.

402-3.02 HMA Pavers. Provide pavers capable of spreading and finishing courses of HMA mixture in lane widths, shoulders, or similar construction applicable to the specified typical section and thicknesses shown on the plans. Repair or replace immediately any paver found to be worn or defective either before or during its use. Provide HMA pavers that meet the following requirements:

- Self-powered with an activated screed or strike-off assembly.
- Capable of operating at forward speeds consistent with satisfactory placement of the mixtures.
- Have a receiving hopper with sufficient capacity for uniform spreading operation and with automatic flow controls to place the mixture uniformly in front of the screed. Heat the screed or strike-off assembly as necessary to produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture.
- When screed extensions are necessary for placement of mainline pavement, provide extensions of the same design as the main screed.
- Mount auger and tunnel extensions on the paver when the screed is extended more than 1 foot for fixed paving widths wider than 12 feet when mat uniformity is not achieved.
- When used for placing the initial paving course, Base, Binder, and Top Courses, provide pavers equipped with approved automatic transverse slope and longitudinal grade screed controls. Provide controls that automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the existing surface. Provide controls capable of maintaining the proper transverse slope and be readily adjustable so transitions and super-elevated curves can be satisfactorily paved. Provide controls that operate from suitable fixed or moving references as prescribed in §402-3.06 Spreading and Finishing.

When paving mainline, provide a paver with functional automatic transverse slope and longitudinal grade screed controls that can be operated from either side of the paver. The transverse slope and longitudinal grade screed controls of the HMA paver may be manually adjusted according to the requirements of §402-3.06 Spreading and Finishing.

402-3.03 Hauling Equipment. Provide HMA transport trucks approved by the Engineer that have clean, smooth, tight metal beds with waterproof covers for transporting HMA mixtures to the work site. When a flexible cover is used, provide a cover that overlaps the vehicle’s sideboards and back by a minimum of 6 inches and is fastened except for live-bottom trucks that have channelized tarp systems. The inside surface of the vehicle body may be lightly coated with a release agent listed on the Approved List for Release
Agents. Do not use petroleum products or solvents as release agents. All hauling equipment is subject to approval by the Engineer.

402-3.04 Rollers. Provide rollers of vibratory, oscillatory, static steel wheel type, or pneumatic tire rollers capable of compacting HMA mixture. The Engineer will inspect rollers prior to start of paving operations to determine acceptability. Provide a minimum of two rollers, one for breakdown and one for finish rolling, unless the HMA mixture placement is on a bridge deck, bridge approaches, or other areas where one roller may be sufficient to achieve the required density. Provide rollers in good mechanical condition, and capable of operating at speeds slow enough to avoid displacement of the mixture. Do not use equipment which results in excessive crushing of aggregate.

Ensure the manufacturer or supplier provides recommended settings for amplitude, frequency, and tire pressure (pneumatic) for each roller model for the thickness of pavement being rolled. The recommendations may either be on a sticker or a plate installed on the roller or a document readily available to the Engineer. For night time paving, provide a roller equipped with at least one light on each fender, or alternatively, at least one light above the roller, visible from a distance of 200 feet. Provide a roller equipped with an automatic audible warning signal when operating in reverse.

A. Vibratory and Oscillatory Rollers. Provide rollers designed for the compaction of HMA mixture. Provide self-propelled roller having single or dual drums meeting the requirements as stated below, weighing at least 8 tons and capable of maintaining set frequency and amplitude.

1. Nominal Amplitude 0.05 inches, maximum
2. Frequency 1500 vpm minimum
3. Drum Width (dual drums) 54 inches, minimum
   (single drum) 84 inches, minimum
4. Speedometer ½ mph or 50 ft per minute increment, maximum

Provide rollers equipped with indicators that provide the operator with the speed, amplitude, and frequency setting readouts. Set the rollers such that they will produce a minimum of 12 impacts per foot during the compaction process.

Provide vibratory and oscillatory rollers equipped with an automatic disconnect system that automatically shuts off the vibration and oscillation when the roller is in a stationary position. Provide roller equipped with mechanical override systems in the event of temporary failure of the automatic disconnect system.

B. Static Steel-wheel Rollers. Provide self-propelled two axle types with a minimum weight of 8 tons.

C. Pneumatic Rubber-tired Rollers. Provide self-propelled rubber tired rollers consisting of two axles on which multiple pneumatic-tired wheels are mounted in such a manner that the rear wheels do not follow in the tracks of the forward wheels and are spaced to give essentially uniform coverage with each pass. Ensure axles are mounted in a rigid frame to provide means for adding ballast. Ensure wheels are mounted so as to oscillate individually or in pairs. Ensure the tires are smooth and show no tread pattern, are of equal size and diameter, and are uniformly inflated. Provide pneumatic rollers that meet the following requirements unless otherwise approved:

1. Maximum Wheel Load 5,600 lbs
2. Tire Compression on Pavement 80±5 psi
3. Maximum Axle Load 22,400 lbs

D. Small Vibratory Rollers. Provide rollers of ride or walk behind type having dual vibratory drums meeting the following requirements:

1. Minimum Drum Width 24 inches
2. Minimum frequency 1500 vpm
**402-3.05 Conditioning of Existing Surface.** When specified in the contract documents, clean the surface of the existing pavement, fill joints and cracks, and level the surface to a uniform grade and cross slope prior to the application of a new HMA course in accordance with the provisions of Section 633 Conditioning Existing Pavement. Clean any foreign material from the pavement resulting from construction operations at no additional cost to the State.

Fill any depressions and wheelpath ruts prior to paving Truing and Leveling course using Table 402-2 Mixture Selection for Filling Wheelruts & Depressions, to select the appropriate mixture type.

<table>
<thead>
<tr>
<th>Depth Range (in)</th>
<th>Mixture Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; ¼</td>
<td>No treatment</td>
</tr>
<tr>
<td>¼≤ Depth &lt; ¾</td>
<td>Shim</td>
</tr>
<tr>
<td>≥ ¾</td>
<td>6.3 or 9.5 Top Course</td>
</tr>
</tbody>
</table>

If a Truing and Leveling (T&L) course is specified in the contract documents, place the course(s) of a minimum variable thickness of proper plant mixture necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement surface. Use Table 402-3 Mixture Selection for T&L Course, to select the appropriate mixture type. Select a mixture such that dragging of stones at the thin edge is minimized, including when constructing wedges for super-elevation. If dragging is excessive in any T&L course, select a different T & L mixture for the application. The surface of this course will be tested in the same manner prescribed in §402-3.10 Surface Tolerance, ensure that the allowable variation from the true surface after compaction does not exceed ⅜ inch.

<table>
<thead>
<tr>
<th>Compacted Thickness Range (in)</th>
<th>Mixture Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness ≤ 1</td>
<td>6.3 Top Course</td>
</tr>
<tr>
<td>1 &lt; Thickness ≤ 2</td>
<td>9.5 or 12.5 Top Course</td>
</tr>
<tr>
<td>2 &lt; Thickness ≤ 3</td>
<td>19.0 or 25.0 Binder Course</td>
</tr>
<tr>
<td>3 &lt; Thickness ≤ 5</td>
<td>25.0 Binder Course or 37.5 Base Course</td>
</tr>
</tbody>
</table>

**402-3.06 Spreading and Finishing**

**A. Tack Coat.** Apply tack coat between all HMA pavement lifts prior to placing HMA mixture regardless of time period between lifts. Do not apply tack coat more than 24 hours prior to the placement of HMA mixture unless approved by the Engineer. Apply tack coat to all contact surfaces of existing HMA and Portland Cement Concrete including such areas as adjacent pavement edges, curbing, gutters, manholes, and other structures where the HMA mixture will be in contact. Tack coat is not required on the surface of Permeable Base courses. Paving over a tack coat should not commence until the emulsion has broken (goes from brown to black) or is tacky when touched.

**B. Joint Adhesive.** Apply joint adhesive to all pavement edges in accordance with Section 418 Asphalt Pavement Joint Adhesive prior to placing the asphalt mixture in order to provide bonding with the newly laid pavement. The application of joint adhesive is for Top Course only unless it is specified for other courses in the contract documents or as required under §402-3.01E. Scheduling HMA Placement.

**C. HMA Mixture Temperature.** For 50, 60, and 70 Series compaction methods, select a desired HMA mixture temperature to be delivered within the mixing and compaction range of 250°F and 325°F, or
as recommended by the PG Binder manufacturer. Notify the Engineer of the desired delivery temperature. Produce and deliver HMA mixtures to the work site, and incorporate into the work within 20°F of the specified temperature. For 80 Series compaction method, select the desired mixture temperature with the concurrence of the Engineer.

**D. HMA Mixture from Multiple Plants.** Do not supply HMA mixture from multiple plants to a single paver.

**E. Reference Line.** Erect and maintain taut reference line positioned at or near the pavement centerline or edge to guide the paver when the initial pavement course is laid for new or reconstructed pavement. Support the reference line at approximately 25 foot intervals on tangent sections and at closer intervals on curves. Tension the line sufficiently to remove any sagging. Use a moving reference of at least 30 feet in length in lieu of a reference line with approval of the Engineer. The moving reference may be a floating beam, ski, or other suitable type such that the resulting pavement course surface is even. A short ski or shoe may also be used for the initial course with the approval of the Engineer if a satisfactory fixed reference such as a curb, gutter, or other fixed reference is adjacent to the pavement. Any course in an adjacent lane may be used as the reference for the use of a short ski. If the proposed floating beam or the short ski does not produce the results similar to those obtained using a taut reference line, discontinue the use of these devices and erect a taut reference line.

Automatic screed controls are not required for shoulders, temporary detours, behind curbs, where existing grades at roadway intersection or drainage structure must be met, or in other areas where its use is impractical.

**F. HMA Mixture Placement.** Use HMA paver(s) to place the HMA mixture either over the entire width or over a partial width that is practical. Operate the paver at a consistent steady speed, correlated to the rate of material delivery, in order to produce a mat free of bumps and dips, resulting in a smooth ride. Place the HMA mixture on a clean, dry, tack-coated surface. Ensure trucks deliver the mixture into the paver upon arrival at the site. Immediately spread and strike off HMA mixture to the required width and loose depth to established line and grade, to obtain the required compacted thickness at the completion of work. If the areas to be paved are less than 1,000 square feet or small and scattered, the HMA mixture may be spread by hand or other method approved by the Engineer. For these areas, dump and spread the mixture such that the compacted thickness meets the thickness specified in the contract documents.

Place all pavement courses using one of the reference line methods required above. Prior to the beginning of rolling, check the loose mat, adjust any irregularities, and remove and replace all unsatisfactory material.

When filling wheel ruts with Shim Course, 6.3 Top Course or 9.5 Top Course mixture in an existing pavement, place mixture in each wheelpath rut separately. Use a drag box configuration or approved equal having side forms to shim the ruts. Spread and strike off the Shim Course material to a uniform width of approximately 4 feet. The intent of the operation is to fill the low area only and not to place the material over the pavement’s full lane width. Ensure the placement equipment wheels and/or other appurtenances do not interfere with the distribution and placement of the Shim Course material.

**G. Top Course Texture and Color.** Supply Top Course HMA mixture from a single plant for the duration of the work such that the pavement surface has a uniform color and texture, except when a contract includes multiple paving sites, or the paving length is more than 5 miles and supply from multiple plants to either end of the paving length is practical. In that case, the above requirement will apply to each paving site and locations at either end of the paving length as approved by the Regional Materials Engineer. Limits of each site will be subject to approval by the Regional Materials Engineer. If a plant breaks down, another plant may supply mixture if the aggregate used for producing the HMA mixture is from the same source, with the concurrence of the Regional Materials Engineer. When
tandem paving is utilized, multiple plants may be used to supply mixture provided the aggregate used
is from the same source. The provisions of §402-3.06 D apply.

**402-3.07 Compaction.** Compact the HMA mixture sufficiently using the appropriate compaction method
specified in Table 402-4 Compaction Methods, to achieve pavement densities in a range of 92% to 97%,
expressed as a percentage of the mixture’s maximum theoretical density (MMTD).

When compacting HMA mixture using 50, 60, or 70 series methods, control all operations of the rollers
including speed, amplitude settings, vibration frequency, and the type of rollers.

Compact the HMA mixture using rollers meeting the requirements of §402-3.04 Rollers. Compact the
HMA mixture immediately after placement, and when the mixture is in the proper condition such that the
rollers do not cause displacement, cracking, or shoving. Initially, compact all courses with the roller
traveling parallel to the centerline of the pavement, beginning at each edge and working toward the center.
Compact super-elevated curves starting at the low-side edge and working toward the higher edge.

Immediately correct any displacement caused by reversing the direction of the roller, or any other
causes, using rakes and additional HMA mixture as required. Exercise care in rolling so as not to displace
the line and grade of the edges of the HMA mat. Keep the wheels properly moistened with water, water
mixed with small quantities of detergent, or other approved material, to prevent adhesion of the mixture to
the rollers. Do not use petroleum products or solvents.

Upon completion of the HMA mixture placement, ensure there are no visible defects in the pavement,
such as shallow ruts, ridges, roller marks, cracking, tearing, segregation, bleeding, or any other
irregularities. Correct any defects that become apparent or replace the defective pavement at no additional
cost to the State.

Compact the HMA mixture along forms, curbs, headers, walls, and other areas not accessible to rollers
with mechanical tampers. On depressed areas, use a trench roller or a small vibratory roller with the
approval by the Engineer.

Remove any HMA mixture that becomes loose and broken, mixed with dirt, or is in any way defective
and replace with fresh HMA mixture. Compact the HMA mixture to conform to the surrounding area.
Correct any area showing an excess or deficiency of HMA material.

Make a minimum of three passes of a pneumatic rubber tire roller for compaction when Shim Course,
6.3 Top Course or 9.5 Top Course is used for filling wheel ruts. Make a minimum of two passes when Shim
Course is used as a skim coat. Use other types of rollers with the approval of the Engineer.

Do not use vibratory compaction when HMA mixture is placed on structural bridge decks or other
structures with less than 2 feet of cover over the structure or when specified in contract documents. If
vibratory compaction is used, repair all damages which may occur to the highway components and adjacent
property, including buried utility and service facilities, at no additional cost to the State.

Monitor density for 50, 60 and 70 Series compaction using density gauges specified in §402-3.07E
Density Gauges. Ensure the density gauge operator possesses a current Density Gauge Inspector
Certification from The New York State Associated General Contractors, or its equivalent, as determined
by the Director, Materials Bureau. Any pavement section placed under 60 or 70 Series which is monitored
by a gauge operator whose certification is revoked for reasons outlined in the New York State Inspector
Certification Program Manual under “Decertification”, will be evaluated by sampling and testing of
pavement cores in accordance with §402-3.08 Pavement Density Samples, and subject to pavement density
adjustment. The above requirement also applies when a density gauge is used for monitoring pavement
density in the areas other than mainline under 50 Series compaction method.

Table 402-4 Compaction Methods associates specific item being placed to the required compaction
method.
TABLE 402-4 COMPACTION METHODS

<table>
<thead>
<tr>
<th>Compaction Methods</th>
<th>Item Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=50 series</td>
<td>402.XX5F0R</td>
</tr>
<tr>
<td>B=60 series</td>
<td>402.XX6F0R</td>
</tr>
<tr>
<td>C=70 series</td>
<td>402.XX7F0R</td>
</tr>
<tr>
<td>D=80 series</td>
<td>402.XX8F0R &amp; other</td>
</tr>
</tbody>
</table>

NOTE:  
XX = 37, 25, 19, 12, 09, 06, 05, 01  
F = Friction requirement (1, 2, 3, 9)  
R = Revision number

A. 50 Series Compaction Method.  On the first day of mainline paving, place and compact the HMA mixture in accordance with the provisions of Option 1 or Option 2. Routine paving is the placement and compaction of HMA mixture after the test section or first day paving.

1. Option 1 (Test Section). Place and compact a test section on the mainline a maximum of 1,500 feet long, at a location approved by the Engineer to determine if the HMA mixture can be compacted uniformly within the 92-97% of MMTD. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 150 feet, in accordance with §402-3.08 Pavement Density Samples.

Extract pavement cores at the marked locations before the road is open to traffic. Take loose mix samples as specified under §402-3.08. Deliver all the samples to the Regional Materials Laboratory for testing and analysis. The following will apply to the test section.

- Place only one test section per day. Subsequent test sections are subject to approval by the Engineer.
- Test Section Adjustment will apply for up to 200 tons placed on each test section.
- A maximum of two test sections per item will be subject to the Test Section Adjustment.
- The Test Section Adjustment will not apply for a test section if any HMA mixture of 150 tons or more is placed on the same day, other than the quantity required for the construction of the test section or permeable base placed under the test section location.
- Pavement Density Quality Adjustment will not apply to the first two test sections. Subsequent test section(s) located on the mainline are subject to Pavement Density Quality Adjustment.
- Do not place HMA mixture under Routine Paving until the results of the pavement cores from the test section have a minimum pavement density QAF of 1.00.
- If the pavement density QAF is less than 1.00, construct another test section.
- If the calculated QAF is 0.60, the Test Section Adjustment will not apply and the RME will evaluate the test section in accordance with §402-3.14 Pavement Evaluation to determine if it can be left in place.

2. Option 2 (First Day Routine Paving). Do not construct a test section on the first day of paving. The Test Section Adjustment will not apply. All material placed and compacted will be subject to a Pavement Density Quality Adjustment in accordance with Routine Paving, below. If the pavement density QAF on the first day of paving is less than 1.00, construct a test section in accordance with Option 1.
3. **Routine Paving.** A paving lot is defined as a day’s production of at least 200 tons. Each paving lot will be equally divided into sublots in accordance with Materials Procedure (MP) 402-02 *Hot Mix Asphalt (HMA) Pavement Density Determination*, based on the quantity placed.

When the quantity placed is less than 200 tons in a day, pavement samples are not required. The density QAF for that day will be 1.00 provided the procedures used in these areas to obtain pavement densities are similar to previously placed pavement sections based on the density gauge test data.

When the quantity placed is more than 200 tons but less than or equal to 2000 tons in a day, the Engineer will divide the lot into 4 equal sublots.

When the quantity exceeds 2000 tons, the Engineer will select one additional pavement core location for up to every 500 tons over 2000 tons, up to a maximum number of cores for a lot of 8.

The Engineer will select and mark a pavement core location in each sublot in accordance with §402-3.08 once the compaction operation is completed, excluding the first 150 feet of the day’s paving.

Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the pavement core holes, take loose mix samples representing the lot, and deliver the sealed pavement cores and loose mix samples to the Regional Materials Laboratory in accordance with §402-3.08 *Pavement Density Samples*. The Department will test samples and analyze the results within one work day of the delivery of the samples. The results of this analysis will be used to determine the pavement density QAF in accordance with MP 402-02. When HMA mixture placement is less than the anticipated quantities, obtain a minimum of two loose mix samples before placement is terminated.

When paving over extended time periods using multiple crews, a new lot will be established when a change in the paving crew occurs. When the work includes multiple paving operations, each paving operation will be considered a lot and evaluated separately.

When two consecutive lots are found to have a density QAF equal to or less than 0.85, stop paving operations and construct a new test section in accordance with *Option 1*.

Monitor density on the material placed on shoulders, widening, crossovers, bridges and ramps with a uniform full-width section of less than 1250 feet in length using the same density gauge(s) and target density used on the mainline. Record the density values on appropriate BR form based on the type of gauge used, in accordance with MP 402-02. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that the shoulder shows signs of distress during compaction, decrease the compaction effort until no further damage occurs to the shoulder or subbase.

B. **60 Series Compaction Method.** On the first day of mainline paving, place and compact the pavement under the provisions of *Option 1* or *Option 2*. Routine paving is the placement and compaction of HMA mixture after *Option 1* or after *Option 2*. Do not place HMA mixture under this method unless both a density gauge and a certified operator are present.

1. **Option 1 (Test Section Only).** Place and compact a test section on the mainline a maximum of 1,500 feet long, at a location approved by the Engineer to determine a Project Target Density (PTD) using the correlation of a density gauge(s) to the pavement cores results and to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. Use the same equipment and procedures to construct the test section that will be used in the construction of the remainder of the course being laid. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 150 feet, in accordance with §402-3.08 *Pavement Density Samples*.

Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density
gauge readings with the gauge type, model, and serial number to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples on Form BR 109.

Extract pavement cores at the marked location in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver density gauge readings, sealed pavement cores and loose mix samples to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

The Department will test the samples and analyze the results within one work day of the delivery of the samples and density gauge readings. The results of the analysis will be used to establish a PTD for each density gauge in accordance with MP 402-02. The following will apply to the test section.

- Place only one test section per day. Subsequent test sections are subject to approval by the Engineer.
- Test Section Adjustment applies for up to 200 tons placed on each test section.
- A maximum of two test sections per item will be subject to the Test Section Adjustment.
- The Test Section Adjustment will not apply for a test section if any HMA mixture of 150 tons or more is placed on the same day, other than the quantity required for the construction of the test section or permeable base placed under the test section location.
- If the average density of the four pavement cores results in a QAF of 0.60, the Test Section Adjustment will not apply and the RME will evaluate the test section in accordance with §402-3.14 Pavement Evaluation to determine if it should be left in place.

2. Option 2 (Test Section and Continue Paving). Place and compact a test section as described under Option 1 on the mainline a maximum of 1,500 feet long, at a location approved by the Engineer to determine a Project Target Density (PTD) using the correlation of a density gauge(s) to the pavement cores results and to determine if the mixture can be compacted uniformly within the 92-97% of MMTD. Use the same equipment and procedures to construct the test section that will be used in the construction of the remainder of the course being laid. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Once the test section is complete, the Engineer will select and mark 4 pavement core locations, excluding the first 150 feet, in accordance with §402-3.08 Pavement Density Samples.

Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number on Form BR 109, to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

Establish an Interim PTD as described in MP 402-02 based on the density gauge used. Use the Interim PTD to monitor pavement density until the Actual PTD is established by the RME. Prior to the determination of an Actual PTD, take 4 additional loose mix samples, in accordance with §402-3.08 and store these samples at the plant.

- The Test Section Adjustment factor will not apply.
- All material placed after the test section for that day will be subject to Pavement Density Quality Adjustment.

Take density gauge readings at every 200 feet along the length of the pavement for each paver pass, at locations randomly selected and marked by the Engineer, in accordance with MP 402-02.
If the density readings at two consecutive locations fall below 96% or above 103% of the Interim PTD or if the moving average of the last 10 density readings falls below 98% of the Interim PTD, stop paving operations and wait for the Actual PTD.

Submit a copy of the appropriate BR form(s) at the end of the first day’s paving to the Engineer as described in MP 402-02. If the moving average of the last 10 density readings is below 98% of the Actual PTD, the Engineer will randomly select and mark 4 pavement core locations in accordance with §402-3.08 over the day’s placement under Interim PTD, excluding the test section.

Take density gauge readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number on Form BR 109, to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples.

Extract pavement cores at the marked locations in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials laboratory in accordance with §402-3.08 Pavement Density Samples.

The Department will test the samples and analyze the results within one work day of the delivery of the samples and density gauge readings. The results of the analysis will be used to establish a PTD for each density gauge in accordance with MP 402-02.

If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed under Interim PTD, excluding the material placed on the test section.

3. Routine Paving. Do not place HMA mixture under Routine Paving until a PTD has been established. Use only density gauge(s) that have been correlated with pavement cores during the construction of the test section and a PTD has been determined by the Regional Materials Engineer. For other gauge(s), construct a new test section under the provisions of “Test Section” to establish a PTD. Compact the pavement sufficiently to achieve the PTD value at each test location. Take density gauge readings at every 200 feet along the length of the pavement for each paver pass, at locations randomly selected by the Engineer, in accordance with MP 402-02. Record density values on the appropriate BR form based on the type of gauge used. Ensure the minimum density reading is at least 96% and no greater than 103% of the PTD at a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations.

If density gauge readings over two consecutive locations fall below 96% or above 103% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, stop routine paving operations and construct a new test section.

Monitor the density on shoulders, ramps, widening and crossovers with the same density gauge to ensure the PTD is achieved. Use the appropriate BR form based on the gauge used to record the density readings in accordance with MP 402-02. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that the shoulder shows signs of distress, decrease the compaction effort until no further damage occurs to the shoulder or subbase.

When HMA mixture placement is less than the anticipated quantities, obtain a minimum of two loose mix samples before placement is terminated. Before extracting the pavement cores, take density gauge readings and record on Form BR 109. Deliver the sealed pavement cores, loose mix samples, and the density gauge readings to the Regional Materials Laboratory for testing.

In addition to the daily density monitoring with a gauge, the Engineer will select and mark 4 pavement core locations every 3rd day of HMA mixture placement on the mainline from that day’s placement for pavement density verification. Extract a set of pavement cores and loose mix samples in accordance with §402-3.08, Pavement Density Samples.

The RME will calculate the PTD based on additional pavement cores taken every 3rd day of HMA mixture placement for pavement density verification. If the calculated PTD differs from the previous PTD by more than 2 lbs/ft³, the Engineer will establish a new PTD.
If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed on day.

a. Provide additional pavement samples to verify pavement density of HMA placed under the following situations:
   - Insufficient number of density readings recorded, either at a specific location or at the required frequency.
   - Paving completed after the only correlated density gauge on site breaks down.
   - Gauge readings do not seem to accurately represent the HMA density.
   - Plant production QAF is 0.85 and need to evaluate the pavement section in accordance with §401-4.10 Evaluation of Sublots Represented by 0.85 QAF, to determine whether to keep it in place.

   The Engineer will select and mark 4 pavement core locations in accordance with §402-3.08 Pavement Density Samples.
   Take density gauge(s) readings in accordance with MP 402-02 at each pavement core location prior to extracting pavement cores based on the type of density gauge used. Provide the density gauge readings with the gauge type, model, and serial number to the Regional Materials Laboratory in accordance with §402-3.08 Pavement Density Samples on Form BR 109.
   Extract a pavement core at the marked location in each sublot before the road is open to traffic, fill the core holes, take loose mix samples representing the lot, and deliver sealed pavement cores and samples to the Regional Materials laboratory in accordance with §402-3.08 Pavement Density Samples.
   The RME will establish a new PTD based on these pavement cores. If the average density of the pavement cores is not between 92% and 97% of the MMTD, the Engineer will apply Pavement Density Quality Adjustment to the material placed under these situations.

b. Provide additional pavement samples to verify PTD used for the situations listed below. The material placed under these situations will not be subject to Pavement Density Quality Adjustment.
   - Changes in condition of existing pavement being overlaid.
   - Excessive plant mixture variations.
   - Using a different Job Mix Formula or a different HMA plant other than the one used to produce mixture for the test section, as long as the aggregate and PG Binder sources do not change.

4. Multiple Paving Sites. When the work includes multiple paving sites, construct a test section at the initial paving site to establish a PTD. For the rest of the paving sites, provide pavement cores, loose mix samples, and gauge readings on the first day to verify PTD.

   The Engineer will direct that a test section be constructed if a different HMA plant other than the one used at previous site(s) is supplying the HMA mixture using different aggregate and PG Binder sources. The Test Section Adjustment will apply.

   When a contract includes multiple sites, the requirement of additional set of pavement cores applies to each paving site.

C. 70 Series Compaction Method. Place and compact HMA mixture in accordance with the contract documents. Do not place HMA mixture, including the construction of the test section, unless both a density gauge and a certified operator are present.
1. Test Section. On the first day of paving, place and compact a test section on the mainline, a maximum of 1,500 feet long in one lane, at a location approved by the Engineer using the same equipment and procedures to be used in the construction of the remainder of the course, to determine the Project Target Density (PTD) using the “peak” method. Ensure the thickness of the test section is the same as the course it represents. Use the first 150 feet of the test section to stabilize the paving operation. Initially, compact the pavement with a breakdown roller once sufficient HMA mixture is placed in the testable area. Select three random locations in accordance with MP 402-02 based on the type of density gauge used and mark these sites so that subsequent density testing can be performed at the same locations. Make necessary vibratory and static passes to “peak” the pavement density such that the density gauge reading is within 92-97% of the MMTD. Take density readings at the three selected sites after every additional machine pass until a “peak” density is achieved. A “peak” density is achieved when the increase in density is less than 2 lbs/ft$^3$ with compaction at 175°F or less. Stop further compaction if the pavement shows signs of distress.

Determine the PTD by calculating the average of the highest density reading from each of the random locations. Use the calculated PTD to monitor the pavement density. The Engineer may request pavement cores to verify the PTD in accordance with MP 402-02.

Routine paving operations may begin after construction of the test section, and after a PTD has been established and been verified by the Engineer based on the evaluation of density readings.

2. Routine Paving. Use only the density gauge(s) that were correlated during the construction of the test section and its corresponding PTD to monitor pavement density during routine paving operations.

Begin routine paving after the PTD has been established. Compact the pavement sufficiently to achieve the PTD value at each test location. Ensure the minimum density reading is at least 96% and no greater than 103% of the PTD in a single test location and 98% of the PTD calculated as a moving average of the last 10 test locations, as determined by a density gauge. Take density gauge readings at every 200 feet along the length of the pavement for each paver pass, at locations randomly selected by the Engineer, in accordance with the MP 402-02. Record these values on the appropriate BR form based on the type of gauge used.

If density gauge readings over two consecutive locations fall below 96% or above 103% of the PTD or if the moving average of the last 10 density gauge readings falls below 98% of the PTD, stop routine paving operations and construct a new test section.

Monitor density on shoulders, ramps, widening and crossovers with the same density gauge to ensure the PTD is achieved. Use the appropriate BR form based on the gauge used to record the density readings in accordance with MP 402-02. If the shoulder subbase is structurally insufficient to sustain the level of compaction such that they show signs of distress, decrease the compaction effort until no damage occurs to the shoulder or subbase.

The Engineer may request pavement samples for density verification of HMA placed under the following situations at no additional cost to the State.

- Insufficient number of density readings recorded, either at a specific location or at the required frequency.
- Paving completed after the only correlated density gauge on site breaks down.
- Gauge readings do not seem to accurately represent the HMA density.

D. 80 Series Compaction Method. Place and compact HMA mixture using either a static compaction or vibratory compaction method.

The number of passes listed in Table 402-6 Number of Passes, are recommended and may be increased or decreased by the Engineer to obtain adequate density. One vibratory pass is defined as one movement of a single drum of the roller over the pavement section in each direction. One static pass is defined as one movement of the roller over the pavement in each direction. Complete all breakdown
roller passes before the mat temperature falls below 250°F. Remove all ruts, ridges, roller marks, or other irregularities from the surface using static rolling. Perform all turning of the rollers on material which has had a minimum of one roller pass. The Engineer may approve alternate compaction procedures for areas where the specified procedures are not applicable. Oscillatory rollers may be used for either rolling option.

### TABLE 402-6 NUMBER OF PASSES

<table>
<thead>
<tr>
<th>Pavement Courses</th>
<th>Static Compaction</th>
<th>Vibratory Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel Wheel Rollers</td>
<td>Pneumatic Rollers</td>
</tr>
<tr>
<td>37.5 Base (Each Lift)</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>25 Binder</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>19 Binder</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>12.5 Top</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>9.5 Top</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6.3 Top</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Permeable Base^2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Based on 12-foot lane width.
2. For the Permeable Base course, compact the mixture between 140°F and 230°F. Up to 2 additional passes may be required to obtain adequate density.

**1. Static Compaction.** Use static compaction only when the compacted thickness of the finished mat is 4 inches or less. Compact the HMA mixture using a 3 static roller train. Ensure the rollers move at a uniform speed and do not exceed 3 mph. Ensure the roller drive wheel or drum is nearest to the paver. When paving multiple lanes simultaneously, increase the required number of rollers proportionately for each additional full lane width unless otherwise approved by the Engineer. Compact the HMA mixture with steel-wheel rollers operating in a static mode. Ensure each pass overlaps the previous roller pass by one-half the width of the roller.

Compact the HMA mixture with a steel-wheel roller immediately followed with a pneumatic rubber-tired roller. Make a minimum of 3 passes of the rubber-tired roller. One pass is defined as one movement of the roller over any point of the pavement in either direction.

Use a steel-wheel roller for finish rolling the HMA mixture to remove all shallow ruts, ridges, roller marks, and other irregularities from the surface.

When the compaction procedure fails to produce acceptable results, adjust the procedure to obtain the desired results.

**2. Vibratory Compaction.** Furnish a vibrating reed tachometer for the exclusive use of the Engineer. Provide a vibrating reed tachometer having a frequency range of 1,000 vpm to 4,000 vpm with a minimum reed interval of 50 vpm between 1,000 vpm and 2,000 vpm and a minimum reed interval of 100 vpm between 2,000 vpm and 4,000 vpm.

Ensure the settings on the rollers produce a minimum of 12 impacts per foot during the compaction process. Impacts are defined as the number of times a drum hits the pavement within one foot of travel and are determined using the following formula:

$$\text{Impacts per foot} = \frac{VPM}{\text{Speed}}$$

VPM = Frequency of the roller (vibration per minute)
Speed = Speed of the roller (feet per minute)
If the impacts are less than the minimum, adjust the settings and/or the speed to meet the minimum impacts requirement.

If satisfactory compaction is not obtained, or damage occurs to highway components and/or adjacent property using vibratory compaction equipment, cease using the vibratory compaction method and complete the work using static compaction methods in accordance with 1. Static Compaction at no additional cost to the State.

If number of roller passes, the roller setup, or minimum impacts per foot is not being met, stop the paving operation, adjust the process as necessary, and restart the operation with the approval of the Engineer.

E. **Density Gauges.** Provide density gauge(s) to monitor pavement density in accordance with MP 402-02.

1. **Nuclear Density Gauge.** Submit a Safety Control plan at least two weeks prior to using the gauge. Provide nuclear density gauge meeting the following requirements:
   • Consist of a radioactive source, scaler, and other basic components housed in a single backscatter unit.
   • Calibrated at least every two years.
   • Operated by personnel trained in the principles of nuclear testing and safety practices.

2. **Non-nuclear Density Gauge.** Provide non-nuclear density gauge meeting the following requirements:
   • Capable of functioning in the temperature and moisture levels experienced during HMA mixture paving.
   • Capable of determining the density of HMA pavements by measuring changes in the electromagnetic field resulting from the HMA compaction process.
   • Calibrated at least every two years.

**402-3.08 Pavement Density Samples**

A. **Pavement Cores.** The Engineer will select one pavement core location for each sublot in accordance with MP 402-02. Take 6 inch diameter pavement cores from within the 10-inch diameter circles outlined by the Engineer. The Engineer will not designate pavement core locations before the rolling operation is completed, and all compaction equipment has moved off the sublot designated for coring. Notify the Engineer immediately if a pavement core is in a location that is believed to not represent the sublot. Extract the pavement cores no later than the end of the following day’s placement. If necessary, cool the pavement so that the core samples are not damaged during coring. Do not separate the core sample from the underlying layers if the pavement core sample does not de-bond during coring. The Regional Materials Laboratory will separate the pavement core layer required for testing from the underlying material by sawing, if necessary.

Extraction of companion cores is not allowed except for the following situations:
   • As described in §402-3.08G Pavement Density Core Test Results
   • To establish an Interim Project Target Density on the first day of paving. In that case, 2 cores maybe taken during the construction of a test section
   • To perform quality control tests during routine paving. A maximum of two cores are allowed with prior permission of the Engineer. Do not take core(s) adjacent to the project cores.

B. **Filling Core Holes.** Fill all pavement core holes with a similar HMA mixture immediately after extracting the cores or before opening the lane to traffic. Prior to backfilling, wipe the core hole with a cloth to remove any standing water. Place HMA mixture in the core hole in layers of 3 inches or less.
and compact each layer with 10-18 lb slide hammer with a diameter of at least 4 inches but less than 6 inches. Use of a shovel or similar method is not allowed. Use an alternative method approved by the Engineer if it provides acceptable results. If core holes are not filled within 2 work days of placement, the Engineer will stop routine paving until the core holes are filled.

C. Loose Mix Samples. On each paving day when pavement cores are required, take 4 loose mix samples in accordance with AASHTO T168 Standard Test Method for Sampling Bituminous Paving Mixtures. Take these samples such that they represent the day’s HMA mixture placement. The RME may utilize loose mix maximum theoretical specific gravity values from plant HMA QC/QA testing. When requested, supply the QCT and QAT results by e-mail or fax to the RME.

D. Securing Pavement Cores. The Engineer will secure and seal the pavement cores in accordance with MP 402-02 once they have been extracted from the pavement.

E. Sample Delivery. Deliver the sealed cores, loose mix samples, and gauge density readings, when required, to the Regional Materials Laboratory no later than the end of the following day’s placement. Submit pavement cores, density gauge readings, and loose mix samples as required for 50, 60, or 70 Series methods together at the end of the day’s placement but no later than a day following placement of the lot. If these samples are not submitted together for any paving lot, the QAF will be assigned a 1.00 or less for that lot when a QAF is applicable. If, for any reason, a delay occurs in the delivery of the lot samples for three consecutive lots, stop paving operations until the samples are delivered and tested.

F. Unacceptable Pavement Cores. Pavement cores damaged during extraction, pavement cores delivered to the Regional Materials Laboratory for testing that are damaged, or pavement cores with damaged or missing security seals will not be tested. The Engineer will select new pavement core locations within a foot forward of the original locations at the same offset. Extract new pavement cores from the newly identified locations.

G. Pavement Density Core Test Results. Upon receipt of test results of the pavement cores and loose mix samples provided by the Regional Materials Laboratory, if the results are not representative of the density gauge data or previous results for similar sublots, notify the Engineer and the Regional Materials Engineer, in writing, within 2 work days. Include details as to what specific test results are not representative, and the reasons, with the notification.

402-3.09 Joints. Ensure the finished pavement at all joints complies with the surface tolerance requirements and exhibits the same uniformity of texture and compaction as other sections of the course. Do not pass rollers over the unprotected edges of a freshly laid mixture unless approved by the Engineer.

Construct all joints, excluding the tapered wedge joint, such that the exposed edge of the newly placed course is full thickness of the course and straight unless the exposed joint will not be part of the joint. If the edge of the newly placed course is not straight or smoothly curved, correct the edge by using a power saw or other approved tools to cut a neat line. Prior to placing the adjacent course, apply joint adhesive in accordance with §402-3.06 Joint Adhesive, to all pavement edges in order to provide bonding with the newly laid pavement.

Place successive HMA courses over an underlying course such that all longitudinal joints are offset no more than 6 inches from the longitudinal joint of the lower pavement course, unless otherwise approved by the Engineer. Place HMA courses on existing PCC pavement such that all longitudinal joints are stacked on top of the joint of the underlying PCC pavement.
A. Transverse Joints. Place courses as continuously as possible to limit the number of transverse joints. Stagger the transverse joints in adjacent lanes a minimum of 10 feet. Form the transverse joint by cutting back the previous placement to expose the full depth of the course.

Set up the paver such that material laid overlaps the previously placed edge by 2 to 3 inches at a thickness of approximately 25% of the compacted thickness of the course. Bump back the overlapped material onto the adjacent hot mat using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Do not broadcast the overlap material onto the fresh mat. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if necessary.

Compact the transverse joint in static mode with the roller parallel to the joint and perpendicular to traffic. Place boards of proper thickness at the edge of the pavement for the off pavement movement of the roller. Make the first pass with the roller operating on the previously laid material with 6 to 8 inches of its drum(s) overlapping onto the uncompacted HMA mixture. If a vibratory roller with pneumatic drive wheels is used, align the first pass with one of the pneumatic wheels directly on the joint and the drum operating in static mode. Make successive passes with the roller drum(s) moving approximately one foot onto the hot material per pass until half the width of the roller is on the hot mat.

B. Longitudinal Joints. Ensure that the longitudinal joints in the Top Course will correspond with the edges of the proposed traffic lanes. Other joint arrangements will require approval of the Engineer.

If a dual-drum vibratory roller is used during construction of a longitudinal joint using either Option 1 or 2, operate the roller in vibratory mode, unless static rolling is required. Operate rollers as close to the paver as practical. Make the first pass with the roller traveling toward the paver and operating on the hot mat with 6 to 8 inches of the roller drum overlapping onto the cold mat. Apply a second pass to the joint as the roller travels back away from the paver.

If a single-drum vibratory roller with pneumatic drive wheels is used, operate the roller in vibratory mode and follow the same procedure except that the roller will be aligned on the joint so that the pneumatic drive wheels travels on the joint. Make all turning movements of the roller on previously compacted material. After applying two roller passes on the longitudinal joint, proceed with the roller to the low side of the lane and compact as described in §402-3.07 Compaction.

For all HMA courses other than Top Course, ensure no more than 100 feet of the longitudinal pavement joint is exposed at the end of the working day when traffic is maintained on the roadway during paving operations. For Top Course of 2 inches or less, refer to §402-3.09C Exposed Longitudinal Joint.

When paving Top Course, construct the longitudinal joint using one of the options below. Use a butt joint for all other HMA courses.

1. **Option A - Butt Joint.** Place the HMA mixture such that it uniformly overlaps the adjacent cold mat 2 to 3 inches at a thickness of approximately 25% of the compacted thickness of the course. Bump back the overlapped material onto the adjacent hot mat using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Do not broadcast the overlap material onto the fresh mat. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if necessary.

   Bumping is not required when the use of a rake creates a safety hazard. Instead, place the HMA mixture in a manner such that the thickness of the uncompacted course is approximately 25% more than the compacted thickness of the adjacent HMA course with a ½ to 1 inch overlap.

2. **Option B - Tapered Wedge Joint.** Use this option when placing Top Course only. Place the HMA mixture for the first mat with an attachment to the paver to provide a sloping wedge with a vertical step-down at the longitudinal pavement joint. Extend a wedge of material from the bottom
of the step-down to the existing surface at a slope of 1 on 8 or flatter. The vertical step-down will be ½ inch minimum after compaction of the mat. Place the second mat such that it uniformly overlaps the adjacent cold mat 1 to 1 ½ inches at a thickness of approximately 25% of the compacted thickness of the HMA course. Bump back the overlapped material onto the adjacent hot mat using a rake so that the roller operator can crowd the material into the hot side of the joint resulting in a smooth and well compacted joint after rolling. Do not broadcast the overlap material onto the lane. If the overlap is excessive, trim off the excess material so that the material along the joint is uniform. Remove and discard the coarse particles of aggregate in the overlap material if necessary.

Bumping is not required when the use of a rake creates a safety hazard. Instead, place the HMA mixture in a manner such that the thickness of the uncompacted course is approximately 25% more than the compacted thickness of the adjacent HMA course with a ½ to 1 inch overlap.

C. Exposed Longitudinal Joint. Expose the longitudinal joint for the Top Course of up to 2 inches to traffic for not more than 24 hours with the following conditions:

- Use Option B, Tapered Wedge Joint, except when the thickness is 1 inch or less where a butt joint may be exposed to traffic.
- Place UNEVEN LANES (W8-11) warning signs posted in advance of the condition, at each ramp, and roadway intersection, and repeated every ½ mile, supplemented with NEXT [X] MILES (W16-4) auxiliary signs to alert drivers of the uneven edge.
- If the exposed longitudinal pavement joint becomes damaged due to rounding of the notched wedge, saw-cut the joint prior to placing the adjacent lane.
- Apply joint adhesive to the exposed joint prior to placement of the adjacent lane in accordance with §402-3.06 Joint Adhesive.

Do not allow exposed joints over the weekends, holidays, or when there are other concerns, such as pending wet weather.

402-3.10 Surface Tolerance. Construct each pavement course to a ¼ inch surface tolerance. The Engineer may test the surface with a 16-foot straight edge or string line placed parallel to the centerline of the pavement and with a 10-foot straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding ¼ inch will be appropriately corrected or the pavement be removed and replaced at no additional cost to the State.

402-3.11 Thickness Tolerance. Construct the pavement so that the final compacted thickness is as near to the nominal thickness as is practical, and within the tolerances specified below. The thickness indicated for each of the various courses of HMA pavement is the nominal thickness.

The Engineer may request pavement cores to determine the thickness of the completed pavement course for final acceptance and payment. Provide work zone traffic control and take pavement cores in accordance
with §402-3.08 Pavement Density Sample, at no additional cost to the State. The Engineer may use another acceptance method such as yield calculations to determine the final thickness for acceptance and payment.

HMA mixture placed as a Truing and Leveling course as described in §402-3.05 Conditioning of Existing Surface, will not be considered in pavement thickness determinations. The allowable tolerance for HMA mixture specified under a single pay item is as follows:

- 1/4 inch or less for a required course whose nominal thickness is 4 inches or less
- 1/2 inch or less for a course or courses whose nominal thickness is over 4 inches

The tolerance for the total thickness of all HMA mixture courses is as follows:

- 1/4 inch or less when the total nominal thickness indicated on the plans is 4 inches or less
- 1/2 inch or less when the total nominal thickness is over 4 inches but not more than 8 inches
- 5/8 inch or less when the total nominal thickness is more than 8 inches

When the HMA mixture is placed on newly constructed subbase material, an additional tolerance of 1/4 inch will be allowed both in the nominal thickness of the course placed directly on the subbase and the total pavement thickness.

No payment will be made for any material placed in excess of the permissible tolerance. Tolerances indicated for the thicknesses of individual courses of multi course pavements (including composite pavements) are guides which should be met as closely as practical. Tolerance for the total thickness of such pavement is also a guide.

The HMA mixture placed may be accepted under the following conditions:

- When the individual course placed does not meet the thickness tolerance but substantially conforms to the plans and specifications, true to line and grade in order to attain a smooth riding pavement.
- When the total thickness of such pavements is less than the specified thickness including tolerances but substantially conforms to the plans and specifications.
- When the total thickness of such pavements is greater than the specified thickness and the excess thickness is necessary to attain a smooth riding pavement surface.

Payment for excess thickness necessary to achieve a smooth riding surface will be considered only in cases where an existing pavement surface has been resurfaced.

**402-3.12 Paver and Equipment Cleaning.** Do not clean tools and equipment used for HMA placement on the pavement surface, or near streams, ponds, drainage structures or other areas that are tributaries to waterways. Use an area approved by the Engineer for cleaning all paving equipment and tools. If possible, remove solid pieces of asphalt by scraping or other mechanical means prior to application of a cleaning agent. If a petroleum product is used for cleaning, contain all liquid products during cleaning operations using tarpaulins, sand pads, pails, or other collection methods to prevent spillage or accidental release. Use hand sprayers or other similar devices to minimize the amount of petroleum product applied. Properly dispose of sand and collected petroleum products as petroleum contaminated soil at no additional cost to the State.

**402-3.13 Shoulder Edge Wedge.** When specified, construct a shoulder edge wedge as detailed in the contract documents. Place HMA mixture on the pavement shoulders where the outside edge of Top and Binder Course consist of an angle of 35° or flatter measured from finished grade to the preceding course surface. Construct the shoulder edge wedge by using a device attached to the screed. Minimize hand work. Begin the top of the tapered section at the end of the shoulder width such that the tapered section will be an additional width of material outside of the paved shoulder width. The shoulder edge wedge is optional at locations where guardrails are installed.
402-3.14 Pavement Evaluation. The Regional Materials Engineer (RME) will evaluate mixtures either placed or produced outside the specification limits which resulted in low quality adjustment factors.

A. Plant Production. When plant production QAF is 0.85, the RME will evaluate the pavement section in accordance with §401-3.10 Evaluation of Sublots Represented by 0.85 QAF, whether to keep it in place.

B. Pavement Density. When a QAF of a paving lot for 50 Series or 60 Series compaction is calculated to be 0.60, the RME will evaluate the lot to determine if it can be left in place. The type of material produced (i.e. Binder, Top), the course in which it is used, and the location of use (i.e., mainline or a non-critical area) will be primary considerations in the determination of whether the HMA mixture can be left in place. If the RME determines that the HMA mixture can be left in place, the Engineer will apply a QAF of 0.60. If the HMA mixture cannot be left in place, remove and replace at no additional cost to the State.

402-4 METHOD OF MEASUREMENT

402-4.01 Hot Mix Asphalt. The quantity of HMA mixture to be measured for payment will be in tons placed to the nearest 0.01 tons.

402-4.02 Plant Production Quality Adjustment. Plant Production Quality Adjustments will be measured in Quality Units determined for each day’s production using the daily Quality Adjustment Factor (QAF) for plant production, determined in accordance with §401-3.07 Documentation. Quality Units for plant production quality adjustments will be calculated using the formula below.

\[
\text{Quality Units} = (\text{Quality Adjustment Factor} - 1.00) \times \text{HMA Placed (Tons)}
\]

402-4.03 Pavement Density Quality Adjustment. Pavement Density Quality Adjustments will be measured in Quality Units determined for each day’s production using the daily Quality Adjustment Factor (QAF) for pavement density. The quantity of HMA mixture subject to adjustment will be determined from quantity placed on the mainline and ramps of uniform width longer than 1250 feet. When shoulders and mainline are placed together, the mainline quantity may be determined using typical sections shown in the contract documents.

The pavement density QAF will not apply to HMA mixture placed on ramps with a uniform full width section less than 1250 feet in length, shoulders, widening, crossovers, and bridges. Payment in these areas will be a QAF of 1.00 based on satisfactory placement and compaction.

Quality Units for pavement density quality adjustments under 50 and 60 Series compaction methods will be calculated using the formula below. No pavement density quality adjustments will be made under 70 and 80 Series compaction methods.

\[
\text{Quality Units} = (\text{Quality Adjustment Factor} - 1.00) \times \text{HMA Placed (Tons)}
\]

A. 50 Series Compaction QAF. The RME will determine the Percent Within Limits (PWL) for the paving lot in accordance with MP 402-02 and determine the QAF as shown in Table 402-7 Quality Adjustment Factors for 50 Series. The Engineer will use the QAF to calculate the Quality Units for the accepted HMA mixture quantity.
### TABLE 402-7 QUALITY ADJUSTMENT FACTORS FOR 50 SERIES

<table>
<thead>
<tr>
<th>Percent Within Limits (PWL)</th>
<th>Quality Adjustment Factor (QAF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWL_{92.97} &gt; 93</td>
<td>1.05</td>
</tr>
<tr>
<td>PWL_{92.97} ≤ 93</td>
<td>\sum \left( \text{PWL}<em>{\text{Segment}} \times \text{Pay Factor}</em>{\text{Segment}} \right) \end{equation}</td>
</tr>
</tbody>
</table>

1. PWL\text{Segment} will be calculated for each of the density ranges in Table 402-8 Density Segment Pay Factors, using the standard deviation and average density for the lot.

### TABLE 402-8 DENSITY SEGMENT PAY FACTORS

<table>
<thead>
<tr>
<th>Density Segment</th>
<th>Segment Pay Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>88 – 89</td>
<td>0.60</td>
</tr>
<tr>
<td>89 – 90</td>
<td>0.70</td>
</tr>
<tr>
<td>90 – 91</td>
<td>0.80</td>
</tr>
<tr>
<td>91 – 92</td>
<td>0.90</td>
</tr>
<tr>
<td>92 – 93</td>
<td>1.00</td>
</tr>
<tr>
<td>93 – 96</td>
<td>1.05</td>
</tr>
<tr>
<td>96 – 97</td>
<td>1.00</td>
</tr>
<tr>
<td>97 – 98</td>
<td>0.90</td>
</tr>
<tr>
<td>98 – 99</td>
<td>0.80</td>
</tr>
</tbody>
</table>

### B. 60 Series Compaction QAF

When pavement density samples are taken and if payment adjustment is applicable, the Engineer will make the adjustment in accordance with Table 402-9 Quality Adjustment Factors for 60 Series. A payment adjustment will be made, based on the Quality Unit Index Price to all the material placed on the mainline for the day the pavement cores represent.

### TABLE 402-9 QUALITY ADJUSTMENT FACTORS FOR 60 SERIES

<table>
<thead>
<tr>
<th>Average Pavement Core Density</th>
<th>Quality Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>\leq 92 \text{ Density} \leq 97</td>
<td>1.00</td>
</tr>
<tr>
<td>91.0 \leq \text{Density} &lt; 92.0 or 97.0 &lt; \text{Density} \leq 98.0</td>
<td>0.95</td>
</tr>
<tr>
<td>90.0 \leq \text{Density} &lt; 91.0</td>
<td>0.90</td>
</tr>
<tr>
<td>88.0 \leq \text{Density} &lt; 90.0</td>
<td>0.85</td>
</tr>
<tr>
<td>\text{Density} &lt; 88.0 or \text{Density} &gt; 98.0</td>
<td>0.60</td>
</tr>
</tbody>
</table>

### 402-4.04 Test Section Adjustment

Test Section Adjustments will be measured in Quality Units using a test section adjustment factor of 0.5 for up to the first 200 tons placed on a test section on the mainline. Quality Units for Test Section Adjustment for 50 and 60 Series compaction methods will be calculated using the formula below.

\[
\text{Quality Units} = 0.5 \times \text{HMA Placed on Mainline (Tons)}
\]

### 402-5 BASIS OF PAYMENT

The unit price bid for all HMA mixture shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including extracting the pavement cores, filling, and compaction of all core holes. Application of tack coat, joint adhesive, and cleaning will be paid separately except when the joint adhesive is applied under §402-3.01E.
Payment of Quality Adjustments will be made based on the number of Quality Units multiplied by the fixed index price for Quality Adjustment to HMA Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>402.011903</td>
<td>Type 2 F9, Asphalt-Treated Permeable Base Course</td>
<td>Ton</td>
</tr>
<tr>
<td>402.017903</td>
<td>Truing &amp; Leveling F9, Superpave HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.018903</td>
<td>Truing &amp; Leveling F9, Superpave HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.058903</td>
<td>Shim Course F9, Hot Mix Asphalt</td>
<td>Ton</td>
</tr>
<tr>
<td>402.068103</td>
<td>6.3 F1 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.068203</td>
<td>6.3 F2 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.068303</td>
<td>6.3 F3 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.095103</td>
<td>9.5 F1 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.095203</td>
<td>9.5 F2 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.095803</td>
<td>9.5 F1 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.096103</td>
<td>9.5 F1 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.096203</td>
<td>9.5 F2 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.096303</td>
<td>9.5 F3 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.097103</td>
<td>9.5 F1 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.097203</td>
<td>9.5 F2 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.097303</td>
<td>9.5 F3 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098103</td>
<td>9.5 F1 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098203</td>
<td>9.5 F2 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098303</td>
<td>9.5 F3 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.098903</td>
<td>9.5 F9 Top Course HMA, Shoulder Course, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.125103</td>
<td>12.5 F1 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.125203</td>
<td>12.5 F2 Top Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.126103</td>
<td>12.5 F1 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.126203</td>
<td>12.5 F2 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.126303</td>
<td>12.5 F3 Top Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.127103</td>
<td>12.5 F1 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.127203</td>
<td>12.5 F2 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.127303</td>
<td>12.5 F3 Top Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128103</td>
<td>12.5 F1 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128203</td>
<td>12.5 F2 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128303</td>
<td>12.5 F3 Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.128903</td>
<td>12.5 F9 Top Course HMA, Shoulder Course, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.195903</td>
<td>19 F9 Binder Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.196903</td>
<td>19 F9 Binder Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.197903</td>
<td>19 F9 Binder Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.198903</td>
<td>19 F9 Binder Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.255903</td>
<td>25 F9 Binder Course HMA, 50 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.256903</td>
<td>25 F9 Binder Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.257903</td>
<td>25 F9 Binder Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.258903</td>
<td>25 F9 Binder Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.376903</td>
<td>37.5 F9 Base Course HMA, 60 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.377903</td>
<td>37.5 F9 Base Course HMA, 70 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.378903</td>
<td>37.5 F9 Base Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.418903</td>
<td>9.5 F9 Temporary Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.428903</td>
<td>12.5 F9 Temporary Top Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
<tr>
<td>402.438903</td>
<td>19 F9 Temporary Binder Course HMA, 80 Series Compaction</td>
<td>Ton</td>
</tr>
</tbody>
</table>
SECTION 405 - COLD MIX BITUMINOUS PAVEMENT (OPEN GRADED)

405-1 DESCRIPTION. This work shall consist of constructing one or more courses of cold mix bituminous pavement on a prepared base in accordance with these specifications and in substantial conformance with the lines, grades, thicknesses, and typical cross-sections shown on the plans or established by the Engineer.

405-2 MATERIALS

405-2.01 Bituminous Material. The bituminous materials required for mixing and for sealing shall meet the requirements of section 702, Bituminous Materials. The type and grade of bituminous material shall be that indicated on the plans or in the proposal.

405-2.02 Aggregates. The aggregates shall be Department approved aggregates meeting the requirements of § 703-02, Coarse Aggregates, for the sizes specified. Screened gravel shall not be permitted unless specified on the plans or in the proposal.

405-2.03 Composition of Mixtures. The bituminous cold mix shall be composed of a mixture of aggregate and bituminous material as ordered and approved by the Engineer. The mix shall be proportioned as specified in Table 405-1, Composition of Cold Bituminous Mixtures.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Mixes</th>
<th>Type 1 General Limits % passing&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Type 2 General Limits % passing&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Type 3 General Limits % passing&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 in</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 in</td>
<td>-</td>
<td>100</td>
<td>75-100</td>
<td></td>
</tr>
<tr>
<td>1 in</td>
<td>100</td>
<td>90-100</td>
<td>50-80</td>
<td></td>
</tr>
<tr>
<td>1/2 in</td>
<td>90-100</td>
<td>15-45</td>
<td>0-15</td>
<td></td>
</tr>
<tr>
<td>1/4 in</td>
<td>15-45</td>
<td>0-10</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1/8 in</td>
<td>0-10</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>No. 200</td>
<td>0-1.0</td>
<td>0-1.0</td>
<td>0-1.0</td>
<td></td>
</tr>
<tr>
<td>Bituminous Material&lt;sup&gt;2,3&lt;/sup&gt;</td>
<td>4.7-7.0</td>
<td>4.0-6.0</td>
<td>3.5-5.5</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Open, Coarse Texture</td>
<td>Open, Coarse Texture</td>
<td>Open, Coarse Texture</td>
<td></td>
</tr>
<tr>
<td>Typical Uses</td>
<td>Surface Course</td>
<td>Intermediate</td>
<td>Base Course</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> Percentage based on total aggregate weight.

<sup>2</sup> Total Emulsion Percentage based on total mix weight.
3. When crushed air-cooled blast furnace slag aggregate is selected, the above bituminous material content shall be increased approximately 25%.

405-3 CONSTRUCTION REQUIREMENTS

405-3.01 Weather Limitations. Bituminous material or mixture shall not be applied on any soft surfaces, when the surface is wet, when the temperature of the surface on which the mixture is to be placed is below 45°F, or when other weather conditions would prevent proper construction of the pavement.

405-3.02 Equipment. The following equipment shall be required:

- Either central pugmill mixer and bituminous paver or Travel plant mixer
- Bituminous material distributor
- Steel wheeled roller, 8-12 Ton or Approved vibratory roller
- Chip spreader
- Power broom
- Motor grader, if required
- Miscellaneous equipment to perform the work

All equipment and the condition of the equipment for this work shall be subject to approval of the Engineer at all times.

Mixing shall be done with a rotating twin paddle shaft pugmill providing suitable pressure-kneading action in mixing. Mixing by blading, shoveling and/or scooping will not be permitted.

The materials shall be mixed either by the travel mix plant method or in a central pugmill mixer.

The mixer shall be either a continuous traveling type, central continuous or batch type pugmill designed to accurately proportion either by volume or by weight, so that when the aggregate and bituminous materials are incorporated in the mix, a thorough and uniform coating will result. The mixer shall be equipped to mechanically or electrically interlock the bituminous feed with the aggregate feed such that uniformity of the mixture is assured at all times. The pugmill mixer, either traveling or central type, shall be provided with weighing, volumetric or other gauging equipment which shall be capable of providing accurate control at all times of the amount of aggregate entering the mixer per time interval. On the central continuous type pugmill a mechanically operated discharge hopper of at least 1 cubic yard capacity shall be provided. The mixer shall be equipped with a positive displacement metering system capable of totalizing the quantity of bituminous material applied to the mixing chamber.

405-3.03 Preparation of the Base. The roadway surface to be covered shall be free from holes, depressions, bumps, waves and corrugations. Any unsuitable surface areas shall be repaired by replacement of the unstable materials or by patching with a material to produce a tight surface having the same elevation as the surrounding surface. The roadway surface shall be broomed when ordered by the Engineer to remove loose material.

405-3.04 Mixing and Spreading. The aggregate and asphalt shall be thoroughly mixed so that the bituminous material is uniformly distributed throughout and all aggregate particles are uniformly coated.

The mixture shall be deposited on the prepared base either in a windrow at the back of the travel mixer or mechanically spread in a uniform layer so as to produce the specified thickness after compaction. If deposited in a windrow, it shall be spread over the entire roadway surface by motor grader or other approved spreader to produce the specified thickness after compaction. The maximum allowable compacted thickness shall be 2 inches for the Type 1 mix (Table 405-1) and 4 inches for the Type 2 and Type 3 mixes (Table 405-1).
405.3.05 Compaction. After spreading, the mixture shall be thoroughly and uniformly compacted with a self-propelled steel-wheeled roller or an approved vibratory roller to obtain a thoroughly compacted pavement. The number of roller passes to achieve the desired compaction shall be approved by the Engineer.

405.3.06 Surface Testing. The finished surface of the pavement shall be tested with a 16 foot straight edge laid parallel with the center line of the pavement. Any area exceeding a 1/4 inch variation from the surrounding area shall be satisfactorily corrected or removed and replaced.

405.3.07 Pavement Sealing. Either prior to initial compaction or immediately after compacting the mix, No. 1A size key stone meeting the requirements of § 703-02, Coarse Aggregates, shall be uniformly spread upon the surface at the rate of 10 to 15 lb/sy and the course rolled. No. 1 size key stone meeting the requirements of § 703-02, Coarse Aggregates, at the rate of 10 to 20 lb/sy, may be used for key stone on the base course mixes. After placement of the No. 1A size key stone, the pavement shall be opened to traffic for a minimum of 3 days before placing the seal coat.

Prior to the application of the seal coat, the pavement surface shall be thoroughly swept and cleaned of all excess material. The seal coat shall be bituminous material asphalt emulsion meeting the requirements of § 702-3101 or § 702-4101 applied at the rate of 0.3 to 0.5 gal/sy (Type 1 mix, Table 405-1) or 0.5 to 0.65 gal/sy (Type 2 mix, Table 405-1). This shall be immediately followed by an application of No. 1A cover aggregate at the rate of 15 to 20 lb/sy which shall then be rolled. In the case where multiple lifts of Cold Mix Bituminous Pavements are used, only the surface of the top course shall require a seal coat. In multiple lift construction, each lift requires an application of key stone to fill voids in the mat.

405.4 METHOD OF MEASUREMENT. The bituminous cold mix pavement shall be measured by the number of tons of compacted aggregate, including key and cover stone, placed in accordance with the specifications.

The liquid bituminous material shall be measured by the liter.

405.5 BASIS OF PAYMENT. The unit price bid per ton shall include the preparation of base, the cost of furnishing all the aggregate, the mixing, placing, compaction and all labor and equipment necessary to complete the work. The bituminous material will be paid for under its appropriate item.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>405.01</td>
<td>Cold Mix Bituminous Pavement (Open Graded)</td>
<td>Ton</td>
</tr>
</tbody>
</table>

SECTION 406 (VACANT)

SECTION 407 - TACK COAT

407.1 DESCRIPTION. This work shall consist of preparing and treating an existing Portland cement concrete surface or hot mix asphalt surface with tack coat in accordance with the Contract documents and as directed by the Engineer.

407.2 MATERIALS. The tack coat shall meet the applicable requirements of §702. Use of alternative tack coat material requires prior approval by the Director, Materials Bureau.

407.3 CONSTRUCTION DETAILS.
407-3.01 Equipment. A distributor shall be used for applying tack coat. The distributor shall be capable of applying the tack coat uniformly on variable widths of surface up to 15 feet.

The distributor equipment shall include a quantity measuring system and a thermometer for measuring temperature of tank contents. Prior to being used on a project, this equipment shall be calibrated in accordance with ASTM D 2995 Standard Practice for Estimating Application Rate of Bituminous Distributors or an equivalent calibration procedure acceptable to the Engineer. The Engineer will witness the equipment calibration or require the Contractor to provide documentation certifying the calibration.

Distributors shall be equipped with circulation spray bars which shall be adjustable both laterally and vertically. An attached bristle broom that drags on the pavement behind the spray bars may be attached to the distributor. If the broom is used, it shall be adjustable laterally and vertically so that the full width of the applied tack coat is bristled uniformly into the pavement surface.

A bituminous material sampling valve shall be attached to the distributor. The distributor tank shall be equipped with an agitator that is capable of ensuring the tack coat remains homogeneous.

Tack coat stored in the distributor tank shall be heated and maintained at a temperature between 85ºF and 160ºF.

Hand operated spray units will be permitted only in areas where the use of a distributor is impractical. The Engineer will determine the final acceptance of all equipment used for applying the tack coat.

407-3.02 Application of Tack Coat. The tack coat contained in the distributor tank shall be homogeneous.

The tack coat shall be applied to a prepared clean pavement. Material shall be applied uniformly across the width of the designated area.

The tack coat shall not be applied on a wet pavement surface or when the pavement surface temperature is below 40ºF.

The application rate shall be as determined in Table 407-1 Tack Coat Application Rates. These are recommended application rates for tack coat on various surface types and may be modified by the Engineer.

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Application Rate (gal/ yd²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diluted Tack Coat</td>
</tr>
<tr>
<td>New Hot Mix Asphalt</td>
<td>0.05 - 0.06</td>
</tr>
<tr>
<td>Milled Surfaces and Existing Hot Mix Asphalt</td>
<td>0.08 - 0.10</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>0.08 - 0.10</td>
</tr>
<tr>
<td>Vertical Surfaces (curbs, drainage structures, and appurtenances)</td>
<td>0.09 - 0.11</td>
</tr>
</tbody>
</table>

407-3.03 Sampling. The Engineer will request samples from the Contractor at the frequency listed in Materials Method 702-2 Asphalt Emulsion - Quality Assurance. The Engineer will witness the Contractor sampling the material. The sample will represent all material from the same certified lot, placed that day.

407-4 METHOD OF MEASUREMENT. The quantity to be measured for payment will be in gallons of tack coat measured at 60ºF to the nearest gallon. The following formula will be used to calculate material quantity at 60ºF:

\[
\text{Volume @ 60ºF} = \text{Volume}_D \times [1 - (\Delta T \times 0.00025)]
\]

\[
\Delta T = \text{Delivered Temperature (ºF) - 60}
\]
Volume_D = Quantity at Delivered Temperature (gallons)

407-5 BASIS OF PAYMENT. The unit price bid per gallon for tack coat shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work.

The Regional Materials Engineer will evaluate material represented by failing samples. If the Engineer elects to leave the material in place, the Contractor shall receive a pay reduction of 75% of the tack bid price, for the pavement section represented by the failing sample.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>407.0102</td>
<td>Diluted Tack Coat</td>
<td>Gallon</td>
</tr>
<tr>
<td>407.0103</td>
<td>Straight Tack Coat</td>
<td>Gallon</td>
</tr>
</tbody>
</table>

SECTIONS 408 AND 409 (VACANT)

SECTION 410 – CHIP SEAL
(Last Revised September, 2016)

410-1 DESCRIPTION. This work shall consist of the construction of a single course chip seal for pavements and/or shoulders in accordance with the contract documents.

410-2 MATERIALS

410-2.01 Bituminous Materials. The bituminous material shall meet the applicable requirements of Section 702.

A. Bituminous Material – Pavement and Shoulders. Ensure that the bituminous material is compatible with the selected aggregate; use item 702-3101P, 702-3102P or 702-4101P.

B. Bituminous Material – Shoulders. For shoulders only, the Contractor shall use item 702-3301P or 702-4201P.

C. Fog Seal. The Contractor shall provide material meeting the requirements of Section 702, Table 702-7, Diluted Tack Coat; or use an alternate material approved by the Director, Materials Bureau.

410-2.02 Aggregates. The aggregate shall conform to the requirements of §703-02, Coarse Aggregates, except as modified herein. The aggregate size shall be No. 1ST or No. 1A, as specified. The aggregate’s flakiness index shall meet the requirements of Materials Method 410, Chip Seal Mix Design.

A. Aggregate – Pavement. The aggregate shall meet one of the following requirements:
   1. Limestone or a blend of limestone and dolomite having an acid insoluble residue content not less than 20.0%
   2. Dolomite.
   3. Sandstone, granite, chert, trap rock, ore tailings, or other similar non-carbonate materials.
   4. Use gravel or blend two or more of: gravel, limestone, dolomite, sandstone, granite, chert, trap rock, ore tailings, or other similar materials to meet the following requirements:
      a. Size 1ST Aggregate. Produce a final blend having noncarbonate plus 1/4 inch particles comprising at least 20.0% of the total aggregate by weight with adjustments to equivalent volumes for materials of different specific gravities.
b. Size 1A Aggregate. Produce a final blend having noncarbonate plus 1/8 inch particles comprising at least 20.0% of the total aggregate by weight with adjustments to equivalent volumes for materials of different specific gravities.

**B. Aggregate - Shoulders.** The aggregate shall conform to the requirements of §703-02, Coarse Aggregates.

**C. Stockpile.** Build an aggregate stockpile at a location approved by the Engineer. When blending multiple aggregates, use automated proportioning and blending equipment to produce a uniformly graded stockpile.

**410-2.03 Cover Sand.** Use cover sand conforming to the requirements of §703-01, Fine Aggregate or §703-02, Coarse Aggregate except as modified in Table 410-1 Cover Sand.

<table>
<thead>
<tr>
<th>Screen Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>90-100</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-3</td>
</tr>
</tbody>
</table>

**410-2.04 Material Sampling and Testing**

**A. Aggregate Stockpile.**

1. **Contractor Testing.** The Contractor shall perform the following tests and submit the results to the Regional Materials Engineer.
   a. Obtain three samples, according to ASTM D75, *Standard Practice for Sampling Aggregates*. Each sample must contain material from each face of the stockpile.
   b. Test samples in accordance with AASHTO T 11, *Materials Finer than #200 Sieve in Mineral Aggregates by Washing*, and AASHTO T 27, *Sieve Analysis of Fine and Coarse Aggregates*. Test results shall be based on the average of three tests.
   c. When required, sample and test the aggregate in accordance with Materials Method 28, *Friction Aggregate Control and Test Procedures*.
   d. Determine the aggregate’s flakiness index as defined by Materials Method 410, *Chip Seal Mix Design*.

2. **Department Testing and Approval.** The Department may elect to sample the aggregate stockpile prior to allowing the Contractor to begin work. Aggregate is subject to quality assurance (QA) testing by the Regional Materials Engineer. Each day of work, the Department will witness and take possession of an aggregate sample obtained by the Contractor. The sample will be taken from the portion of the stockpile to be used in that day’s production, and represent the entire quantity of aggregate placed that day.
   The Department will evaluate any material failing QA testing to determine if it will be left in place. Material represented by a sample failing QA testing that is left in place will be subject to pay reductions.
   Samples shall meet appropriate friction values. All chip seal previously placed with material from a stockpile rejected for non-carbonate or acid insoluble residue content will be rejected.

**B. Cover Sand.** Sampling and gradation testing of cover sand shall be performed according to the requirements of 410-2.04 A.1. Copies of test results shall be furnished to the Department prior to applying the cover sand.
**C. Bituminous Material.** Bituminous material is subject to QA testing by the Materials Bureau. The Engineer will evaluate any material failing QA testing to determine if it will be left in place. Material represented by a sample failing QA testing that is left in place will be subject to pay reductions.

**410-2.05 Mix Design.** Complete a mix design for pavements and/or shoulders in accordance with Materials Method 410. A shoulder mix design is required when Contractor operations require the shoulder to be treated separately from the mainline. Mix designs shall be submitted to the Engineer a minimum of two weeks prior to the start of the work.

**410-3 CONSTRUCTION DETAILS**

**410-3.01 General**

**A. Weather and Seasonal Limitations.** Chip Seal shall be placed during the period from May 1st through September 7th. Material shall not be applied to a pavement surface when the:

1. Surface has standing water or is saturated.
2. Surface temperature is less than 60°F.
3. Ambient temperature is less than 50°F.
4. Weather conditions would prevent proper construction of the chip seal.

**B. Equipment.** All equipment shall be maintained in satisfactory working conditions at all times.

1. **Sweepers**
   
a. **Self-propelled Rotary Power Broom.** The self-propelled rotary power broom shall be designed, equipped, maintained and operated so the pavement surface can be swept clean.

b. **Self-propelled Pick Up Broom or Vacuum Sweeper.** The self-propelled equipment shall be designed, equipped, maintained and operated so that the pavement can be swept clean. Excess aggregate shall be contained in an onboard hopper and disposed of.

2. **Bituminous Material Distributor**
   
a. The distributor shall be equipped, maintained, and operated so that bituminous material can be applied uniformly on variable widths up to 15 feet; and at controlled temperature and rates from 0.05 to 0.55 gallons per square yard. Prior to starting work, the distributor shall be calibrated for transverse and longitudinal application rate by ASTM D 2995, *Standard Practice for Estimating Application Rate of Bituminous Distributors*, or an equivalent method approved by the Engineer. The Engineer will witness the equipment calibration or require the Contractor to provide documentation certifying the calibration.

b. The distributor shall uniformly apply the bituminous material at the specified rate with a maximum allowable variation of 0.02 gallons per square yard.

c. Distributor equipment shall include accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with full circulation spray bars adjustable laterally and vertically. The distributor shall be equipped with a bituminous material sampling valve.

3. **Aggregate Spreader**
   
The aggregate spreader shall be a self-propelled unit capable of uniformly spreading the aggregate at the required rate on a minimum width of 6 inches wider than the width of the lane to be treated. Prior to starting work, the spreader shall be calibrated using ASTM D 5624, *Standard Test Method for Determining the Transverse-Aggregate Spread Rate for Surface Treatment*
Applications. The Engineer will witness the equipment calibration or require the Contractor to provide documentation certifying the calibration.

4. **Pneumatic Tire Roller**

   Pneumatic tire rollers shall be self-propelled and have oscillating wheels with smooth tread tires and will have a minimum ground contact pressure of 80 psi. The tire pressure for all wheels shall be uniform within ± 5 psi. The rollers shall be operated at a maximum speed of 5 mph. Refer to Table 410-2 Number of Rollers for the minimum number of rollers required.

C. **Surface Preparation.** Perform all surface preparations prior to applying the chip seal.

   1. Thoroughly clean the entire area to be overlaid of dirt, oil, and other foreign materials. Remove all debris and standing water.
   2. Cover all manhole covers, water boxes, catch basins, and other such utility structures within the area being treated with plastic, building felt, or other material approved by the Engineer. Remove the covers each day.
   3. The Contractor shall remove pavement markings.

410-3.02 Chip Seal

A. **Application of Bituminous Material.** Bituminous material shall be applied in a uniform, continuous spread over the section to be treated and within the temperature range recommended by the manufacturer. The Contractor shall document and report to the Engineer any field changes in application rates from the mix design submittal.

   Where longitudinal joints are to occur, the application of bituminous material from the initial pass shall extend 6 inches beyond the area to be covered with aggregate. Subsequent passes of the bituminous spreader shall overlap the exposed bituminous material and the edge of the initial aggregate pass.

   Uncovered bituminous material shall not be exposed to traffic. All bituminous material shall be covered with aggregate before opening to traffic.

   The distributor shall be moving forward at proper application speed at the time the spray bar is opened. If any skipped areas or deficiencies occur, the operation shall be immediately stopped. The bituminous material shall not be applied more than 200 feet in advance of the self-propelled aggregate spreader. The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous material on the surface of the roadway.

B. **Application of Cover Aggregate.** Immediately following the application of the bituminous material, cover aggregate shall be spread at the rate established by the Contractor in the mix design. The Contractor shall document and report to the Engineer any field changes in application rates from the mix design submittal. Spreading shall be accomplished in such a manner that construction equipment or other vehicles shall not drive on the uncovered and newly applied bituminous material. Any free bituminous material on the surface caused by a deficient amount of cover aggregate shall be covered by broadcasting additional aggregate over the deficient area.

   Longitudinal joints shall be parallel to the centerline. Ensure that longitudinal joints will correspond with the edges of the proposed traffic lane. Where any construction joint occurs, the edges shall be broomed back and blended so there are no gaps and the elevations are the same, and free from ridges and depressions.

   Initial rolling of cover aggregate shall occur within 5 minutes after the application of bituminous material. Cover aggregate shall receive a minimum of three roller passes within 30 minutes of bituminous material application. Use Table 410-2 Number of Rollers to determine the minimum number of rollers required:
C. Sweeping. Prior to opening the roadway to unguided traffic, sweep loose stone from the newly treated surface. Additional sweeping shall be performed as directed by the Engineer during a 5-day period following placement of the chip seal.

D. Opening to Traffic. After chip seal application, controlled traffic may be permitted at the Contractor’s option. Traffic shall be maintained at a speed not to exceed 15 mph for a period of 3 hours after placement of the chip seal by the use of pilot vehicles or an alternative method approved by the Engineer.

- Traffic Advisory Signs - immediately after completion of the chip seal, the section shall be signed with black on orange W8-7 LOOSE STONE signs and black on orange 30 MPH W13-1P advisory speed plaques for a period of seven days. The warning sign and the advisory speed plaque shall be installed on the same post as specified in the MUTCD. The signs shall be posted at ½ mile intervals. The first sign shall be posted in advance of the section in accordance with the MUTCD. The day and night visibility of the sign assemblies shall be enhanced by either 18 inch square orange flags for daytime visibility and low intensity Type A flashing warning lights for night visibility or high intensity Type B flashing warning lights for 24 hour visibility.

Use Table 410-3 Pilot Vehicles to determine the number of pilot vehicles required:

<table>
<thead>
<tr>
<th>Table 410-3 Pilot Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Miles Surfaced In Previous Three Hours</td>
</tr>
<tr>
<td>&lt; 2</td>
</tr>
<tr>
<td>≥ 2</td>
</tr>
</tbody>
</table>

E. Application of Fog Seal. Prior to applying fog seal, the surface shall be swept. Follow the requirements of Application of Bituminous Material. The fog seal application rate is 0.05 to 0.15 gallons per square yard.

F. Application of Cover Sand. Within 5 minutes of applying the fog seal, spread the cover sand uniformly over the fog seal at an application rate of 2-5 pounds per square yard.

G. Opening to Traffic After Fog Seal and Cover Sand. The Contractor shall determine when traffic may be permitted on the treated chip seal. More time may be required for areas with limited exposure to sunlight.

410-4 METHOD OF MEASUREMENT. The quantity of chip seal to be measured for payment will be square yards of material in place, making no deductions for minor untreated areas such as catch basins and manholes.

The bituminous material for the chip seal will be measured by the number of 60°F gallons incorporated in
the work.

The bituminous material for the fog seal will be measured by the number of 60°F gallons incorporated in the work.

The following formula will be used to calculate bituminous material quantity at 60°F:

\[
\text{Volume} @ 60°F = \text{Volume}_D \times [1 - (\Delta T \times 0.00025)]
\]

Where:
\[\Delta T = \text{Delivered Temperature (°F)} - 60\]
\[\text{Volume}_D = \text{Quantity Delivered (gallons)}\]

Cover Sand will be measured by the number of square yards of material in place, making no deductions for minor untreated areas such as catch basins and manholes.

**410-5 BASIS OF PAYMENT.** The unit price bid per square yard for chip seal shall include the cost of all labor, materials and equipment necessary to perform the work. Pavement cleaning, pavement marking removal, work zone traffic control and pilot vehicles will be paid for separately.

If QA test results for aggregate exceed the rejection limit in Table 410-4, the Regional Materials Engineer will evaluate if the material can remain in place. If the material is left in place, the chip seal item will be subject to a reduction in payment according to Table 410-4:

<table>
<thead>
<tr>
<th>TABLE 410-4 CHIP SEAL PAY TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ST Aggregate</td>
</tr>
<tr>
<td>Pay Reduction</td>
</tr>
<tr>
<td>Rejection Limit % Passing</td>
</tr>
<tr>
<td>1/2 Sieve</td>
</tr>
<tr>
<td>(100 – X) * 10</td>
</tr>
<tr>
<td>&lt; 97</td>
</tr>
<tr>
<td>1/4 Sieve</td>
</tr>
<tr>
<td>(X – 15) * 5</td>
</tr>
<tr>
<td>&gt; 20</td>
</tr>
<tr>
<td>200 Sieve</td>
</tr>
<tr>
<td>(X – 1.5) * 50</td>
</tr>
<tr>
<td>&gt; 2</td>
</tr>
<tr>
<td>Flakiness Index</td>
</tr>
<tr>
<td>(X – 25) * 5</td>
</tr>
<tr>
<td>&gt; 30</td>
</tr>
</tbody>
</table>

1A Aggregate

| Pay Reduction                   |
| Rejection Limit % Passing       |
| 1/2 Sieve                       |
| (100 – X) * 10                  |
| < 97                            |
| 1/4 Sieve                       |
| (90 – X) * 5                    |
| < 85                            |
| 1/8 Sieve                       |
| (X – 15) * 5                    |
| > 20                            |
| 200 Sieve                       |
| (X – 1.5) * 50                  |
| > 2                             |
| Flakiness Index                 |
| (X – 25) * 5                    |
| > 30                            |

\[X = \text{QA % Passing test value}. \text{ Negative values indicate full payment. The QA results for the 200 sieve and Flakiness Index will be calculated to the nearest tenth. All other QA values will be rounded to the nearest whole number.}\]

Bituminous material used for chip seal will be paid for under a separate item as the number of 60°F gallons of material used.

Bituminous material for the fog seal will be paid for under a separate item as the number of 60°F gallons of material used.
The Engineer will evaluate any bituminous material failing QA testing to determine if it will be left in place. If the material is left in place, the bituminous material will be subject to a reduction in payment according to Table 410-5:

<table>
<thead>
<tr>
<th>Number of Failing QA Test Results</th>
<th>Pay Reduction of Bituminous Material Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15%</td>
</tr>
<tr>
<td>2</td>
<td>25%</td>
</tr>
</tbody>
</table>

Cover sand will be paid for under a separate item.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>410.10</td>
<td>Chip Seal (1A)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>410.20</td>
<td>Chip Seal (1ST)</td>
<td>Square Yard</td>
</tr>
<tr>
<td>410.30</td>
<td>Bituminous Material (Chip Seal)</td>
<td>Gallons</td>
</tr>
<tr>
<td>410.40</td>
<td>Bituminous Material (Fog Seal)</td>
<td>Gallons</td>
</tr>
<tr>
<td>410.50</td>
<td>Cover Sand</td>
<td>Square Yard</td>
</tr>
<tr>
<td>410.60</td>
<td>Pick Up Broom or Vacuum Sweeper</td>
<td>Each</td>
</tr>
</tbody>
</table>

SECTION 411 - STABILIZED GRAVEL SURFACE COURSE
(Last Revised January, 2020)

411-1 DESCRIPTION. The work shall consist of placing a stabilized gravel surface course with additive, if specified, on a prepared base in accordance with these specifications and in conformance with the lines and grades shown on the plans or as directed by the Engineer.

411-2 MATERIALS

411-2.01 Gravel. The gravel shall conform to the following gradation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 in</td>
<td>100</td>
</tr>
<tr>
<td>1/4 in</td>
<td>30 - 65</td>
</tr>
<tr>
<td>No. 200</td>
<td>10 - 20</td>
</tr>
</tbody>
</table>

Particles passing the No. 40 sieve size shall have a maximum liquid limit of 30 and a plasticity index ranging from 3 to 8. The maximum loss in 4 cycles of the Magnesium Sulfate Soundness Test shall be 30. If the gravel as obtained from the bank is deficient in any of the requirements specified, such deficiency shall be corrected by screening, processing and/or blending with other acceptable materials before stockpiling. The requirements of §733-04 B, Stockpiling shall apply to all gravel furnished for this work.

411-2.02 Chemical Additives. Chemical additives, if required, shall meet the applicable requirements of the following subsections:

<table>
<thead>
<tr>
<th>Chemical Additive</th>
<th>Item No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium Chloride</td>
<td>712-02</td>
</tr>
<tr>
<td>Sodium Chloride</td>
<td>712-03</td>
</tr>
</tbody>
</table>
411-3 CONSTRUCTION DETAILS

411-3.01 Placement. After the base has been brought to grade and cross section, as shown on the plans, thoroughly compacted, and approved by the Engineer, the Contractor shall place the stabilized gravel surface course.

When calcium or sodium chloride additives are specified, they shall be added by an approved mechanical distributor after the gravel has been spread and prior to the addition of water. Calcium chloride shall be added in the amount of 1/2 pound per square yard per inch of compacted thickness of the course. Sodium chloride shall be added at a rate of 2 pounds per square yard per inch of compacted thickness of the course which is equivalent to approximately 2% of sodium chloride based on dry weight of aggregate. Water shall then be added to the material in amounts as directed by the Engineer.

If the Contractor so elects, only the calcium chloride may be added to the gravel material as a water solution. In such cases the Contractor shall submit to the Engineer a detailed description in writing of the proposed procedure of operations. Construction shall not be started until the Engineer’s approval is obtained in writing.

411-3.02 Mixing

A. Gravel Without Additive. Water shall be thoroughly dispersed by any appropriate methods which will insure a uniform consistency and moisture content within the limits for proper compaction.

B. Gravel With Additive. The water and the chemical additive shall be thoroughly and uniformly incorporated with the gravel for the full depth of the course, by mixing with an approved power-driven rotary type mixing machine. Mixing shall continue until the material is of uniform composition. The Contractor may elect to mix the materials in an approved plant of the pugmill type. Mixing by blading, shoveling and/or scooping will not be permitted.

411-3.03 Compaction. When the in-place material is of uniform consistency and has a moisture content within the limits for proper compaction, as determined by the Engineer, it shall be thoroughly compacted by the use of self-propelled pneumatic tired or vibratory compactor in accordance with the requirements of Section 203, Compaction. During the compaction operation, light grading shall be done as required to maintain the surface of the course true to grade and cross-section. In confined areas, inaccessible to rollers, mechanical rammers shall be used to obtain the compaction required in §203-3.03C. The finished surface of the stabilized gravel course shall be rolled in a float of free water with a smooth steel wheeled roller weighing not less than 10 tons. In all cases, the material must be so thoroughly compacted that it will not displace under the roller.

This course shall not be placed in excess of 500 linear feet without being shaped, compacted and finish rolled.

When posts for guide railing are to be installed adjacent to a stabilized gravel surface course, extreme care shall be taken during installation of the posts so that the stabilized gravel surface course is not disturbed.

411-3.04 Surface Preparation for Treatment

A. Calcium Chloride Stabilized Gravel Surface Course. After the calcium chloride stabilized gravel surface course has been completed, water shall be applied to the surface in amounts as directed by the Engineer. Immediately following the application of water, calcium chloride shall be applied on the surface with an approved mechanical spreader at the rate of 1/2 pound per square yard.

B. Sodium Chloride Stabilized Gravel Surface Course. After the sodium chloride stabilized gravel surface course has been brought to final grade and cross section and rolling has been completed, the
course shall be permitted to cure for a minimum of 10 days at a minimum temperature of 60°F before any additional pavement courses are applied. The cured completed surface course shall be broomed to remove dust, before application of the overlying course.


411-4 METHOD OF MEASUREMENT. The quantity for payment, in cubic yards of material, shall be computed within the payment lines shown on the plans or otherwise ordered in writing by the Engineer, and in accordance with the plans and specifications.

411-5 BASIS OF PAYMENT. The unit bid price per cubic yard shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that the water, the calcium chloride, and the sodium chloride shall be paid for under their appropriate items. No direct payment will be made for any losses of material which may result from shrinkage, compaction, foundation settlement, waste, overflow, erosion, leakage, or any other causes; the cost of such losses shall be included in the price bid for this work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>411.01</td>
<td>Stabilized Gravel Surface Course</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>411.02</td>
<td>Calcium Chloride Stabilized Gravel Surface Course</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>411.03</td>
<td>Sodium Chloride Stabilized Gravel Surface Course</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>

SECTION 412 - CRACK SEALING ASPHALT PAVEMENTS

412-1 DESCRIPTION. The work in this section shall include work required for crack sealing asphalt pavements.

412-2 MATERIALS. Materials shall be as specified in the special specifications.

412-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

412-4 METHOD OF MEASUREMENT. As specified in the special specifications.

412-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 413 - MICRO-SURFACING

413-1 DESCRIPTION. The work in this section shall include work required for micro-surfacing.

413-2 MATERIALS. Materials shall be as specified in the special specifications.

413-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

413-4 METHOD OF MEASUREMENT. As specified in the special specifications.

413-5 BASIS OF PAYMENT. As specified in the special specifications.
SECTION 414 - QUICK-SET SLURRY

414-1 DESCRIPTION. The work in this section shall include work required for quick-set slurry.

414-2 MATERIALS. Materials shall be as specified in the special specifications.

414-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

414-4 METHOD OF MEASUREMENT. As specified in the special specifications.

414-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 415 - PAVER PLACED SURFACE TREATMENT

415-1 DESCRIPTION. The work in this section shall include work required for paver-placed surface treatment.

415-2 MATERIALS. Materials shall be as specified in the special specifications.

415-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

415-4 METHOD OF MEASUREMENT. As specified in the special specifications.

415-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 416 - COLD RECYCLING

416-1 DESCRIPTION. The work in this section shall include work required for cold recycling.

416-2 MATERIALS. Materials shall be as specified in the special specifications.

416-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

416-4 METHOD OF MEASUREMENT. As specified in the special specifications.

416-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 417 – HOT MIX ASPHALT USING RECYCLING TREATMENTS
(New Section January, 2017)

417-1 DESCRIPTION. This specification includes two processes for in-place recycling hot mix asphalt pavements: heater scarification (HS) and hot-in-place recycling (HIPR). The HMA pavement surface is heated using specialized equipment to soften the asphalt.
In the HS process, the softened HMA surface is scarified to a specified depth as detailed in the contract documents. The scarified asphalt pavement is then mixed with a recycling agent that rejuvenates the asphalt. This mix is then placed and compacted back onto the roadway. The scarified layer must be overlaid.

In the case of the HIPR, the multi-step recycling process of the existing pavement includes heating, milling, and adding a recycling agent to rejuvenate the asphalt; then mixing, placing, and compacting the mixture. The resulting recycled pavement does not require an overlay. If the contract documents require the addition of virgin HMA 19.0 mix during the HIPR process, then the resulting pavement will require an overlay.

417-2 MATERIALS

417-2.01 Recycling Agent. Use a recycling agent specifically designed as a rejuvenator meeting the requirements outlined in Section 702 – Bituminous Materials, 8. Asphalt Recycling Agent, Table 702-9 Recycling Agent or Table 702-10 Emulsified Recycling Agent. At the start of and during production, provide certified test results and documented quantities to the Engineer for each shipment of recycling agent. The use of any other grade of recycling agent or other product requires prior approval from the Director, Materials Bureau. A minimum 2-week notice is needed for this approval.

417-2.02 Mixture Design. Determine the application rate of the recycling agent for heater scarification and hot in-place recycling by taking and analyzing a minimum of three cores per lane mile or a maximum of 20 cores per project from the existing HMA pavement. Take these cores from locations that represent the entire project condition.

Make sure that the designed application rate of the recycling agent provides the average penetration value of the recovered asphalt binder from the loose mix samples, taken during both the HS and HIPR process, to have an increase of at least 30% or more than the average penetration value of the recovered asphalt binder from the existing pavement cores. Do not exceed the final penetration value of 90. Perform all the sample tests for the penetration values in accordance with AASHTO T 49, Penetration of Bituminous Materials.

417-2.03 Virgin Hot Mix Asphalt. When specified in the contract documents, add virgin 19.0 HMA binder mix to the Hot-In-Place Recycling mixture. Provide virgin HMA meeting the requirements outlined in Section 402 – Hot Mix Asphalt (HMA) Pavements. The contract proposal will include the performance-graded (PG) binder, mix type, mix design level, and rate of virgin HMA. Do not use RAP in the virgin HMA mix.

417-3 CONSTRUCTION DETAILS. §401-3 and §402-3, Construction Details, apply, except as modified below:

417-3.01 General

A. Pavement Markings. Remove all epoxy or thermoplastic pavement markings, and other markings when ordered by the Engineer.

B. Cleaning. Clean the existing pavement and shoulder to be heater scarified or hot in-place recycled by using mechanical sweepers, or other effective means until the surface is free of all debris material, which might interfere with the scarification or milling process.

C. Calibration for Spray Unit and Recycling Injection System. Calibrate the metering system in accordance with NYSDOT’s Materials Procedure (MP) 417-01 - Calibration of Metering System for Recycling Equipment. Other calibration methods may be used with the approval of the Engineer. A minimum 2-week notice is required when scheduling this calibration. Perform the calibration of the metering system in the presence of the Regional Materials Engineer or designee. Work shall not
progress until the calibration has been completed and verified. Each project requires an approved calibration. Approved calibrations are valid for 90 days and may be used for more than one project. If the calibration date exceeds 90 days, then recalibrate the metering system.

417-3.02 Heater Scarification (HS).

A. Heater Scarification Train. The heater scarification train consists of at least two heating units and a heater scarification unit consisting of a scarifier, a sprayer, a milling/remixer drum, and a screed.

1. Preheating or Heating Unit. This unit must generate sufficient radiant heat with no open flame to soften the asphalt pavement to the depth required. The burner assembly must be adjustable to heat between 8 and 14 feet in width. The entire heating unit must be enclosed and vented to contain the heat and prevent damage to adjacent properties and landscape. Additional heating units may be required if the temperature behind the screed does not meet specification requirements.

2. Heater Scarification Unit. This equipment must be a self-contained machine designed to reprocess only the upper layers of the existing HMA pavement. The heater scarification unit must be self-propelled and capable of operating at speeds of 8 to 26 feet per minute while uniformly heating and scarifying the existing HMA pavement to the minimum loose mix depth specified in the contract documents. Listed below are the various units that are part of the heater scarification train.

   a. Scarifier. The scarifying unit must contain at least 2 rows of spring-loaded tines that are adjustable to scarify 8 to 14 feet wide. The tines in a row must be no more than 1.0 inch apart. This unit must also be able to conform to the pavement contours to ensure a uniform penetration from the tines and prevent damage to utility structures.

   b. Sprayer. This unit must be immediately behind the scarifying unit and capable of uniformly applying the recycling agent to the reclaimed asphalt pavement at the approved rate. Select the size of the nozzles located on the spray bar and pump based upon the rate of application and the forward speed of the heater scarification unit. This unit must be equipped with a measuring system which is capable of maintaining the required application rate of the recycling agent within a tolerance of ± 5% for the mix design. The measuring system must continuously verify and display the application rate of recycling agent and cumulative total with respect to the volume of scarified material for the road surface.

   c. Mill/Remixer. Immediately following the application of the recycling agent, an enclosed milling unit is required to mill the asphalt pavement to the loose mix depth specified in the contract documents, thoroughly mixing the recycling agent with the scarified and milled pavement. The mill/remixer unit is an integral part of the scarifying machine and must be located between the spray unit, which applies the recycling agent, and the screed. This unit must be operated hydraulically and able to work at variable speeds up to 120 rpm.

   d. Screed. The attached heated, augered vibratory screed must be able to uniformly distribute the hot scarified material to the desired longitudinal and transverse section. The screed must be adjustable from 8 to 14 feet wide, equipped with an adjustable crown control and each end of the screed must have hand wheel adjusting screws for providing the desired longitudinal grade and transverse slope.

B. Mixture Verification and QC Testing.
1. **First day:** Prior to the scarification process, the Engineer will select two core locations on the existing pavement. These locations will be within a lane mile or fraction thereof if production is less than one mile. Extract two cores at each location and test one core from each location for penetration of the extracted asphalt binder from the surface layer only. Provide the companion core from each location to the Engineer for testing by the Department for verification purposes.

   During the scarification process, take four loose mix samples prior to compaction at each location where cores were taken. These samples will be representative of the day’s production. Take samples either behind the screed or any place after the spraying and mixing units. Identify all samples by their locations at the project site. Test two of the loose mix samples from each core location for penetration and provide the other two loose mix samples to the Engineer, which may be evaluated by the Department’s Lab to verify test results. Take all the required core and loose mix samples after the first 500 feet of the day’s production.

   Submit penetration test results to the Engineer by the end of the next day’s production. If test results are not provided, the Engineer may shut down the scarification process until the results are submitted. Determine the penetration of the PG binder recovered from the recycled mixture in accordance with AASHTO T 49. The average penetration value of the loose mix samples must be at least 30% or more than the penetration of the core samples taken from the existing pavement.

   If the average penetration values of the loose mix samples fail to meet this requirement, adjust the application rate and submit the new adjusted application rate to the Engineer. Repeat the procedure described above for taking and testing samples. Submit the penetration test results to the Engineer by end of the next day’s production. Continue adjusting the application rate and taking samples until average penetration values of the loose mix samples meet the specification requirement of at least 30% or more than the penetration values of the core samples.

2. **Routine Day:** If the specification requirements are met after the first day’s production, take samples as described above every three days of production for quality control and quality assurance purposes. Samples of the scarified pavement prior to rejuvenation can be taken as an option instead of the core samples. When sample results do not meet the specification requirements, make adjustment to the application rate and take samples as described above.

   If, at anytime, the average penetration value of the loose mix samples is greater than 90, the Engineer may evaluate the pavement section and request the scarified pavement be removed and replaced at no additional cost to the State. The evaluation may include, but not limited to, testing penetration of the core sample, location of the section, etc. If core samples are required for this evaluation, take them at no additional cost to the State and submit them to the Department for testing. Also, if the recycled pavement is not satisfactory to the Engineer, additional tests may be required at no cost to the State.

C. **Placement.** Radiantly heat the existing HMA pavement surface with no open flame using specialized equipment to soften the HMA surface and scarify to a specified depth as detailed in the contract documents. Take care not to overheat the existing pavement thereby softening the underlying asphalt pavement not to be milled or scarified and that burning of the existing asphalt cement does not occur. Operate the heating unit(s) in a manner to prevent damage to adjacent property and vegetation. Repair all heat-damaged areas immediately, at no additional cost to the State.

   Control the heater scarification equipment to ensure the temperature of the scarified mixture is maintained between 275°F and 325°F. Verify this temperature within 5 feet behind the screed unit.

   Control the speed of the equipment to ensure that the recycled pavement is properly milled, mixed, and uniformly distributed to the proper thickness, slope, and crown shown on the contract plans. Take extra care in controlling heater scarification equipment to prevent segregation of the recycled mix at the start and end of paving production as well as any points where the heater scarification train needs
to stop and restart. Control the width of each pass to provide proper placement of longitudinal joints, including a 3-inch overlap onto adjacent lane passes.

Add recycling agent uniformly to the scarified HMA pavement at the predetermined application rate to produce a homogenous HMA recycled mix.

Ensure that the final recycled pavement conforms to the requirements of §402-3.10, Surface Tolerance and §402-3.11, Thickness Tolerance. Measure the depth of the loose scarified mix behind the screed unit prior to the rolling operation. Adjust the paving equipment if the loose mix depth does not provide the compacted depth specified in the contract documents.

In areas not accessible to scarifying equipment, such as around catch basins or manholes, the Engineer will determine if they require repair. Pavement surfaces that are in good condition do not require repair. Repair all areas with cracks or spalls, as approved by the Engineer, at no additional cost to the State.

D. Compaction. Compact the recycled mixture in accordance with §402-3.07, D., 80 Series Compaction Method.

E. Overlay. Once work is completed, overlay the recycled HMA pavement to the satisfaction of the Engineer. Place the overlay prior to the end of the paving season. This work must be done under a separate pay item in the contract documents.

417-3.03 Hot In-Place Recycling (HIPR).

A. Hot-In-Place Recycling Train. The HIPR train consists of a preheating unit, main recycling unit consisting of a heating system, a hot milling unit, a recycling injection system, a blending unit/mixing chamber, and a conventional paver. The equipment must be capable of processing the existing pavement to a minimum depth of 2 inches. HIPR equipment approved for use will appear on the Department’s Approved List. Detailed requirements and procedures for approval of the HIPR equipment are available from the Materials Bureau. A minimum of 30 days is required for approval consideration.

1. Preheating or Heating Unit. This unit must generate sufficient radiant heat with no open flame to soften the asphalt pavement to the depth required. The burner assembly must be adjustable to heat between 8 and 14 feet in width. The entire heating unit must be enclosed and vented to contain the heat and prevent damage to adjacent properties and landscape. Additional heating units may be required if the temperature behind the screed does not meet specification requirements.

2. Main Recycling Unit. This equipment must be a self-contained machine designed to reprocess only the upper layers of the existing HMA pavement. The HIPR train must be self-propelled and capable of operating at speeds of 8 to 26 feet per minute while uniformly heating and recycling the existing HMA pavement to the minimum loose mix depth specified in the contract documents. Listed below are the various units that are part of the HIPR train.

a. Heating System. This part of the main recycling unit must meet the same requirements for the preheater.

b. Hot Milling Unit. This unit must be capable of uniformly loosening the preheated asphalt pavement to the depth specified in the contract documents. The milling unit must be equipped with separate automatic grade controls operated from skis. The milling head must be extendable between 8 and 14 feet to accommodate various road widths and utility structures.

c. Recycling Injection System. The recycling equipment must have a recycling agent injection system with electronic controls so that the required application rate for the recycling agent is maintained at a tolerance of ± 5% from the mix design target. The recycling injection
system must continuously verify and display the application rate of recycling agent and cumulative total with respect to the volume of milled material from the road surface.

d. **Blending Unit / Mixing Chamber.** The recycling equipment must have a chamber capable of blending the recycled pavement, virgin HMA, if any, and recycling agent into a homogenous, uniformly blended mixture. This equipment must be capable of placing the recycled mixture in a windrow to be conveyed into the HMA placement equipment. The Engineer may approve other methods.

3. **Asphalt Placement Equipment.**

   a. **Pickup Conveyor.** This equipment must have the capability to pick up the windrowed HMA recycled mixture on the roadway and convey it into the paving hopper where a surge of HMA material is kept to ensure that a constant supply of asphalt material is available for the paver.

B. **Mixture Verification and QC Testing.**

1. **Daily Quality Control (QC) Testing:** Ensure all tests are performed by a certified Quality Control Technician in accordance with §401-3.01, Quality Control and §401-3.02, Production Facility Laboratory, for the virgin hot mix asphalt.

2. **First day:** Prior to the recycling process, the Engineer will select two core locations on the existing pavement. These locations will be within a lane mile or fraction thereof if production is less than one mile. Extract two cores at each location and test one core from each location for penetration of the extracted asphalt binder from the surface layer only. Provide the companion core from each location to the Engineer for testing by the Department for verification purposes.

   During the recycling process, take four loose mix samples prior to compaction at each location where cores were taken. These samples will be representative of the day’s production. Identify all samples by their locations at the project site. Test two loose mix samples from each core location for penetration and provide the other two loose mix samples to the Engineer, which may be evaluated by the Department’s Lab to verify test results. Take all the required core and loose mix samples after the first 500 feet of the day’s production.

   Submit penetration test results to the Engineer by the end of the next day’s production. If test results are not provided, the Engineer may shut down the paving operations until the results are submitted. Determine the penetration of the PG binder recovered from the recycled mixture in accordance with AASHTO T 49. The average penetration value of the loose mix samples must be at least 30% or more than the penetration of the core samples taken from the existing pavement.

   If the average penetration values of the loose mix samples fail to meet this requirement, adjust the application rate and submit the new adjusted application rate to the Engineer. Repeat the procedure described above for taking and testing samples. Submit the penetration test results to the Engineer by end of the next day’s production. Continue adjusting the application rate and taking samples until average penetration values of the loose mix samples meet the specification requirement of at least 30% or more than the penetration values of the core samples.

3. **Routine Day:** If the specification requirements are met after the first day’s production, take samples as described above every three days of production for quality control and quality assurance purposes. Samples of the recycled pavement prior to rejuvenation can be taken as an option instead of the core samples. When sample results do not meet the specification requirements, make adjustment to the application rate and take samples as described above.
If, at anytime, the average penetration value of the loose mix samples is greater than 90, the Engineer may evaluate the pavement section and request the recycled pavement be removed and replaced at no additional cost to the State. The evaluation may include, but not limited to, testing penetration of the core sample, location of the section, etc. If core samples are required for this evaluation, take them at no additional cost to the State and submit them to the Department for testing. Also, if the recycled pavement is not satisfactory to the Engineer, additional tests may be required at no cost to the State.

C. Placement. Radiantly heat the existing HMA pavement surface with no open flame using specialized equipment to soften the HMA surface and recycle to a specified depth as detailed in the contract documents. Take care not to overheat the existing pavement thereby softening the underlying asphalt pavement which is not to be milled and that burning of the existing asphalt cement does not occur. Operate the heating unit(s) in a manner to prevent damage to adjacent property and vegetation. Repair all heat-damaged areas immediately, at no additional cost to the State.

Control the speed of the HIPR train to ensure that the recycled pavement is properly milled, mixed, and uniformly distributed to the proper thickness, slope, and crown as shown on the contract plans. Control the width of each pass to provide proper placement of longitudinal joints, including a 3-inch overlap onto adjacent lane passes.

Blend the milled asphalt pavement, recycling agent, and virgin HMA if specified, to produce a homogenous HMA recycled mix. Use the application rates of the recycling agent and virgin HMA as determined by the mix design. If virgin HMA is required, the addition into the recycling process must be within ± 2.2 lbs/yd² of the mix design target. The temperature of the recycled mixture must be between 250°F and 325°F prior to initial compaction.

Ensure that the final recycled pavement conforms to the requirements of §402-3.10, Surface Tolerance and §402-3.11, Thickness Tolerance. Measure the depth of the loose recycled mix behind the screed unit prior to the rolling operation. Adjust the paving equipment if the loose mix depth does not provide the compacted depth specified in the contract documents.

In areas not accessible to recycling equipment, such as around catch basins or manholes, the Engineer will determine if they require repair. Pavement surfaces that are in good condition do not require repair. Repair all areas with cracks or spalls, as approved by the Engineer, at no additional cost to the State.

D. Compaction. Compact the recycled mixture in accordance with §402-3.07, C., 70 Series Compaction Method.

417-4 METHOD OF MEASUREMENT

417-4.01 General (Vacant)

417-4.02 Heater Scarification (HS). This work will be measured as the number of square yards of pavement surface recycled as detailed in this specification.

417-4.03 Hot in-Place Recycling (HIPR). This work will be measured as the number of square yards of pavement surface recycled as detailed in this specification.

Virgin HMA will be measured as the number of tons of hot mix asphalt furnished and incorporated in the work. A QAF of 1.00 will be assigned to virgin material meeting the specification requirements as tested by the QCT. A QAF of 0.85 will be assigned to virgin material that fails to meet the specification. Quality Units will be determined when there is a disincentive and will be calculated as per §402-4, Method of Measurement.
417-4.04 Recycling Agent. The quantity of recycling agent to be measured for payment will be the number of gallons incorporated in the work, measured at a temperature of 60°F. The following formula will be used to calculate material quantity at 60°F:

\[
\text{Volume@ 60°F} = \text{Volume}_D \times [1 - (\Delta T \times 0.00025)]
\]

Where,

\[
\Delta T = \text{Delivered Temperature (°F)} - 60
\]

\[
\text{Volume}_D = \text{Quantity at Delivered Temperature (gallons)}
\]

417-5 BASIS OF PAYMENT. Removal of pavement markings and cleaning of the existing pavement will be paid under separate pay items in the contract documents.

417-5.01 General (Vacant)

417-5.02 Heater Scarification (HS). The unit price bid per square yard for this item shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including heating, scarifying, mixing, paving, compacting, coring, and testing of the recycled materials. No deduction will be made in areas such as catch basins or manholes where the scarifying equipment cannot be used.

417-5.03 Hot in-Place Recycling (HIPR). The unit price bid per square yard for this item shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including heating, milling, mixing, paving, compacting, coring, and testing of the recycled materials. No deduction will be made in areas such as catch basins or manholes where the recycling equipment cannot be used.

The provisions of §402-5, Basis of Payment shall apply for virgin HMA. When there is a disincentive, the payment adjustment will be made based on the Index Price listed in the contract documents. The index price shown in the itemized proposal for each Quality Unit shall be considered the price bid. The unit (index) price is NOT to be altered in any manner by the bidder. Should the bidder alter the price shown, the altered figure will be disregarded and the original price will be used to determine the total amount bid for the contract.

417-5.04 Recycling Agent. The unit price bid per gallon of recycling agent shall include the cost of all labor, material, and equipment necessary to complete the work satisfactorily. The Regional Materials Engineer will evaluate the material represented by any failing sample of recycling agent. If the Engineer elects to leave the material in place, the Contractor shall receive a pay reduction of 75% of the bid price of the recycling agent for the pavement section represented by the failing sample.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>417.01</td>
<td>Heater Scarification</td>
<td>Square Yard</td>
</tr>
<tr>
<td>417.02</td>
<td>Hot In-Place Recycling</td>
<td>Square Yard</td>
</tr>
<tr>
<td>417.0101</td>
<td>Recycling Agent</td>
<td>Gallon</td>
</tr>
</tbody>
</table>

SECTION 418 – ASPHALT PAVEMENT JOINT ADHESIVE

(New Section September, 2016)
418-1 DESCRIPTION

This work shall consist of furnishing and installing joint adhesive in accordance with the contract
documents and as directed by the Engineer.

418-2 MATERIALS

Use a product which appears on the NYSDOT Approved List under ASPHALT PAVEMENT JOINT
ADHESIVE (705-19) meeting the requirements of §705-19.

418-3 CONSTRUCTION DETAILS

General. Furnish all equipment that is necessary to clean the construction joint and to apply the joint
adhesive. Use equipment meeting the description and/or performance requirements described herein and
approved by the Engineer. Apply the joint adhesive to the construction joints.

Joint Preparation. Prepare longitudinal and transverse construction joints as discussed below and place
adjacent asphalt pavement on the same day that the joint adhesive is applied.

Use a high pressure air lance to thoroughly clean the joint surface of dust, dirt, foreign material, sand
and any other extraneous materials immediately prior to applying the joint adhesive. Install suitable traps
or devices on the compressed air equipment to prevent moisture and oil from contaminating the joint
surfaces. Maintain these devices and see that they are functioning properly. Protect the public from
potentially objectionable and/or hazardous airborne debris.

Joint Adhesive. Heat and melt the joint adhesive in a melter constructed either as a double boiler filled
with a heat-transfer medium between the inner and outer shells, or with internal tubes or coils carrying joint
adhesive through a heated oil bath and into a heated double wall hopper. The melter will be equipped with
separate thermometers to indicate the temperature of the heat transfer medium and the joint adhesive
material, positive temperature controls, and with a mechanical agitator or a recirculation pump to assure a
homogeneous blend of the joint adhesive.

Check the discharge temperature of the joint adhesive with a non-contact infrared thermometer or other
suitable thermometer. Discharge the joint adhesive at the manufacturer's recommended application
temperature and maintain the joint adhesive at ± 10°F of the application temperature indicated on the
material packaging.

Applying joint adhesive is not permitted if the melter and discharge temperatures do not meet the
requirements described above.

Equip the discharge hose with a thermostatically controlled heating apparatus or insulate it to maintain
the proper joint adhesive application temperature. Holster the discharge hose to the melter if it is not
thermostatically heat controlled. Circulate the joint adhesive from the discharge hose and the melter to
maintain the proper joint adhesive application temperature.

Do not use joint adhesive material that has been heated beyond the safe heating temperature. If the
manufacturer's recommendations allow the joint adhesive to be reheated or heated in excess of six hours,
recharge the melter with fresh material amounting to at least 20 percent of the volume of the material
remaining in the melter.

Application. Apply the joint adhesive when surface temperature is 40°F and rising. Use an applicator wand
fitted with a sealing shoe to strike-off the adhesive. Strike-off the joint adhesive to provide a 1/4 inch to 3/8
inch thick band. The finished bands are to be approved by the Engineer.

Wedge Joints. Apply the joint adhesive to the entire vertical face and the upper 2 inches of the
wedge joint.

**Butt Joints.** Apply the joint adhesive to the entire vertical face of the butt joint.

The joint adhesive will be considered cured when construction and/or vehicular traffic does not track or pick up the material. Reapply joint adhesive to any areas damaged by construction and/or vehicular traffic prior to placing the adjacent asphalt pavement.

418-4 METHOD OF MEASUREMENT

This work will be measured as the number of linear feet of joint adhesive satisfactorily furnished and installed.

418-5 BASIS OF PAYMENT

The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>418.7603</td>
<td>Asphalt Pavement Joint Adhesive</td>
<td>Linear Foot</td>
</tr>
</tbody>
</table>

**SECTION 419 - FOG SEAL**

419-1 DESCRIPTION. The work in this section shall include work required for fog seal (stand alone for shoulder and median).

419-2 MATERIALS. Materials shall be as specified in the special specifications.

419-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

419-4 METHOD OF MEASUREMENT. As specified in the special specifications.

419-5 BASIS OF PAYMENT. As specified in the special specifications.

**SECTION 420 - POROUS ASPHALT PAVEMENT**

420-1 DESCRIPTION. The work in this section shall include work required for porous asphalt pavement.

420-2 MATERIALS. Materials shall be as specified in the special specifications.

420-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

420-4 METHOD OF MEASUREMENT. As specified in the special specifications.

420-5 BASIS OF PAYMENT. As specified in the special specifications.
SECTION 490 - COLD MILLING

490-1 DESCRIPTION. This work shall consist of the milling, shaping and removal of portions of existing surfaces by a cold milling process, and subsequent cleaning, utilizing equipment and procedures meeting the requirements in this specification.

The work shall consist of Miscellaneous Cold Milling or Production Cold Milling of bituminous or portland cement concrete as indicated in the contract documents and as shown on the plans.

490-2 MATERIALS

490-2.01 Equipment. Milling machines shall be power operated, self-propelled machines capable of removing the desired thickness of existing surfaces. The machines shall have sufficient power, traction and stability to accurately maintain depth of cut and slope. They shall be capable of producing a finished profile and cross slope to within 1/4 inch of that required and shall produce a uniform surface texture free from gouges and ridges greater than 3/8 inch in depth.

The machines shall be equipped with a means to control dust and other particulate matter created by the cutting action.

The machines shall have an integral loading system or sufficient equipment shall be provided to accomplish complete removal of milled material at a rate equivalent to the milling rate.

Vacuum trucks, street sweepers or power brooms shall be used to clean the milled surfaces. The Engineer may disallow the use of power brooms in urban, residential or other sensitive areas if the dust raised by the broom is deemed by the Engineer to be objectionable.

490-2.02 Disposal of Material. Material removed during the milling process, including foreign debris within or on the pavement, shall become the property of the Contractor and shall be disposed of at a site obtained by the Contractor.

490-3 CONSTRUCTION DETAILS

490-3.01 General. Milling shall be performed at the locations and in accordance with the details indicated on the plans.

When indicated on the plans, profile and cross slope shall be controlled by a taut reference string line. The reference elevation and string line shall be established by the Contractor and subject to the approval of the Engineer.

Areas not accessible to the milling machine, such as around and/or adjacent to inlets, manholes, curbs and transverse joints on structures, may be removed by a small milling machine, handwork or other methods approved by the Engineer.

All milled material, including that removed by other means, shall be immediately removed from the milled surfaces and adjacent surfaces. Surfaces shall be cleaned of all fines and dust prior to opening to traffic. The Contractor shall conduct operations in such a manner that dust is controlled and is not objectionable. Milled and adjacent surfaces shall be cleaned again, as directed by the Engineer, prior to the placement of tack coats, or pavement courses if traffic has been allowed on the milled surface and/or if more than 48 hours have elapsed since the initial cleaning.

The Contractor shall maintain drainage at catch basins, according to the details shown on the plans, or in a manner approved by the Engineer.
When working adjacent to traffic, the Contractor shall immediately remove material that is spilled on the traveled way.

Milled surfaces to be overlaid with asphalt concrete shall be covered with at least a single course of asphalt concrete before the end of the paving season. Portland cement concrete overlays shall be completed over milled surfaces before the end of the paving season. Damage to milled surfaces resulting from traffic or other causes such as, but not limited to, raveling, fuel spillage or any contaminants which would inhibit bond, shall be repaired or remilled by the Contractor in a manner approved by the Engineer.

**490-3.02 Production Cold Milling.** Production cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.

**490-3.03 Miscellaneous Cold Milling.** Miscellaneous cold milling of bituminous or portland cement surfaces shall be performed in accordance with the details and at the locations indicated on the plans.

**490-3.04 Production Cold-Mill Surface Planing.** Production cold-mill surface planing of bituminous concrete surfaces shall be performed in accordance with the details and at the locations indicated on the plans. When specified, the milling machine shall control the profile and cross slope with a moving reference at least 30 feet in length. The moving reference may be a floating beam, ski, or other suitable type such that the resulting milled surface is sufficiently even.

In areas accessible to the milling machine, construct a milled surface to a maximum 1/2 inch tolerance. If the pavement surface is not being constructed or has not been constructed to this tolerance based upon visual observation or upon riding quality, the Engineer may test the surface with a 15 foot straight edge or string line placed parallel to the centerline of the pavement and with a 10 foot straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding 1/2 inch will be satisfactorily corrected at no additional cost to the State.

**490-4 METHOD OF MEASUREMENT.** The quantity shall be measured as the number of square yards of pavement surface milled in accordance with the plans and this specification.

In no case will a deduction in area be made for minor unmilled areas due to catch basins, manholes, transverse joints, or minor low areas in pavements from the measured surface area that has been milled. Minor unmilled or low areas are those areas of 10 square yards or less.

**490-5 BASIS OF PAYMENT.** The unit price bid per square yard shall include the cost of furnishing all labor and equipment necessary to complete the milling, including the removal of pavement by other means, the removal and disposal of milled material, the removal and hauling of milled material to a designated storage area when indicated in the contract documents and cleaning the resultant surface after milling. No payment will be made for additional cleaning that may be necessary just prior to placement of anyoverlaying pavement courses or tack coats. The cost of maintaining drainage shall be included in the price bid for work zone traffic control. The cost of providing tack coats, overlay courses, and temporary pavement wedges around drainage structures, manholes, valve boxes, bridge abutments and beginning and ends of milled pavement shall be paid for separately.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>490.10</td>
<td>Production Cold Milling of Bituminous Concrete</td>
<td>Square Yard</td>
</tr>
<tr>
<td>490.15</td>
<td>Production Cold-Mill Surface Planing of Bituminous Concrete</td>
<td>Square Yard</td>
</tr>
<tr>
<td>490.20</td>
<td>Production Cold Milling of Portland Cement Concrete</td>
<td>Square Yard</td>
</tr>
<tr>
<td>490.30</td>
<td>Miscellaneous Cold Milling of Bituminous Concrete</td>
<td>Square Yard</td>
</tr>
<tr>
<td>490.40</td>
<td>Miscellaneous Cold Milling of Portland Cement Concrete</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

**SECTIONS 491 THRU 499 (VACANT)**
Section 500
PORTLAND CEMENT CONCRETE

SECTION 501 - PORTLAND CEMENT CONCRETE - GENERAL

501-1 DESCRIPTION. These general requirements apply to concrete furnished for pavement, structures and incidental construction. Additional requirements may be specified in the contract item. All testing will be done in accordance with Department procedures.

501-2 MATERIALS

501-2.01 Composition of Mixtures. The Contractor shall inform the Regional Director, in writing, of the materials sources prior to mixing concrete. Proportion a homogenous Portland cement concrete mixture using the pre-approved materials listed under 501-2.02, Material Requirements. Produce the class of concrete indicated in the contract documents. However, substitutions may be made according to Table 501-1, Concrete Class Options.

<table>
<thead>
<tr>
<th>TABLE 501-1 CONCRETE CLASS OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Class</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>C</td>
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<td>D</td>
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<tr>
<td>DP</td>
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<td>H</td>
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<tr>
<td>F, G, GG, or HP</td>
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<tr>
<td>I</td>
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<td>J</td>
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</tbody>
</table>

Notes:
1. Regional Director approval required for pavement applications, including approach slabs. D.C.E.S. approval required for structural or deck applications. May not be used in mass placements, or as a substitute for class A in Sign Structure, Signal Pole, and Luminary Foundations.
2. The requirements of §502-2.01 and §502-2.02 apply.

501-2.02 Material Requirements

<table>
<thead>
<tr>
<th>Portland Cement</th>
<th>701-01</th>
<th>Admixtures</th>
<th>711-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blended Portland Cement</td>
<td>701-03</td>
<td>Fly Ash</td>
<td>711-10</td>
</tr>
<tr>
<td>Concrete Sand</td>
<td>703-07</td>
<td>Microsilica</td>
<td>711-11</td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td>703-02</td>
<td>GGBFS *</td>
<td>711-12</td>
</tr>
<tr>
<td>CNBCI **</td>
<td>711-13</td>
<td>HRP ***</td>
<td>711-14</td>
</tr>
</tbody>
</table>
A. Cementitious Materials. Use only cementitious materials meeting §701-01 whose brand name and type appears on the Department’s Approved List. Cementitious materials stored over the winter at concrete producing facilities will be retested for specification compliance. All contaminated, or hardened cementitious material will be rejected and not used in Department work.

The Department will consider requests to evaluate alternate cements, pozzolan or microsilica. The use of alternatives is subject to approval by the Director, Materials Bureau.

1. Portland Cement. Use Type I, Type II or Type I/II cement, except as indicated below or in the contract documents.

Type I cement is restricted to fresh water and low sulfate soil areas. Use Type II or Type I/II cement in high sulfate, and salt water areas. Salt water areas are defined as; The Hudson River south of the Newburg-Beacon Bridge, and all other tidal / sea water spray areas of New York State. Type I/II cement is defined as a cement that meets the requirements of both Type I and Type II cements. High alkali cement is defined as any portland cement having an alkali content in excess of 0.70% as denoted on the Approved List. High alkali cement use is restricted, unless otherwise approved by the Regional Director, to mixtures that do not contain reactive aggregates (as denoted in the Department’s List of Approved Sources of Aggregates).

2. Blended Portland Cement. Blended cements meeting the requirements of 701-03, may be used as follows:

a. Type IP or SM. Blended Portland Cement (Type IP or Type SM), may be used in all classes of concrete listed in Table 501-03, Concrete Mixtures, except Class F. Type IP or SM blended cement replaces the portland cement/pozzolan portion of the designed mix in Class DP, G, GG, or HP concrete. When using Type IP or SM blended cement in Class DP and HP concrete, an addition of Microsilica §711-11 is required.

b. Type SF. Blended Portland Cement (Type SF), may be used in Class DP or HP concrete. Type SF blended cement replaces the portland cement/microsilica portion of the designed mix in Class DP or HP concrete. When using Type SF blended cement in Class DP or HP concrete, an addition of Fly Ash, §711-10, or Ground Granulated Blast Furnace Slag (GGBFS), §711-12, is required.

c. Ternary Blend. Blended Portland Cement (Ternary Blend), may be used in Class DP or HP concrete. Ternary blend cement in Class DP or HP concrete replaces the entire portland cement/pozzolan/microsilica portion of the designed mix. No subsequent addition of cementitious material is required or allowed.

3. Pozzolan. Pozzolan is defined as Fly Ash, §711-10, or Ground Granulated Blast-Furnace Slag (GGBFS), §711-12. All classes of concrete, except Class F, allow or require a pozzolan as a partial replacement for portland cement. Classes DP, G, GG, and HP concrete require the use of a pozzolan.

4. Microsilica. Class DP and HP concrete require Microsilica, §711-11, as a partial replacement for portland cement. Microsilica, a pozzolanic material, is not included in the definition of a pozzolan in these specifications.
5. High Reactivity Pozzolan. High Reactivity Pozzolans which meet the requirements of §711-14 may be considered as supplementary cementitious materials in concrete mixtures where enhanced physical properties are desired. With prior approval from the Regional Materials Engineer, these materials may be allowed in lieu of microsilica in specialized and high performance concrete mixtures.

B. Aggregates. Use aggregate from a source on the Approved List of Sources of Fine and Coarse Aggregates that also meets the following requirements for gradation and friction.

1. Gradation. Samples will be taken from stockpiles, barges, conveyor belts, or bins and tested for gradation at the plant site in accordance with NYSDOT Materials Method 9.1. Rejected aggregates may be reprocessed or reworked to meet the gradation requirements.

   a. Concrete Sand. Use only sand meeting the requirements of §703-07, Concrete Sand.

   b. Coarse Aggregate. Use only crushed stone, crushed gravel, or crushed slag meeting the requirements of §703-02, Coarse Aggregates in either one or a combination of size designations specified in Table 703-4, Sizes of Stone, Gravel, and Slag and graded according to Table 501-2, Coarse Aggregate Gradations.

   Aggregates that are uniform in size, but do not meet the requirements in Table 703-4, may be approved by the Regional Director. When these sizes are combined to meet the mixture gradation requirements of Table 501-2, the gradation requirements of §703-02 shall not apply. Blending of aggregates during the batching process may be approved by the Regional Director. When blending aggregates prior to batching, the blending method requires approval by the Regional Director.

<table>
<thead>
<tr>
<th>TABLE 501-2 COARSE AGGREGATE GRADATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Sizes</td>
</tr>
<tr>
<td>1 1/2 inches</td>
</tr>
<tr>
<td>1 inch</td>
</tr>
<tr>
<td>1/2 inch</td>
</tr>
<tr>
<td>1/4 inch</td>
</tr>
</tbody>
</table>

NOTES:
ASTM C33 Size Number 7 is an acceptable equivalent to the Type CA 1 gradation.
ASTM C33 Size Number 57 is an acceptable equivalent to the Type CA 2 gradation.
Material passing the No. 200 sieve (wet) is limited to a maximum 1.0 % by weight for ASTM sizes 7 and 57.

2. Friction. Sample and test aggregate for friction characteristics according to the procedures of Materials Method 28 “Friction Aggregate Control and Test Procedures.” The Engineer will identify pavement areas, if any, represented by failing samples according to the procedures of Materials Method 28 “Friction Aggregate Control and Test Procedures.”

   a. Concrete Sand. For use in concrete pavements, bridge decks, precast pavers, or any other item used in concrete highway wearing surfaces, sand (natural or manufactured) must contain at least 25.0% acid-insoluble residue in the plus No. 30 size fraction and in the minus No. 30 size fraction. Sands may be blended to meet this requirement.

   b. Type I Coarse Aggregate. Use coarse aggregate meeting one of the of the following requirements:
• Sandstone, granite, chert, traprock, ore tailings, slag, or other similar noncarbonated materials.
• For concrete mixtures containing CA1 coarse aggregate: gravel or a blend of rock types containing no less than 90.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 inch, plus 1/4 inch primary size fraction.
• For concrete mixtures containing CA2 coarse aggregate: gravel or a blend of rock types containing no less than 90.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 1/2 inch, plus 1/2 inch and the minus 1/2 inch, plus 1/4 inch primary size fractions.

c. Type 2 Coarse Aggregate. Use coarse aggregate meeting one of the following requirements:
• Limestone, dolomite, or a blend of the two, having an acid-insoluble residue content not less than 20.0%.
• Sandstone, granite, chert, traprock, ore tailings, slag, or other similar noncarbonate materials.
• For concrete mixtures containing CA1 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 inch, plus 1/4 inch primary size fraction.
• For concrete mixtures containing CA2 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 1/2 inch, plus 1/2 inch and the minus 1/2 inch, plus 1/4 inch primary size fractions.

d. Type 3 Coarse Aggregate. Use coarse aggregate meeting one of the following requirements:
• Limestone or a blend of limestone and dolomite having an acid-insoluble residue content not less than 20.0%.
• Dolomite.
• Sandstone, granite, chert, traprock, ore tailings, slag or other similar noncarbonate materials.
• For concrete mixtures containing CA1 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 inch, plus 1/4 inch primary size fraction.
• For concrete mixtures containing CA2 coarse aggregate: gravel or a blend of rock types containing no less than 20.0% noncarbonate particles (by weight with adjustments to equivalent volumes for materials of different specific gravities) in the minus 1 1/2 inch, plus 1/2 inch and the minus 1/2 inch, plus 1/4 inch primary size fractions.

e. Type 9 Coarse Aggregate. Use coarse aggregate meeting the requirements of §501-2.02 B.1.b. Coarse Aggregate.

C. Admixtures. Use only admixtures which meet the requirements of §711-08, or §711-13, and which appear on the Department’s Approved List of Materials. Admixtures which do not conform to these requirements are subject to evaluation by the Materials Bureau.
**501-2.03 Concrete Batching Facility Requirements.** Batching facilities must be of sufficient design and capacity to produce the quantity of concrete specified. Batching facilities that differ from conventional designs will be considered for use by the Director, Materials Bureau.

**A. Acceptance.** Each facility requires initial and annual approval by the Director, Materials Bureau. The Regional Director may disapprove use of a previously approved facility at any time for non-conformance with the specifications. Once disapproved, production for Department work will not be allowed until corrective measures are implemented under the approval of the Regional Director.

**A. Bins.** Each facility requires:

- Sufficient size and number of storage bins to produce the quantity of concrete specified.
- Positive separations between fine aggregate and various sizes of coarse aggregates.
- Separate cement, pozzolan, High Reactivity Pozzolan, and microsilica bins, except Type I and Type II cement may be combined in common storage unless the cement is intended for use in high sulfate or salt water areas as described in §501-2.02 A. Cementitious Materials.
- Cement, pozzolan, High Reactivity Pozzolan and microsilica bins with protection from rain and moisture.
- A means of safely obtaining uncontaminated samples from all microsilica bins.
- A means of safely obtaining uncontaminated samples from any cement, pozzolan or High Reactivity Pozzolan bin that has been determined by the Regional Materials Engineer as either unsafe to sample, or difficult to verify the acceptability of its contents.

Sampling will be conducted, or witnessed by the Regional Materials Engineer’s representative.

**B. Weigh Hoppers and Discharge Chutes.** Each facility requires:

- Separate weigh hoppers for aggregate and cementitious materials.
- Enclosed cement weigh hopper to protect against moisture and reduce escaping dust.
- Chutes arranged so that materials will not lodge or be lost on discharge.
- No chutes suspended from any part of the weighing system.
- Vibrators arranged so that no significant vibrations are transmitted to the scales or other plant control equipment during the weighing process.

**D. Scales.** Each facility requires:

- Load cell type scales which indicate the load at all stages of the weighing operation, from zero to full capacity, when installed for weighing materials after January 2, 2003.
- Scales that meet the requirements of the National Institute of Standards and Technology, Handbook 44, with no less than 500 nor more than 2000 scale divisions.
- Digital displays that match the primary scale within 1 division.
- Minimum resolution of digital displays equivalent to the minimum resolution on the primary scale.
- Digital displays located in direct sight of the operator’s normal work station.
- Face of digital displays protected from manipulation.

Test all plant scales for accuracy, at no additional cost, by a qualified technician as follows:

- Annually, prior to use for Department work.
- At intervals of not more than 90 calendar days.
Whenever a plant changes location.
At any time ordered by the Regional Director.

Provide a cradle or test platform approved by the Regional Materials Engineer, for each scale. Provide at least 20 certified 50 lb. test weights for performing scale accuracy tests. The certification of compliance for the test weights must be made available upon request at the time of the scale accuracy test. The use of a set of test weights for multiple facilities may be permitted, providing that the test weights are available for use within one hour after request. When directed by the Regional Director, protect the scales, and displays from manipulation by locking or sealing. Any evidence of tampering will be cause for rejection.

**E. Proportioning Control Equipment.** Proportion the materials by automatic proportioning devices approved by the Director, Materials Bureau. The Regional Director may require the locking or sealing of proportioning equipment that is subject to manipulation. Install automatic proportioning equipment in a dust and weather protected area of at least 36 square feet, with no internal dimension less than 6 feet.

Include equipment to:

- Produce all batches in fully automatic mode using preprogrammed US Customary mix designs. The only manual operation allowed is a switch or button to start the batching sequence and/or discharge the completed batch.
- Accurately proportion the various components of the mixture by weight, or by volume for admixtures and water, in the proper order so that aggregates and cementitious materials are displayed cumulatively (when appropriate).
- Deliver each constituent within the tolerances indicated in Table 501-4, Batching Tolerances.
- Control the cycle sequence.
- Interrupt and stop the automatic batching operations via auxiliary interlock cutoff circuits, whenever an error exceeding the acceptable tolerance occurs in proportioning, for all materials except water.
- Time the mixing operations for central mix plants, and provide a clear indication on the recordation whenever the mix time has been interrupted.

Interlock the system so that during the batching of cementitious materials, aggregates and admixtures:

- No inlet gate can open while the weigh hopper discharge gate is open.
- No inlet gate can open while another material is being weighed in a shared weigh hopper.
- No weigh hopper discharge gate can open while the hopper is being filled nor until the full batch weight is within delivery tolerance.
- No new batch can be weighed until the hopper is entirely empty of the previous batch and the scale has returned to within the allowable zero tolerance.

**A. Admixture Dispensing Systems.** Equip plants with calibrated systems that meet the following:

- A sufficient number of dispensing systems to supply the concrete mixture specified.
- The ability to dispense each admixture through its own measuring system.
- Accurate measurement within the tolerance limits specified in Table 501-4, Batching Tolerances.
- A bypass valve to obtain a calibrated sample of admixture from each measuring device.
- Uniform distribution of admixture throughout the mix within the specified mixing period.
- When multiple admixtures are added, no direct contact with each other prior to mixing.
• An approved automatic admixture dispensing system in plants equipped with automated proportioning systems.
• Volumetric measuring devices interlocked with the automated proportioning equipment that insure the preset quantity has been actually measured and completely discharged.
• A readable indication at the operator's normal work station of the actual quantity batched.

Interlock the admixture system with the automated proportioning system so that aggregate and/or cement weigh hopper discharge gates cannot be opened until the preset quantity of admixture has been batched or discharged.

Recordation of the presence of admixture is dependent on completion of admixture discharge.

G. Recordation Equipment. Equip all plants with digital recording instruments approved by the Director, Materials Bureau, that meet the following requirements:

• Is readily accessible and readable at the operator’s normal work station.
• Provides separate quantity recordation of each aggregate component, cement, pozzolan, High Reactivity Pozzolan, microsilica, admixture, fine aggregate moisture content, and water (at central mix plants) for each batch of concrete. Water at central mix plants may be recorded by weight or volume.
• Records the batch number, concrete class, date (day, month, year), and time of day to the nearest minute on each batch record.
• Provides cumulative recordation (when batching cumulatively) of weight and/or volume as indicated on the batching scale or meter within an accuracy of \( \pm 1 \) scale or meter graduation.
• Has a minimum recorder resolution equivalent to or less than the minimum graduation on the scale or meter, unless otherwise approved by the Director, Materials Bureau.
• Provides a clear and legible copy of all batch records, containing permanent identification of the time and all quantities in each batch, to the Department.
• Automatically stamps the date and time of batch completion on each batch and/or delivery ticket.
• Provides clear identification on batch recordation when:
  - Initiating a batch without all conditions satisfied for full automated production.
  - An out of tolerance condition is accepted during batching.
  - A system is taken out of the full automated mode during the batching sequence.
  - A system produces a “demonstration” or “simulated” batch.
  - A system reprints a batch ticket.
  - The timing of a central mixer has been interrupted.

When the automation system can produce other than standard size batches (full, half or quarter cubic yard increments), recordation will be subject to approval of the Director, Materials Bureau.

H. Inspection Facility. Provide a weatherproof building or trailer, for use as an inspector's testing laboratory and office that meets the following criteria:

• Meets all applicable uniform fire prevention and building code requirements.
• Office area partitioned from the testing laboratory.
• Minimum gross area of 160 square feet, a minimum internal width of 7 feet and a ceiling height of not less than 7 1/2 feet.
• Protected from a noise level greater than an 8 hour, time weighted average of 85 dBA.
• Laboratory area with tables, work benches, shelving, and other equipment for testing portland cement concrete mixes.
• Increase the area proportionally to house and operate any additional testing equipment, and when there are multiple plants at one site, size the increase of the laboratory and office space to be adequate for performing inspection duties during all production circumstances.

Use the inspection facility only for its intended purpose, and when the inspection facility is used by more than one inspection authority, the Department will have priority. The facility and its location are subject to approval by the Regional Materials Engineer. Maintain the inspection facility, office, and testing equipment in good operating and clean condition. The Producer will be responsible for routine cleaning.

Equip the inspection facility with the following:

1. **Office Equipment.** A Standard size (approx. surface dimensions: 30 x 60 inches) office desk with drawers and a chair, and a fireproof file cabinet with at least two locking drawers and two keys.

2. **First Aid Equipment.** An adequately stocked first aid kit at the plant site including:
   • An emergency eye wash station in the laboratory area.
   • Safety equipment including gloves, dust mask, etc..

3. **Sanitary Facilities.** A flush type toilet at the plant site, enclosed in a properly vented, separate room and complying with applicable sanitary codes. A portable toilet may be substituted when a facility is set up on a temporary basis for a specific project.

4. **Lighting.** Electric, non glare, providing a minimum illumination level of 1000 lux at desk and work bench level.

5. **Laboratory Sink / Potable Water.** A Sink and faucet with an adequate supply of clean water for testing, and if necessary, a water cooler for potable drinking water.

6. **Heating and Cooling.** Adequate heating and air conditioning equipment to maintain an ambient temperature of 70±5°F.

7. **Ventilation.** Minimum 3.5 cfs exhaust hood, vented to the atmosphere, located over the sample drying area.

8. **Communication Equipment.** A telephone with a dedicated line in the laboratory office and a fax machine at the inspection facility or plant site for the inspector’s use.

9. **Fire Extinguisher.** A 10 pound capacity multi-class ABC fire extinguisher, maintained and located in the laboratory area.

10. **Coarse Aggregate Sieve Shaker.** Power driven, with a minimum clear sieve area of 324 square inches.
    • Anchored to a firm base.
    • Imparts a vertical, or lateral and vertical motion.
    • Equipped with an automatic timing shut-off device and dust cover.
    • Fully enclosed and weatherproof when located outside the inspection facility.

- Power driven, independent of the coarse aggregate shaker.
- For 8 inch minimum diameter sieves.
- Imparts a vertical, or lateral and vertical motion.
- Equipped with an automatic timing shut-off device.
- Fully enclosed and weatherproof when located outside the inspection facility.

12. Sample Splitter. Able to split samples with a particle size of 1/2 – 2 inches.

13. Large Scale. Minimum capacity of 14 kg, with a maximum gradation of 0.005 kg meeting AASHTO M-231 Class G20. Scales provided as new or replacement after September 1, 2004, must be digital.”

14. Small Scale. Minimum capacity of 1500 g, with a maximum gradation of 0.1 g meeting AASHTO M-231 Class G2. Scales provided as new or replacement after September 1, 2004, must be digital.

15. Sample Drying Appliance. Stove or hot plates sized to rapidly dry aggregate samples with a minimum total of four burners.

16. Miscellaneous Testing Equipment. Miscellaneous equipment as per Department written directives or as requested by the Regional Director.

17. pH Test Kit. pH test kit meeting the requirements of Materials Procedure NY 90-1 for all plants supplying concrete containing microsilica (711-11).

501-2.04 Concrete Mixer and Delivery Unit Requirements. Each mixer requires a Manufacturer's plate, which contains the mixing capacity of the mixer, in a convenient visible location. Repair or replace blades inside the drum that have become heavily encrusted with mortar, or are loose, broken, bent, scalloped or worn 20% in any dimension or otherwise damaged.

A. Central Mixers. Central mixers meeting the following may be used unless otherwise specified:
- Equipped with an acceptable timing device that prohibits a batch of concrete from being discharged before the specified mixing time has elapsed (as per §501-3.03 C) without a clear indication on the recodarion equipment.
- Able to discharge the entire batch in an unrestricted manner into a hopper or delivery unit.

B. Delivery Units. Delivery units are subject to inspection as per NYSDOT Materials Method 9.1 and approval by the Regional Director. If found unfit, it will be disapproved until properly repaired. Completely clean and empty the agitating and non-agitating units of concrete and wash water before loading again.

1. Truck Mixer Requirements. Use an inclined axis rotating drum type with a water tank system able to measure water (gallons) going into the drum within a 2% accuracy, and equipped with a hatch in the drum periphery to permit access to inspect the inside.

Each truck mixer unit will be inspected and approved annually by the Regional Materials Engineer for use in Department work, and additional inspections will be made during use to determine its operating condition. Truck mixers will not be permitted to mix batches greater than the maximum capacity indicated on the Manufacturer's rating plate.
a. Transit Mixed Concrete. Equip each truck mixer used for transit mixed concrete with an electrical revolution-counting device, appearing on the Approved List, mounted in a clearly visible position as follows:

- Separate counters showing: The number of drum revolutions at speeds within the mixing range and the total number of drum revolutions.
- Both counters legible to one revolution and designed to accept a non-standard electric plug for resetting each counter to read zero when loading at the batch plant.
- Tamper-proof such that if tampering occurs, the counters will become inoperative or the device will otherwise indicate tampering, including the interruption of electric power.
- Installed to count the number of revolutions of the drum only in the direction of mixing.
- Adjusted so that it counts the number of revolutions specified for the mixing and agitating drum speed within the tolerances indicated on the Manufacturer’s rating plate, but not to exceed the following Department’s requirements for truck mixers:
  - Mixing - 6 RPM minimum to 18 RPM maximum
  - Agitating - 2 RPM minimum to 6 RPM maximum
  - The mixing and agitating revolution limits may be adjusted for individual mixing units upon approval of the Director, Materials Bureau.

b. Central Mixed or Truck Mixed Concrete. Equip each truck mixer used for central or truck mixed concrete, either as described in §501-2.04 B.1.a., for Transit Mixed Concrete, or as follows:

- Mixing speed capability - 6 RPM minimum to 18 RPM maximum.
- Agitating speed capability - 2 RPM minimum to 6 RPM maximum.
- Approved counter-located in a position readily visible to the Engineer that accurately counts the number of revolutions in the direction of mixing.

2. Non-Agitating/Open Haul Units for Central Mixed Concrete. Each truck shall be:

- Sound and watertight enough to prevent loss of material during delivery.
- Free of contamination.
- Covered to protect the concrete from adverse drying or precipitation, when ordered by the Engineer.

C. Mobile Concrete Mixing Units. A mobile concrete mixing unit, with the Engineer’s approval, may be used for miscellaneous work such as curb, gutter, headwalls, catch basins, manholes, drop inlets, field inlets, sign foundations, lighting structure foundations, anchor units, pullboxes, leveling footings and similar placements.

   Equip the mobile mixing unit with proportioning devices that deliver the materials within the following tolerances by weight:

<table>
<thead>
<tr>
<th>Material</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>0 to +4%</td>
</tr>
<tr>
<td>Admixtures</td>
<td>±3%</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>±2%</td>
</tr>
<tr>
<td>Water</td>
<td>±1%</td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td>±2%</td>
</tr>
</tbody>
</table>

Use a self contained, continuous mixing type, that meets the following:

- Carries unmixed dry bulk cementitious materials, fine and coarse aggregate, water and admixtures sufficient for at least 6 cubic yards per batch, unless otherwise approved by the Regional Materials Engineer.
• Measures the amount of cement being introduced into the mix by a clearly visible meter which is kept clean at all times.
• Records the quantity of cement by a ticket printer that, as a minimum, records the number of revolution counts of the cement feeder.

1. Water system

a. Provides positive control of the water flow into the mixing chamber.
b. Water flow indicated by a readily adjustable flow-meter to provide for minor variations in aggregate moisture.
c. Equipped with a bypass valve or hose suitable to determine batching accuracy.

2. Admixture System

a. Equipped with at least one admixture delivery system.
b. Provides positive control of the admixture flow into the unit's mix water system.
c. Flow-meters to control the amount of admixture added to the mix.
d. Dispenses admixtures in a manner that provides uniform distribution throughout the concrete.
e. Adds admixture in the amount necessary to achieve the required air content.
f. Equipped with a bypass valve to obtain a calibrated sample to determine batching accuracy.

3. Mobile Mixing Unit:

a. Capable of combining aggregates, cement, water and admixture into a thoroughly mixed and uniform weight, and discharging the mixture without segregation.
b. Set the mixing time to achieve proper and uniform mix, as determined by the Engineer.
c. Stockpile all mix materials at the project site, unless otherwise approved by the Engineer.
d. Provide the necessary scales, containers and personnel, approved by the Engineer, to calibrate the unit.
e. Calibrate the unit and provide a record of the calibration to the Engineer for the mix design to be used. The Regional Materials Engineer will furnish the mix design information and the calibration procedure. The Department reserves the right to witness calibration of the unit.
f. Prior to actual use, demonstrate to the Engineer that the concrete meets the specification requirements for slump, air content and proportioning. Proportioning may be verified in accordance with NYSDOT Materials Method 9.4.

Correct any improper mixer conditions as approved by the Engineer. Improper conditions include, but are not limited to, blades that have become heavily encrusted with mortar, or are loose, broken, bent, scalloped, or worn 20% in any dimension or otherwise damaged. The Engineer will discontinue use of a unit that performs unsatisfactorily.

D. Small Mixing Units. The Engineer may allow a small construction mixer to mix small quantities of concrete. Mix for at least 90 seconds after all materials are in the mixer, and the Engineer will test the concrete for the specified slump and air content.

501-3 CONSTRUCTION DETAILS

501-3.01 Proportioning. Proportion all ingredients, except for admixtures, according to Table 501-3, Concrete Mixtures and as determined by the Department unless otherwise indicated in the contract documents. Any concrete mix design not meeting the requirements of Table 501-3 will be subject to approval by the Director, Materials Bureau.
A. Aggregates and Cementitious Materials. Aggregate and cementitious material proportions are indicated in Table 501-3, Concrete Mixtures, for standard classes of concrete. Mixes containing aggregate other than those permitted by §501-2.02B, Aggregates, are subject to approval by the Director, Materials Bureau.

Certain aggregates appear in the Approved List of Sources of Fine & Coarse Aggregates that have use limitations if combined with a high-alkali portland cement. The Regional Materials Engineer may allow the use of these aggregates in combination with high-alkali cements provided that pozzolans are substituted for cement in the following way:

<table>
<thead>
<tr>
<th>Concrete Class Specified</th>
<th>Substitute Cement by Mass With</th>
<th>Class Substitution Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, C, E, H</td>
<td>15-20% Class F Fly Ash (711-10)</td>
<td>HP¹</td>
</tr>
<tr>
<td>I, J</td>
<td>15-20% Class F Fly Ash (711-10)</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>15-20% Class F Fly Ash (711-10)</td>
<td>DP¹</td>
</tr>
<tr>
<td>G² and GG²</td>
<td>20% Class F Fly Ash (711-10)</td>
<td>-</td>
</tr>
<tr>
<td>F</td>
<td>No Substitution Allowed</td>
<td>-</td>
</tr>
</tbody>
</table>

NOTES:
1. Class HP and DP concrete may be substituted to mitigate ASR as listed above. Classes HP and DP require the replacement of portland cement with 20% pozzolan and 6% microsilica. The pozzolan may be either Class C or F Fly Ash (§711-10) or Ground Granulated Blast Furnace Slag (§711-12).
2. Classes G and GG require the replacement of portland cement with 20% pozzolan. The mitigation of ASR in Classes G and GG must be accomplished using Class F Fly Ash (§711-10).

Notify the Regional Materials Engineer prior to using pozzolan substitutions to mitigate ASR when using reactive aggregates in combination with a high alkali cement. Approval may be withdrawn when unsatisfactory results occur.

B. Admixtures. Admixtures are used to achieve the desired set retardation, water reduction, slump, air content, and to protect reinforcing steel from corrosion. Admixtures are not considered part of the solid volume in the concrete mixture. The admixture manufacturer’s recommended maximum dosage rate should not be exceeded to obtain the desired results as specified in Table 501-3.

1. Air Entrainment. Air entraining agent is required for all mixes to produce concrete with an air content in the range specified in Table 501-3, Concrete Mixtures unless otherwise indicated in the contract documents. The Engineer will test the concrete for plastic air content, and reject concrete with air contents outside the specified limits.

2. Retardation. The setting time of concrete may be retarded when necessary for proper placement. A water- reducing and retarding admixture (§711-08, ASTM Type D), is required in Class DP for Structural Slab Overlays (Section 584), Class HP for Superstructure Slabs and Structural Approach Slabs (Section 557), Class G and Class GG concrete. It may be used with, or in place of, a water- reducing admixture (§711-08, ASTM Type A) in other applications that allow Class DP or Class HP. Limit the use of the water- reducing and retarding admixture to the minimum amount required to achieve retardation during placing conditions. Unless otherwise specified, the use of water- reducing and retarding admixtures are subject to approval of the Regional Director.
3. Water Reduction. Unless otherwise specified, a water-reducing admixture (§711-08, ASTM Type A), is required in Classes DP, HP, I and J concrete. For all other classes, except G and GG, a water-reducing admixture may be used, subject to advance notification and approval of the Regional Materials Engineer.

High Range Water-Reducing Admixtures (§711-08, ASTM Type F), may not be used unless allowed by specification, plans, or the Director, Materials Bureau.

4. Corrosion Inhibitors. Corrosion Inhibitors, meeting the requirements of §711-13, may be used in special applications where specified in the plans, contract documents, or as directed by the Director, Materials Bureau.

C. Water. Add water to obtain the slump desired by the Engineer, within the Design Mix Guidelines of Table 501-3, Concrete Mixtures. The Engineer will test the concrete for slump, and reject concrete with a slump greater than the guidelines for use in Department work.

Concrete with insufficient slump may be adjusted to within the guidelines of §501-3.03 by adding water and remixing, when permitted by the specifications or the Engineer.

D. Pozzolan. Up to 20% of the cement content for Classes A, C, D, E, H, I, and J may be substituted with a pozzolan (Fly Ash or GGBFS), except where prohibited by the Regional Director. No additional pozzolan is permitted in Classes DP, G, GG, or HP. No pozzolan is permitted in Class F.

E. Microsilica. Microsilica meeting the requirements of §711-11 may be added as part of a Blended Cement (§701-03, Type SF or Ternary Blend) or batched independently as a powder.

F. High Reactivity Pozzolan (HRP). When permitted by Regional Materials Engineer, HRP meeting the requirements of §711-14 may be batched independently as a partial replacement for Portland cement in specialized or high performance mixes.

<table>
<thead>
<tr>
<th>Concrete Class</th>
<th>T.C.M. Content (lb/cy)</th>
<th>Sand % Total Agg. (solid volume)</th>
<th>Water/cementitious mat'ls (by weight)</th>
<th>Air Content % desired (Range)</th>
<th>Slump Range (in)</th>
<th>Type of Coarse Aggregate Gradation</th>
<th>Primary Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>606</td>
<td>36.2</td>
<td>6.5 (5.0 - 8.0)</td>
<td>2 1/2 - 3 1/2</td>
<td>CA 2</td>
<td>general purpose structural</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>605</td>
<td>35.8</td>
<td>6.5 (5.0 - 8.0)</td>
<td>1 - 3</td>
<td>CA 2</td>
<td>Pavement: slipform paving, form paving</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>725</td>
<td>45.8</td>
<td>7.5 (6.0 - 9.0)</td>
<td>2 1/2 - 3 1/2</td>
<td>CA 1</td>
<td>thin structural applications</td>
<td></td>
</tr>
<tr>
<td>DP</td>
<td>725</td>
<td>45.8</td>
<td>7.5 (6.0 - 9.0)</td>
<td>3 - 5</td>
<td>CA 1</td>
<td>thin structural applications, overlays</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>648</td>
<td>35.8</td>
<td>6.5 (5.0 - 8.0)</td>
<td>3 - 4</td>
<td>CA 2</td>
<td>structural slabs and structural approach slabs</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>716</td>
<td>34.6</td>
<td>0.38</td>
<td>6.5 (5.0 - 8.0)</td>
<td>2 - 3</td>
<td>CA 2</td>
<td>high early strength for pavement or structural applications</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>-----------------</td>
<td>------</td>
<td>------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>G (^3)</td>
<td>727</td>
<td>45.0</td>
<td>0.45</td>
<td>6.0 (4.0 - 8.0)</td>
<td>6 - 7</td>
<td>CA 2</td>
<td>underwater</td>
</tr>
<tr>
<td>GG (^3)</td>
<td>800</td>
<td>45.0</td>
<td>0.45</td>
<td>6.0 (4.0 - 8.0)</td>
<td>6 - 7</td>
<td>CA 1</td>
<td>underwater (special)</td>
</tr>
<tr>
<td>H</td>
<td>675</td>
<td>40.0</td>
<td>0.44</td>
<td>6.5 (5.0 - 8.0)</td>
<td>3 - 4</td>
<td>CA 2</td>
<td>pumping applications</td>
</tr>
<tr>
<td>HP (^2)</td>
<td>675</td>
<td>40.0</td>
<td>0.40</td>
<td>6.5 (5.0 - 8.0)</td>
<td>3 - 5</td>
<td>CA 2</td>
<td>pumping, structural slabs, approach slabs, substructures exposed to chlorides</td>
</tr>
<tr>
<td>I (^4)</td>
<td>640</td>
<td>41.0</td>
<td>0.44</td>
<td>6.0 (4.0 - 8.0)</td>
<td>1/2 - 1 1/2</td>
<td>CA 2</td>
<td>slip forming highway median barriers</td>
</tr>
<tr>
<td>J (^4)</td>
<td>680</td>
<td>45.8</td>
<td>0.44</td>
<td>6.0 (4.0 - 8.0)</td>
<td>1/2 - 1 1/2</td>
<td>CA 1</td>
<td>slip forming structural median barriers, parapet walls and curbs</td>
</tr>
</tbody>
</table>

NOTES:
1. Mixture proportions will be computed by the Regional Materials Engineer using the fineness modulus and bulk specific gravities (saturated surface dry) of the aggregates proposed for use.
2. Class DP and HP require the replacement of portland cement with 20% pozzolan and 6% microsilica and the addition of a water reducing admixture and/or water-reducing and retarding admixture. Refer to §501-3.01 B, Admixtures.
3. Class G and GG require the replacement of portland cement with 20% pozzolan, and the addition of a water-reducing and retarding admixture. Refer to §501-3.01 B, Admixtures.
4. These mixes require the use of a water reducing admixture. Refer to §501-3.01 B, Admixtures.
5. T.C.M. = Total Cementitious Material.
6. Slump range for slipform paving is 1 – 2 1/2 inches and for fixed form paving is 1 1/2 – 3 inches.

501-3.02 Handling, Measuring and Batching Materials. Arrange the batching facility and equipment to assure a continuous supply of material to the work.

When written approval is granted by the Director, Materials Bureau, bagged material may be incorporated into the mix. Adjust the batch size to use whole bags of bagged material. The handling, measuring and batching of bagged material must be verified and documented by a Department representative.

A. Stockpiles. Build good draining bases for stockpiles, at the batching facility, on prepared aggregate, concrete, metal or wood surfaces, or barge floors, subject to approval by the Regional Director. Build the stockpiles by methods which do not cause particle segregation. Stockpile all aggregates separately, by source and size so that no cross contamination occurs. Label all Department approved stockpiles by source number.

Handle aggregates throughout the batching process such as to maintain uniform grading of the material. In case the aggregates contain a high or non-uniform moisture content, stockpile the aggregates for a sufficient length of time to stabilize the moisture content.

Equip each plant with a moisture sensing device that indicates, on a readily visible scale or chart, the fine aggregate moisture content as it is batched. Indicate the free moisture content on the batch recordation during batching. The free moisture content during batching is limited to a maximum of 8% of the fine aggregate’s saturated-surface dry weight.
The Regional Materials Engineer will determine the acceptability and accuracy of the moisture sensing device. If the device is considered accurate, the free moisture content of the fine aggregate may be allowed to be adjusted between batches based on the most recent moisture reading. No adjustment for free moisture will be allowed for an individual batch after batching starts.

**B. Heating Materials for Cold Weather Concreting.** Use equipment that uniformly heats the materials. To obtain the specified temperature of the plastic concrete when the air temperature is below 32°F, heat the aggregates by steam or dry heat and heat the mix water. When the air temperature is 32°F or more, and the aggregates are free of ice, the specified temperature may be obtained by heating only the mix water. The equipment and operations for heating the materials must be approved by the Regional Director prior to use on Department projects.

<table>
<thead>
<tr>
<th>Specified Temperature Range</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix Water</td>
<td>70°F</td>
<td>180°F</td>
</tr>
<tr>
<td>Aggregate</td>
<td>40°F</td>
<td>100°F</td>
</tr>
<tr>
<td>Plastic Concrete in place</td>
<td>50°F</td>
<td>70°F</td>
</tr>
</tbody>
</table>

To avoid the possibility of flash set when water is heated over 100°F, combine the water and aggregate in the mixer so that the water temperature is reduced before cement is added.

**C. Batching.**

1. **Aggregates.** When sizes are weighed cumulatively, allow a ±2% tolerance for each draw weight, based on the combined aggregate batch weight. If sizes are weighed separately, apply the tolerance to each scale weight.

2. **Cement and Pozzolan.**
   a. *Batching without microsilica or HRP added independently on a common scale.* Weigh the cement, blended cement, or pozzolan cumulatively with a ±1% tolerance for each draw weight (based on the combined weight of all cementitious materials). Weigh the pozzolan last in the weighing sequence.

   b. *Batching with microsilica or HRP added independently on a common scale.* Weigh all cementitious materials cumulatively with a ±0.5% tolerance for each draw weight (based on the combined weight of all cementitious materials). Double the minimum allowable batch weight. Weigh the microsilica or HRP last in the weighing sequence.

3. **Microsilica and High Reactivity Pozzolan (HRP).**
   a. *Batching with cement, Type IP or SM blended cement, or pozzolan on a common scale.* Weigh the microsilica or HRP cumulatively with a ±0.5% tolerance for each draw weight (based on the combined weight of all cementitious materials). Double the minimum allowable batch weight. Weigh the microsilica or HRP last in the weighing sequence.

   b. *Batching microsilica or HRP on a separate scale.* Weigh the microsilica or HRP with a ±1% tolerance (based on the total weight of microsilica or HRP).

**D. Delivery Tickets.** Each delivery ticket must contain the following:
- SiteManager Mix ID
- Delivery Ticket Number
- Plant Identification, with plant name and location and/or facility number
- Contract Number
- Concrete Class or Item Number
- Quantity (Nominal Batch Size)
- Truck Number
- Batch Number
- An Automatically Applied Time-Date Stamp (immediately upon completion of batching) which may consist of one of the following:
  - Time - Date stamp by separate printing device on a regular ticket
  - Time - Date printed by a batch weight recorder on a printed ticket.
  - Time - Date printed by a batch weight recorder on a printed tape. Affix a copy of the tape to the regular delivery ticket.

**E. Failure of Automatic Batching, Admixture Dispensing and Recording Equipment.** If automatic proportioning, admixture dispensing or recording instruments fail, the plant may be allowed, subject to approval of the Regional Director or his representative, to continue producing concrete for the Department for up to 48 hours from the time of breakdown. Written permission of the Regional Director will be required to operate without these instruments for periods longer than 48 hours. During this period, batch all materials within the automatic proportioning system tolerances.

### TABLE 501-4 BATCHING TOLERANCES

<table>
<thead>
<tr>
<th>Component</th>
<th>Tolerance Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement, Pozzolan, or Blended</td>
<td>± 1% (by weight) of total cementitious materials, if no microsilica or HRP is weighed cumulatively on a common scale.</td>
</tr>
<tr>
<td>Cement</td>
<td>± 0.5% (by weight) of total cementitious materials, if microsilica or HRP is weighed cumulatively on a common scale.</td>
</tr>
<tr>
<td>Microsilica or HRP</td>
<td>± 0.5% (by weight) of total cementitious materials, if weighed cumulatively with any other cementitious material.</td>
</tr>
<tr>
<td>Aggregates</td>
<td>± 2% (by weight)</td>
</tr>
<tr>
<td>Water 1</td>
<td>± 1%</td>
</tr>
<tr>
<td>Admixtures (711-08, or 711-13)</td>
<td>± 3% by volume, or ± 1 meter pulse, whichever is greater.</td>
</tr>
<tr>
<td>Admixtures (others)</td>
<td>Contact Director, Materials Bureau</td>
</tr>
<tr>
<td>Zero - Aggregate 2</td>
<td>± 2%</td>
</tr>
<tr>
<td>Zero - Cementitious Materials 2</td>
<td>± 1%</td>
</tr>
<tr>
<td>Zero - Water (weighed) 1,2</td>
<td>± 1%</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Tolerance applies to water batched at central mix plants only.
2. Zero tolerance applies to empty scales, based on the minimum allowable batch size.
3. All tolerances are based on the pre-programmed target quantity.

**501-3.03 Concrete Mixing, Transporting and Discharging.**

**A. General.** Mix the concrete at a central mix plant, in truck mixers in transit or at the site. When mixed at a central mix plant, transport the concrete in vehicles acceptable to the Regional Director. Place the fresh concrete directly into the forms or into conveyance equipment approved by the Regional Director before evidence of initial set. No water addition will be permitted after the mix has reached the mid-point of the slump range, as indicated in Table 501-3, Concrete Mixtures, for the class used. Concrete with a discharge temperature exceeding 90°F will be subject to rejection.

Notify the Regional Materials Engineer’s office by 3:00 PM on the day before any production for the Department. Supply fresh concrete at a rate consistent with placement operations as determined...
by the Engineer. The Regional Director may disapprove the use of any type of concrete mixing or transporting units when unsatisfactory results occur.

Load the mixer, regardless of type, in a manner approved by the Regional Director and mix batches of concrete no larger than the rated capacity shown on the Manufacturer's plate.

A summary of time limitations for various types of concrete mixing equipment, from the beginning of batching to the completion of discharge, is given in Table 501-7, Summary of Concrete Batching, Mixing, Hauling and Discharging.

**B. Concrete Uniformity.** Use a mixer that combines aggregates, cementitious materials, water and admixtures into a uniform weight within the specified time. The mixer is required to discharge the mixture without segregation, and meet the uniformity requirements in Table 501-5, Concrete Uniformity. The Department will perform tests when required by the specifications or requested by the Regional Director.

It will only be necessary to verify that mixing equipment meets uniformity requirements if evidence of non-uniform concrete is found or a reduced mixing time for central mixers is requested. A reduction in the batch size below the rated mixer capacity or reduced mixing speed tolerance limits may be required to obtain uniformity.

<table>
<thead>
<tr>
<th>TABLE 501-5 CONCRETE UNIFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>Weight per cubic foot calculated to an air-free basis</td>
</tr>
<tr>
<td>Air Content, % by volume of concrete</td>
</tr>
<tr>
<td>Slump:</td>
</tr>
<tr>
<td>Average slump 4 in or less</td>
</tr>
<tr>
<td>Average slump greater than 4 in</td>
</tr>
<tr>
<td>Coarse aggregate content, portion by weight of each sample retained on a No. 4 sieve</td>
</tr>
<tr>
<td>Unit weight of air-free mortars based on average for all comparative samples tested</td>
</tr>
</tbody>
</table>

**NOTE:** The Department will take samples at the mixer discharge point and test in accordance with Materials Method 9.2.

**C. Central Mixed Concrete.** Central mixed concrete is concrete mixed in a stationary mixer and transported in approved agitating or non-agitating delivery units to the deposition point. Use a minimum 90 second mixing time after all materials are in the drum, unless tests show that the requirements of Table 501-5, Concrete Uniformity, can be consistently obtained at a lesser time as approved by the Director, Materials Bureau.

Use delivery units that transport thoroughly mixed concrete without loss of uniformity meeting the requirements of §501-2.04B.1.b. or §501-2.04B.2., pertaining to Central Mixed Concrete.

Travel on a haul road free from holes, washboarding or other features that cause segregation in plastic concrete.

Do not exceed the time limit between completion of mixing at a central mix plant and completion of discharge as noted in Table 501-6, Time Limits for Delivery of Central Mixed Concrete.

When transporting central mixed concrete in units approved for truck mixing, add a minimum of 90% of the design water to the mix with the batch plant water system.

Two additions of water will be allowed at the discharge point to obtain initial slump. After each addition, mix the concrete at least 30 mixing-speed revolutions before discharging. The initial loads may, with prior written approval by the Regional Materials Engineer, also be adjusted by using a water-reducing admixture (711-08, ASTM Type A). This adjustment will be limited to the first
trucks arriving for a particular placement before any adjustments have been made at the batching facility. Observe the maximum number of mixing revolution or water addition requirements. Make all subsequent admixture additions or adjustments during production at the batching facility. No additions or adjustments are allowed when non-agitating / open haul units are used.

### TABLE 501-6 TIME LIMITS FOR DELIVERY AND DISCHARGE OF CENTRAL MIXED CONCRETE

<table>
<thead>
<tr>
<th>Delivery Unit</th>
<th>Maximum Time (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Agitating / Open haul</td>
<td>30</td>
</tr>
<tr>
<td>Agitating - rotating drum</td>
<td>90 *</td>
</tr>
</tbody>
</table>

* The Engineer will reject the concrete if there is evidence of initial set, and may reduce the time limit in hot weather or under unusual conditions if unsatisfactory results occur. For concrete that does not contain a water-reducing and retarding admixture, the time to initial strike-off or placement of subsequent lifts is included in the delivery and discharge time limit.

**D. Transit Mixed Concrete.** Transit mixed concrete is concrete batched at the production facility and mixed completely in a truck mixer at the following locations or combinations thereof: the plant, while in transit, or the discharge point. Transit mix may be used for all concrete items unless otherwise specified. Use a truck mixer meeting the requirements of §501-2.04B.1.a., pertaining to Transit Mixed Concrete.

Load the mixer as follows:
1. Totally drain the drum of wash water before loading.
2. Revolve the drum while loading the mix ingredients and add approximately 90% of the design water.
3. Begin mixing within 5 minutes of cement to aggregate contact.

### TABLE 501-7 SUMMARY OF CONCRETE BATCHING, MIXING, HAULING AND DISCHARGING

<table>
<thead>
<tr>
<th>Central Mixed Concrete</th>
<th>Transit Mixed Concrete</th>
<th>Truck Mixed Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin Batching</td>
<td>Begin Batching</td>
<td>Begin Batching</td>
</tr>
<tr>
<td>Load mixer</td>
<td>Hatch load, or ribbon load materials through barrel hopper.</td>
<td>Hatch load, or ribbon load materials through barrel hopper.</td>
</tr>
<tr>
<td>End of Batching and Begin Mixing</td>
<td>Add approx. 90% of design water</td>
<td>Load aggregates. Drum may be rocked or revolved</td>
</tr>
<tr>
<td>90 Second minimum after all materials are in the mixer.</td>
<td></td>
<td>Load Cement (See Note 3)</td>
</tr>
<tr>
<td>End of Mixing</td>
<td>Cement In Contact With Aggregates</td>
<td>Cement In Contact With Aggregates</td>
</tr>
<tr>
<td>Open Haul</td>
<td>5 Minutes max.</td>
<td>30 Minutes max.</td>
</tr>
<tr>
<td>Rotating</td>
<td>▲</td>
<td>Load Cement</td>
</tr>
<tr>
<td>Units</td>
<td>Cement In Contact With Aggregates</td>
<td>(See Note 3)</td>
</tr>
<tr>
<td>Rotating Drum</td>
<td>5 Minutes max.</td>
<td>Cement In Contact With Aggregates</td>
</tr>
<tr>
<td>Agitate 2-6 rpm</td>
<td>Begin Mixing</td>
<td>90 Minutes max.</td>
</tr>
<tr>
<td>30 Minutes maximum</td>
<td>at plant or in transit</td>
<td>Load Cement (See Note 3)</td>
</tr>
<tr>
<td>(See Note 2)</td>
<td>Class HP or Class DP</td>
<td>Cement In Contact With Aggregates</td>
</tr>
<tr>
<td>Completion of Discharge</td>
<td>100 rev. minimum</td>
<td>30 Minutes max.</td>
</tr>
<tr>
<td>(When concrete is transported in units approved for mixing, see Note 1)</td>
<td>200 rev. maximum</td>
<td>Load Cement (See Note 3)</td>
</tr>
<tr>
<td>90 Minutes max.</td>
<td>Mix: 6-18 rpm</td>
<td>Cement In Contact With Aggregates</td>
</tr>
<tr>
<td>(Note 2)</td>
<td>All Other Classes</td>
<td>90 Minutes max.</td>
</tr>
<tr>
<td></td>
<td>100 rev. minimum</td>
<td>Load Cement (See Note 3)</td>
</tr>
<tr>
<td></td>
<td>160 rev. maximum</td>
<td>Cement In Contact With Aggregates</td>
</tr>
<tr>
<td></td>
<td>Mix: 6-18 rpm</td>
<td>Cement In Contact With Aggregates</td>
</tr>
<tr>
<td></td>
<td>All Other Classes</td>
<td>30 Minutes max.</td>
</tr>
<tr>
<td></td>
<td>100 rev. minimum</td>
<td>Load Cement (See Note 3)</td>
</tr>
<tr>
<td></td>
<td>160 rev. maximum</td>
<td>Cement In Contact With Aggregates</td>
</tr>
</tbody>
</table>
Mix: 6-18 rpm
End of Mixing
Agitate 2-6 rpm
Begin Discharge
50 Minutes maximum
Completion of Discharge

NOTES:
1. The remainder of the design water may be added at the work site to attain initial slump. When approved by the Regional Materials Engineer, only the first trucks may be adjusted to obtain initial slump using a water-reducing admixture (711-08, ASTM Type A). Exceeding the maximum mixing revolutions or water addition requirements will not be permitted.
2. For mixtures that do not contain a water-reducing and retarding admixture (711-08, ASTM Type D), the 90 minute maximum time includes the time to initial strike-off, or placement of subsequent lifts.
3. Add cement through hatch. Do not move drum while cement is being added.

   Mix for a minimum of 100 mixing-speed revolutions and then check for consistency. If the truck is en route to the project, change the speed from mixing to agitating after 100 mixing revolutions. Unless restricted by local traffic laws, do not stop the rotation of the drum during transit.

   Two additions of water will be allowed to obtain initial slump at the discharge location. After each addition, mix at least 30 mixing speed revolutions. For Class DP or HP concrete, mix a total of 100 to 200 mixing speed revolutions. For all other classes of concrete, mix a total of 100 to 160 mixing speed revolutions.

   The initial loads may, with prior written approval by the Regional Materials Engineer, also be adjusted by using a water-reducing admixture (§711-08, ASTM Type A). This adjustment will be limited to the first trucks arriving for a particular placement before any adjustments have been made at the batching facility. Observe the maximum number of mixing revolution or water addition requirements. Make all subsequent admixture additions or adjustments during production at the batching facility.

   After mixing, either discharge the load immediately or revolve the drum at agitating speed. Once begun, discharge the entire load within 50 minutes.

   For mixes containing a water-reducing and retarding admixture, the total time interval from the moment the cement makes contact with the aggregates to the completion of discharge shall not exceed 90 minutes.

   For mixes that do not contain a water-reducing and retarding admixture, the total time interval from the moment the cement makes contact with the aggregates to the completion of initial strike off or placement of subsequent lifts shall not exceed 90 minutes.

   The Regional Director may reduce the total time limit in hot weather or under unusual conditions, if unsatisfactory results are obtained.

E. Truck Mixed Concrete. Truck mixed concrete is concrete completely mixed in a truck mixer meeting the requirements of §501-2.04B.1.b. Truck Mixers, after adding water at the discharge location. Apply §501-3.03D. Transit Mixed Concrete, except as follows:

1. Loading of Mixer:

   a. Regular Truck Mix (cement in contact with moist aggregates). The drum may be rocked or revolved while loading coarse and/or fine aggregates with admixtures. Load the cement last, while keeping the drum stationary. Begin mixing within 30 minutes of cement to aggregate contact.
b. Layered Truck Mix (cement in contact with Saturated Surface Dry (SSD) or drier coarse aggregate). Batch the fine aggregate with admixtures, coarse aggregate and cement all separately. Load these materials through a hatch in the side of the drum in the following sequence: fine aggregate with admixtures, coarse aggregate, and cement last. The drum may be rocked after adding each aggregate size, but kept stationary while loading the cement. Begin mixing within 90 minutes of cement to coarse aggregate contact.

2. Mixing: Begin mixing at the discharge location. Add water to the drum either from the head section or by dual injection from both the head and discharge end. Mix for a minimum 100 revolutions or until uniform concrete of the specified consistency is produced, whichever is longer. Do not exceed a 15 minute mixing period.

3. Discharge: Discharge the entire load within 30 minutes after mixing.

501-4 METHOD OF MEASUREMENT. The Engineer will compute the volume of concrete as the number of cubic yards within the payment lines indicated on the plans or as specified by the Engineer. No deductions will be made for the volume of embedded reinforcement, structural shapes or joint materials. Also, no deductions will be made in concrete pavement for catch basins, manholes, etc. unless otherwise indicated in the contract documents.

501-5 BASIS OF PAYMENT. Include the cost of furnishing all materials, equipment and labor necessary to complete the work in the unit price bid for the appropriate items.

SECTION 502 - PORTLAND CEMENT CONCRETE PAVEMENT
(Last Revised May, 2019)

502-1 DESCRIPTION. Construct a Portland Cement Concrete (PCC) pavement and shoulders, if required, as detailed in the contract documents.

502-2 MATERIALS

Portland Cement Concrete 501
Chemically Curing Adhesive for Portland Cement Concrete (PCC) 701-14
Pavement Applications
Highway Joint Sealants (ASTM D6690, Type IV) 705-02
Premoulded Resilient Joint Filler 705-07
Preformed Elastic Longitudinal Joint Seal 705-10
Preformed Elastic Transverse Contraction and Expansion Joint Seal 705-12
Lubricant for Preformed Elastic Joint Sealer 705-13
Longitudinal Joint Ties 705-14
Transverse Joint Supports 705-15
Wire Fabric for Concrete Reinforcement 709-02
Epoxy Coated Bar Reinforcement, Grade 60 709-04
Quilted Covers (for curing) 711-02
Plastic Coated Fiber Blankets (for curing) 711-03
Polyethylene Curing Covers (white opaque) 711-04
Membrane Curing Compound 711-05
Form Insulating Materials for Cold Weather Concreting 711-07
Water 712-01
If requested, provide the Engineer with any appropriate manufacturer’s details and/or instructions for use of listed materials before use of the product.

In addition to meeting the requirements of §701-14, Chemically Curing Adhesive for Portland Cement Concrete (PCC) Pavement Applications, the material used to anchor longitudinal joint ties, dowels, or other miscellaneous items into hardened concrete must be a pourable, two-component, 100% solid structural epoxy dispensed:
- From side-by-side cartridges by manual or pneumatically powered injection guns.
- Through a static mixing nozzle that homogeneously mixes the material without any hand mixing.

**502-2.01 Concrete.** Use Class C concrete furnished in accordance with Section 501, Portland Cement Concrete – General, when specified. High-Early-Strength (HES) concrete, meeting the requirements of §502-2.02, may be substituted for closure or short placements, subject to the Engineer’s approval.

**502-2.02 High-Early-Strength (HES) Concrete.** Use HES concrete where required in the contract documents or where the Contractor’s request to use HES concrete is approved by the Engineer.

Whether required or requested, design the HES mix to satisfy the opening to traffic time requirements of the project and Table 502-1, High-Early-Strength Concrete Mix Requirements. Submit the HES concrete mix design to the Engineer. Include admixture brands and dosages as well as mixing, transporting, placing, paving, curing, and anticipated strength gain details.

Produce and place a 4.0 yd³ (minimum) trial batch at an off-contract location selected by the Contractor and agreed upon by the Engineer. Produce the trial batch using the same materials and processes as those to be used to produce concrete for the contract. Provide the Engineer a 7-day minimum advance notification of trial batch production. Produce and place the trial batch in the presence of the Engineer, the Regional Materials Engineer, and Materials Bureau personnel.

Provide an American Concrete Institute (ACI) Certified Concrete Field Testing Technician, Grade I, or higher, to:
- Measure slump, air content, and unit weight of the trial batch.
- Cast cylinders from the trial batch for compressive strength and durability testing.

Determine the compressive strength of the trial batch concrete at the desired time as discussed in §502-3.16C, Project Strength Determination.

The Materials Bureau will render a decision on mix acceptability, curing, and opening to traffic requirements within 45 calendar days of trial batch production. Changes other than minor fluctuations in admixture dosage rates require a new mix design and trial batch. The Engineer will reject the concrete if the specified plastic air content is not achieved. The Engineer may halt paving and order additional trial batches whenever the specified compressive strength requirements are not achieved.

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Desired</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Day Compressive Strength</td>
<td>4000 psi</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Opening Compressive Strength</td>
<td>2500 psi</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Freeze-Thaw Loss (Test 502-3P, 3% NaCl)</td>
<td>-</td>
<td>0.0 %</td>
<td>3.0 %</td>
</tr>
<tr>
<td>Plastic Air Content</td>
<td>5.0 %</td>
<td>6.5 %</td>
<td>8.0 %</td>
</tr>
<tr>
<td>Water – Cement Ratio (w/c)</td>
<td>-</td>
<td>-</td>
<td>0.40</td>
</tr>
<tr>
<td>Slump²</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**NOTES:**
1. See §502-3.16, Opening to Traffic.
2. There are no minimum or maximum requirements for slump, however mix must be fluid enough to finish without segregating.

502-2.03 Performance Engineered Mixes (PEM). If specified, design a concrete mixture proportioned to meet the requirements of the contract documents. Procedures for mix approval and acceptance will also be included in the contract documents.

502-2.04 Load Transfer Dowel Bars. Refer to 705-15 for Dowel bar requirements. If specified, load transfer dowel bars other than epoxy coated steel may be required. The material requirements as well as the approval and acceptance procedures will be included in the contract documents.

502-3 CONSTRUCTION DETAILS. Hold a pre-pave meeting 7 to 14 day before the planned start of paving with the Engineer, any PCC paving and saw cutting subcontractors, and concrete suppliers to coordinate all aspects of paving and inspection, including equipment review, construction methods, and time and personnel requirements.

Construct a smooth, well consolidated, properly finished, textured, and cured pavement to the line and grade depicted in the contract documents, ± 1/4 inch vertically at any location.

502-3.01 Equipment. Provide the Engineer with an equipment list and specifications a minimum of 14 days prior to the planned start of PCC paving. Bring all equipment needed to place, consolidate, finish, texture, cure, saw cut, seal, and test the PCC pavement to the job site a minimum of 1 full work day before its use to allow examination by the Engineer. Repair or replace any equipment found to be defective before or during its use. Discontinue any operation if unsatisfactory results are being obtained. Use of equipment other than described below is subject to the approval of the Director, Materials Bureau.

A. Slipform Paving. Use a self-propelled slipform paver equipped with:
- Rigid side forms that laterally support the concrete and minimize edge slumping.
- A full-width finishing pan.
- Attached internal vibrators capable of consolidating the entire concrete placement.

Slipform paving consists of a single paver, or a placer/spreader followed by a separate paver, capable of placing, spreading, consolidating, screeding, and finishing the concrete such that hand finishing is kept to a minimum. Use equipment guided by a reference system that ensures the pavement is placed to the specified line, grade, and cross section.

B. Fixed Form Paving

1. Forms. Use straight forms without horizontal joints meeting Table 502-2, Form Requirements, and equipped with:
- At least 3 stake pockets spaced 3 feet apart (maximum), each having a positive, nondetachable wedge.
- Positive, interlocking devices capable of holding abutting sections together to form neat, tight joints.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Steel, 1/4 inch thick, minimum.</td>
</tr>
<tr>
<td>Length</td>
<td>10 feet, minimum.</td>
</tr>
</tbody>
</table>
Flexible, curved, or wooden forms may be used in irregular areas or curved sections having horizontal radii of 100 feet or less.

2. **Paving Equipment.** Use fixed form paving equipment specifically made for placing concrete. The equipment must be capable of placing, spreading, consolidating, screeding, and finishing the concrete to the specified line, grade, and cross section such that hand finishing is kept to a minimum. Use equipment with either attached internal vibrators or in conjunction with hand-held internal vibrators.

C. **Vibrators.** Use paver-mounted internal vibrators capable of consolidating the entire concrete placement that are:
- Capable of being shut off without shutting off the paver.
- Equipped with frequency controls readily accessible to the paver operator.
- Capable of simultaneously operating at the same frequency as the other paver-mounted vibrators.
- Capable of operating through a frequency range of 6,000 - 10,000 vibrations per minute.

Check vibrator operating frequencies daily when paving begins. Check frequencies under load with the Engineer present. If the paver is not equipped with direct-read frequency gauges for each vibrator, supply the Engineer with a calibrated, hand-held tachometer, including instructions, to monitor vibrator frequencies. The tachometer will remain the Contractor’s property after paving is complete.

Use hand-held vibrators capable of operating through a frequency range of 6,000 - 10,000 vibrations per minute in any location that is not consolidated by internal vibrators attached to the paving equipment.

D. **Saw Cutting Equipment.** Use diamond blade saws capable of making straight cuts to the dimensions depicted in the Standard Sheets that are equipped with cutting guides, blade guards, water cooling systems, dust controls, and cut depth control.

Maintain equipment and supplies to ensure uninterrupted saw cutting. Early entry saws require approval from the Director, Materials Bureau. Submit requests to use early entry saws at least 7 calendar days before paving.

E. **Curing Compound Applicators.** Use atomizing mechanical sprayers capable of exerting consistent pressure without hand pumping that are equipped with tank agitators to continuously mix the curing compound. Use nozzles with spray shields to prevent drift. Flush nozzles daily before use.

Maintain equipment and supplies, including extra nozzles, to ensure uninterrupted curing compound application. In a multi-lane slip form paving operation, use self-propelled applicators guided by the same reference system as the slip form paver. Otherwise, applicators need not be self-propelled.

F. **Drills.** Use gang drills with a minimum of 2 independently powered and driven drills. Use tungsten carbide drill bits. Rest and reference the drill rig frame on and to the pavement surface such
that the drilled holes are cylindrical, perpendicular to the surface being drilled, and repeatable in terms of position and alignment. Hand-held drills are permitted for drilling holes in longitudinal joints if there is not enough room to use gang drills resting on the pavement surface.

G. Joint Sealing - Highway Joint Sealant. Heat the sealant in a melter constructed either:
- As a double boiler with the space between inner and outer shells filled with oil or other heat-transfer medium.
- With internal tubes or coils carrying the sealant through a heated oil bath and into a heated double-wall hopper.

Do not use direct heating. Use a melter capable of maintaining the sealant’s pouring temperature and providing homogeneous sealant equipped with:
- Positive temperature control.
- Continuous full sweep mechanical agitation.
- Separate thermometers indicating the temperatures of the heat transfer medium and the sealant in the hopper. Do not place any sealant if the thermometers are defective or missing.

Provide 2 thermometers having stems 18 inches long and temperature ranges sufficient to meet the requirements of this specification. Use a discharge hose equipped with a controlled heating apparatus or sufficiently insulated to maintain the proper sealant pouring temperature. Use nozzles that apply the joint sealant within the joint confines for the full width and depth of the joint.

H. Air Blasting Equipment. Use equipment with traps or other installed devices that prevent moisture and oil from contaminating the concrete surface. Use a compressor that delivers air at a minimum of 120 cfm and develops a minimum nozzle pressure of 90 psi. Check the compressed air stream purity daily with a clean white cloth.

502-3.02 Weather Limitations

A. Rain. Do not pave in the rain. Supply sufficient quilted covers, plastic coated fiber blankets, or polyethylene curing covers near the paving operation when rain may be expected. Securely cover any concrete exposed to rain that has not reached initial set or will be visibly affected by the rain.

B. Cold Weather. Place concrete when the air temperature is 40°F and rising, or warmer, and when the surface temperature of the area to be paved is 40°F, or warmer. Stop paving when the air temperature falls below 40°F. Measure temperatures in the shade to an accuracy of 1°F. Refer to §502-3.11C, Cold Weather Curing.

502-3.03 Subbase Course. Install a subbase course in accordance with Section 304, Subbase Course, before placing PCC. If the area is available, extend the prepared subbase course at the same line, grade, and cross slope as the area being paved such that it is at least:
- 3 feet beyond the longitudinal edges of a slipform pavement.
- 1 foot beyond the outside longitudinal edges of the fixed forms.

Additional subbase course that is not included in the finished work will be paid for under Section 304 items included in the contract.

502-3.04 Slipform Paving. Establish a reference system to achieve the specified smoothness level. If string lines are used, set them by survey and use dual lines whenever possible.
Maintain uniform concrete quality and head in front of the paver. Coordinate concrete delivery to maintain continuous forward movement of the paver and avoid excessive delivery truck queues. Keep paver tracks clear of concrete and debris before and during paving.

Wet the entire subbase surface without forming puddles or mud immediately before placing concrete.

Consolidate the entire concrete placement using internal vibrators attached to the paver. Combine paver forward speed, vibrator frequency, and vibrator depth to consolidate the concrete without segregation, vibrator trails, or contacting the joint assemblies. Discontinue vibration and tamping if the paver stops.

Determine edge slump by extending a 2 foot (minimum) long straightedge over the longitudinal pavement edges. Immediately correct edge slumps greater than 1/4 inch that are between concrete placements and greater than 3/8 inch at free edges and HMA shoulders.

502-3.05 Fixed Form Paving.

A. Setting Forms. Compact the supporting layer at the form line such that the forms are supported for their full length. Set forms to string lines placed at the pavement elevation, line, and grade and to achieve the specified smoothness. If a form sits above the string line, remove the form and trim the form line to the proper grade. If a form sits below string line, remove the form and fill and compact the low area with granular material at least 6 inches on both sides of the form. Frequently check form grade and alignment while paving. Reset forms as necessary.

Set forms to accommodate a full day’s paving before placing concrete. Extend forms beyond construction bulkheads to provide a working platform at the end of a placement. Secure each form with a minimum of 3 pins, each of sufficient length to hold the forms in place without movement during any operation. Lock the forms together such that the form ends are aligned and the joints are tight and smooth. Run the paving equipment atop the forms before placing any concrete and recheck form alignment. Reset forms as necessary.

Align keyway strips in a smooth, horizontal plane, parallel to the top of the form. Match keyway strips on abutting forms such that a nearly seamless keyway results.

B. Paving. Apply oil to forms before placing concrete. Immediately before placing concrete, wet the entire subbase surface without forming puddles or mud. Uniformly distribute the concrete in front of the paver by maneuvering the delivery truck chute. If concrete is spread by hand, use come-alongs or shovels. Do not use rakes or hand-held vibrators to spread concrete.

Maintain uniform concrete quality and head in front of the paving machine and without running over the screeds. Coordinate concrete delivery to maintain continuous forward movement of the paver and avoid excessive delivery truck queues. Keep form tops clean before and during paving.

Consolidate the entire concrete placement using internal vibrators attached to the paver. Combine paver forward speed, vibrator frequency, and vibrator depth to consolidate the concrete without segregation, vibrator trails, or contacting the joint assemblies. Discontinue vibration and tamping if the paver stops.

Use hand-held vibrators ahead of the paving equipment to consolidate all concrete not consolidated by machine-mounted internal vibrators. Keep hand-held vibrators perpendicular to the pavement surface. Vibrate between 2 and 4 seconds in each location, overlapping adjacent locations. Do not drag vibrators through the concrete. Do not walk through consolidated concrete.

Mark the midpoint (± ½ inch) of each transverse contraction joint such that the saw cut operator can accurately locate the first-stage saw cut locations.

C. Form Removal. Remove forms after the concrete has developed sufficient strength to allow removal without damaging the pavement. Repair pavement damaged during form removal. Remove forms before making second-stage saw cuts.
502-3.06 Joint Construction. The Engineer will inspect the longitudinal joint ties and transverse joint supports for compliance to the relevant Materials Details before any joint hardware placement is allowed. Construct joints in accordance with the Standard Sheets and approved Materials Details. Do not stand on joint hardware.

Base final joint layout on construction staging and the actual location of utilities, drainage structures, intersections, tapers, and other irregular areas. Submit a proposed joint layout to the Engineer at least 10 calendar days prior to PCC paving. Obtain the Engineer’s approval of the joint layout before paving.

Inserting dowels and/or longitudinal joint ties into plastic concrete will be considered. Submit a plan to verify dowel and tie locations, depth, and alignment to the Engineer for consideration. Do not insert dowels or ties until the plan is approved by the Engineer.

Make first-stage saw cuts 1/8 inch wide. Make second-stage saw cuts, clean, and seal joints in accordance with §502-3.12, Sealing Joints.

A. Transverse Joints. Transverse joints include contraction, expansion, hinge, and construction joints. Secure joint supports to the subbase as depicted in the Materials Details. Maintain joint supports in their proper position and alignment during paving.

Construct transverse joints perpendicular to both the pavement surface and longitudinal joints in the area being paved. Use a 15 foot maximum transverse joint spacing for pavements having standard slab widths of 12 to 13 feet. For pavements having other slab widths, determine typical maximum and minimum transverse joint spacing in accordance with the following:

\[
L_{\text{max}} = W_{\text{min}} \times 1.33 \\
L_{\text{min}} = \frac{W_{\text{max}}}{1.33}
\]

where:

- \(L_{\text{max}}\) = maximum transverse joint spacing (slab length)
- \(L_{\text{min}}\) = minimum transverse joint spacing (slab length)
- \(W_{\text{max}}\) = maximum slab width across the pavement (load carrying slabs only)
- \(W_{\text{min}}\) ≤ 13 feet
- \(W_{\text{min}}\) = minimum slab width across the pavement (load carrying slabs only)

1. Transverse Contraction Joints. All transverse joints are contraction joints unless otherwise shown in the contract documents. Contraction joints are constructed in a straight line across the full width of the PCC pavement and shoulders. Contraction joints may be angled (rather than straight across a pavement) at tied longitudinal joints between lanes placed separately if the placements do not have the same centerline, e.g., where a ramp centerline diverges from parallel to the pavement centerline. Contraction joints may terminate at, or be misaligned at, untied longitudinal joints as discussed in §502-3.06B3, Untied Longitudinal Joints.

Store transverse contraction joint support assemblies in inverted stacks at the project site. Cover stored epoxy coated steel such that it is protected from direct sunlight. Handle joint supports such that no twisting or bending occurs during storage and positioning. Supports with bent, twisted, or deformed wires will be rejected.

Before placing concrete, position transverse joint supports such that the:

- Entire longitudinal axis of each dowel is located at the mid-depth of the pavement slab or up to 1 inch below the mid-depth of the slab.
- Longitudinal axes of the dowels are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one dowel end relative to the other is 1/4 inch.
- Midpoint of the longitudinal axis of each dowel is at the center of the joint (±1 inch).
• Longitudinal axes of the two end dowels are 4 to 8 inches from the longitudinal joints.
• Longitudinal axes of the dowels are spaced 12 inches apart.

Mark the location of each contraction joint on the subbase before placing concrete such that the assembly is properly positioned. Also mark the longitudinal midpoints of the dowels such that the saw cut operator can accurately locate first-stage saw cuts. In a slipform paving operation, mark the joint support midpoint on the subbase immediately adjacent to the pavement. In a fixed form paving operation, mark the joint support midpoint on the form or such that the saw cut operator can easily locate the joint midpoint. Do not cut the shipping wires.

Make first-stage saw cuts as soon as the concrete has hardened sufficiently to permit sawing without causing raveling wider than 1/8 inch. Replace blades if raveling persists. Center first-stage saw cuts within 1 inch of the longitudinal midpoints of the dowels.

Complete first-stage saw cuts before any uncontrolled cracking occurs. Be prepared to make first-stage saw cuts 24 hours a day to prevent uncontrolled cracking. Provide lighting required to make first-stage saw cuts at night at no additional cost to the State.

Sweep or wash first-stage saw cut debris from the pavement before it rains, or before opening the pavement to any traffic, such that debris does not enter the joint.

2. Transverse Expansion Joints. Construct transverse expansion joints as part of the utility and drainage structure isolation systems depicted in the Standard Sheets or where indicated in the contract documents. Handle and position expansion joint supports in accordance with §502-3.06A1, Transverse Contraction Joints.

Construct expansion joints using 1/2 inch thick remolded resilient joint filler placed in 1 piece between longitudinal joints. Tightly place and support abutting sections of joint filler such that no concrete infiltrates the joint. Place expansion caps on the dowels as depicted in the Materials Details. Do not tap or hammer the caps onto the dowels.

No saw cuts are required in expansion joint construction. Remove the finishing cap, if supplied, after the concrete has developed sufficient strength to prevent damage.

3. Transverse Construction Joints. Construct transverse construction joints wherever there is an interruption of more than 30 minutes in concrete paving operations. Construct these joints as wide as the concrete placement, typically 1 or 2 lanes, but not necessarily the full pavement width. Align construction joints with transverse contraction or construction joints in adjacent lanes. Construction joints may be formed by bulk heads, saw cuts, concrete removal, or any combination thereof.

When required, drill and anchor dowels in accordance with §502-3.06D, Drill and Anchor Dowels or Ties, such that they meet the positioning requirements of §502-3.06A1, Transverse Contraction Joints.

a. Bulkheads. Ensure the bulkhead can support the weight of the plastic concrete. Bulkheads may be slotted or solid. Place a slotted bulkhead over the dowels of an exposed joint assembly such that half of the dowel lengths are embedded within newly placed concrete. Immediately remove plastic concrete in front of the bulkhead and from the exposed joint support.

The transverse joint assembly may be omitted and a solid bulkhead may be used. In this case, drill and anchor dowels, if required, into the transverse joint face.

b. Saw Cut. Saw cut full depth construction joints at locations that satisfy the minimum and maximum slab length requirements of §502-3.06A, Transverse Joints. Saw cut when the concrete has obtained sufficient strength to be saw cut without damage to concrete to remain in place. Do not cut within 12 inches of a longitudinal joint tie. Remove the hardened concrete ahead of the saw cut. Drill and anchor dowels, if required, into the saw cut face such that they...
meet the positioning requirements. Do not drill into longitudinal joint ties.

In lieu of drilling holes, the contractor may use transverse joint supports fabricated with closed-end, hollow plastic cylinders instead of dowels. Use hollow cylinders with outer diameters equal to the drilled hole diameters described in §502-3.06D, Drill and Anchor Dowels or Ties. Position cylinders as required in §502-3.06A1, Transverse Contraction Joints.

Saw cut the newly placed concrete full depth and full width through the midpoint of the longitudinal axis of each cylinder (± 1 inch). Remove hardened concrete and the joint assembly ahead of the saw cut. Remove the hollow cylinder embedded in the concrete that remains and anchor the dowels in accordance with §502-3.06D, Drill and Anchor Dowels or Ties, to the required alignment in §502-3.06A1, Transverse Contraction Joints.

c. Removal. Remove all concrete to the midpoint of the preceding transverse joint without damaging the dowels, dowel coatings, or the pavement to remain in place.

4. Transverse Hinge Joints. Do not place hinge joints without the Engineer’s approval. Construct transverse hinge joints when a slab length exceeds the geometric requirements of §502-3.06, Transverse Joints. (This situation typically occurs near structures that are skewed from perpendicular to the pavement centerline.) Locate hinge joints such that they are equally spaced between other types of transverse joints. Construct hinge joints in accordance with §502-3.06A1, Transverse Contraction Joints, except the positioning requirements do not apply. Instead, position transverse hinge joint supports such that the:

- Entire longitudinal axis of each deformed bar is located at the mid-depth of the pavement slab or up to 1 inch below the mid-depth of the slab.
- Longitudinal axes of the bars are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one bar end relative to the other is 1 inch.
- Midpoint of the longitudinal axis of each bar is at the center of the joint (± 1 inch).
- Longitudinal axes of the two end bars are 4 to 10 inches from the longitudinal joints.
- Longitudinal axes of adjacent bars are spaced 4 to 18 inches apart.

B. Longitudinal Joints. When a longitudinal joint item is specified, select tie type, size, spacing, and positioning in accordance with the 502 Standard Sheets and contract documents. Provide a minimum clearance of 3 inches between the end ties in a slab and any part of the transverse joint support. Keep ties free of materials that inhibit bonding to concrete or anchoring material. Maintain ties in their proper position during paving.

It is highly desirable to align longitudinal joints with the permanent pavement markings. Tied longitudinal joints located in the wheel paths of the completed pavement will require ties placed 24” on center.

1. Longitudinal Joints Between Lanes Paved Simultaneously. Use one-piece ties fabricated into assemblies capable of securely holding 2 or more ties. Secure the assemblies to subbase prior to paving in accordance with the Materials Details.

Make first-stage saw cuts parallel to the pavement centerline and perpendicular to the pavement surface before uncontrolled cracking occurs. Use equipment specified in §502-3.01D, Saw Cutting Equipment. Replace saw blades if raveling wider than 1/8 inch occurs. Center first-stage saw cuts within 1 inch of the longitudinal midpoint of the ties.

Sweep or wash first-stage saw cut debris from the pavement before it rains, or before opening the pavement to any traffic, such that debris does not enter the joint.
2. **Tied Longitudinal Joints Between Lanes Paved Separately.** In a slip form operation, construct a butt joint and drill and anchor one-piece ties into the hardened concrete in accordance with §502-3.06D, Drill and Anchor Dowels and Ties.

Use #6 ties, 22 inches (minimum) long between travel lanes and 18 inches (minimum) long between a travel lane and a PCC shoulder. Anchor ties between travel lanes 10 inches into the previously placed concrete, leaving 12 inches (minimum) projecting from the joint face. Anchor ties between a travel lane and a PCC shoulder 8 inches (minimum) into the previously placed concrete, leaving 10 inches projecting from the joint face.

Place end ties in a slab 14 to 18 inches from the transverse joint. Typically, space ties between the end ties 36 inches apart, maximum. Pavements having 4 or more tied lanes, or 3 lane pavements 12 inches (or more) thick, may require a decreased spacing in accordance with the contract documents.

In a fixed form operation, construct either a butt or a keyed joint. Drill and anchor one-piece ties as discussed above, or use multiple-piece ties. Apply a corrosion inhibiting coating to the threads of all multiple-piece tie components before assembly. Bolt the female portion of the tie to the form prior to paving as depicted in the Standard Sheets. Insert and tighten the male ends before paving the adjacent lane. Ensure all threaded connections are tight.

First-stage saw cuts are not required between lanes paved separately.

3. **Untied Longitudinal Joints.** Construct untied longitudinal joints at utilities and/or drainage structures, at intersections, between adjacent lanes having non-parallel center lines (such as ramps), or where indicated in the contract documents. Form as depicted in the Standard Sheets. Transverse joint type, location, and alignment may be changed when a transverse joint intersects an untied longitudinal joint.

Patch honeycombing along the untied longitudinal joint face to achieve a smooth surface prior to applying the bond breaker and placing the adjacent concrete.

First-stage saw cuts are not required.

**C. Utility and Drainage Structures and Telescoping Manholes.** Detail jointing around each utility and drainage structure in the proposed joint layout submitted to the Engineer for approval. Refer to the Standard Sheets for jointing and reinforcement around utilities and drainage structures. When possible, do not isolate, or “box out,” utilities and drainage structures from the pavement. Instead, set and center utilities and drainage structures between transverse joints and pave the slab with the structure at the same time as the surrounding pavement. Use a minimum slab length, $L_{\text{min}}$, as defined in §502-3.06A, Transverse Joints. Reinforce the slab that contains the structure. Select reinforcement size and spacing such that:

$$A_s \geq 0.0018(s)(t)$$

where:

- $A_s$ = Area of a steel bar (in$^2$)
- $s$ = Spacing of steel bars (in). Minimum 3” clearance between bars.
- $t$ = Slab thickness (in)

Use mat reinforcement with steel in both directions. Use top and bottom double mat reinforcement for slabs thicker than 10”. Refer to the Standard Sheet for mat reinforcement placement locations.

When using telescoping manholes, remove temporary support bolts from the telescoping manhole casting as soon as the concrete hardens.
D. **Drill and Anchor Dowels or Ties.** Do not drill holes until the concrete has developed sufficient strength to withstand drilling without damage. Damage from drilling shall be addressed in accordance with §502-3.14, Damaged or Defective Concrete.

Drill such that the hole diameters are in accordance with the anchoring material manufacturer’s written recommendations. Replace worn bits when necessary to ensure the proper hole diameter is drilled.

Follow the anchoring material manufacturer’s written recommendations for cleaning the holes. As a minimum, clean the drilled holes with compressed air. Insert the nozzle to the back of the hole to force out all dust and debris.

When using new cartridges of anchoring material, ensure the initial material exiting the nozzle appears uniformly mixed. If it is not uniformly mixed, waste the material until uniformly mixed material extrudes.

Place the anchoring material in the back of the hole using a nozzle with sufficient reach. Push the dowel or tie into the hole while twisting such that the air pocket within the hole is heard to burst and the anchoring material is evenly distributed around the bar. Use sufficient amounts of anchoring material such that it slightly extrudes out the hole as the bar is inserted.

502-3.07 **Paving Adjacent To Existing Concrete.** Wherever paving equipment operates on existing PCC pavement that is to remain, install bolt-on track covers or rubber tired, flangeless wheels. Remove all debris on the existing PCC pavement in the equipment track. Immediately remove any concrete that spills onto the existing concrete.

When paving from (or to) a transverse construction joint or intersecting pavement, use hand-held vibrators to thoroughly consolidate any concrete inaccessible to the paving equipment vibrators. Hand finish these areas with the minimum effort required to produce an acceptable surface. Do not dump the grout box head into the pavement concrete when approaching a construction joint.

502-3.08 **Plastic Thickness Determination.** Provide the Engineer with a round, rigid, nonaluminum probe, having a 1/8 inch diameter. The Engineer will determine the plastic concrete thickness by inserting the probe and measuring the insertion depth. The Engineer will check thickness at least every 150 feet of paving and at least 2 feet from the placement edge. Keep several probes at the project.

The minimum measured plastic thickness must be equal to (-1/4 inch) or greater than the thickness required in the contract documents. Areas not meeting minimum thickness will be treated in accordance with §502-3.14, Damaged or Defective Concrete. If 2 consecutive measurements do not meet minimum thickness, stop paving and reestablish the paving operation to achieve acceptable thickness.

502-3.09 **Finishing.** Provide an ACI certified concrete flatwork finisher to supervise finishing. Provide proof of ACI flatwork certification to the Engineer.

Mechanically finish the pavement after consolidation and strike off. Use machine mounted finishers such as full-width finishing pans, transverse oscillating screeds, longitudinal floats, pan floats or separate pieces of equipment such as tube floats. Correct bumps with a 16 foot straight edge or bump cutter specifically made for finishing concrete.

After mechanical finishing, hand finish the pavement to correct and seal minor imperfections. Hand finish with magnesium floats, lutes, and/or trowels. Use work bridges to hand finish concrete inaccessible from the pavement edge. Keep hand finishing to a minimum. Do not use excess mortar or discarded concrete to fill low areas. Do not add water to the concrete surface to close imperfections. Do not trowel bleed water into the surface. Stop paving or reformulate the concrete mix if surface imperfections that require additional water to close routinely occur.

Ensure the saw cut operator can locate joint sealant locations between separate, adjacent placements. This may be accomplished with a small radius (1/4 inch) edger along the edge of the second placement.
502-3.10 Texturing. Immediately after finishing and prior to applying the curing compound, texture the concrete surface using one of the following procedures in accordance with the contract documents. Apply longitudinal tining if no texturing method is designated in the contract documents. Additional requirements, such as Mean Texture Depth measured by a sand patch test or a profiler may be performed to check texturing adequacy. For a closed drainage system, provide an 8 - 12 inch blank in the texture along the pavement edges to enhance drainage to catch basins.

A. Longitudinal Tining. Texture the concrete parallel to the pavement centerline with a set of evenly spaced spring steel tines. Use rectangular tines 1/8 inch wide, 1/32 inch thick, and approximately 5 inches long at a center-to-center spacing of 3/4 inches.

Operate the tine head manually or mechanically. In either case, hold the tines as near an angle of 45° to the concrete surface as possible to minimize mortar dragging. Produce tine texture 1/16 - 1/8 inch deep with minimal dislodging of aggregate. Do not make multiple tine passes in the same area. Keep tines 2 - 4 inches from the placement edges. Keep the tines free of hardened concrete.

B. Artificial Turf Drag. Use a seamless strip of artificial turf drag appearing on the Department's Approved List entitled “Turf Drag” under “Equipment, Concrete Related.” Produce a consistent texture, free of ridges or gouges, parallel to the pavement centerline either by hand or by attaching a weighted strip to the paver, texture/cure machine, or work bridge. Periodically replace or clean the drag to remove hardened concrete paste that compromises texture.

502-3.11 Curing. Apply curing compound no later than 5 minutes after texturing. The Engineer may stop paving if curing lags beyond the time limits noted. Cure Class C concrete placed between June 1 and September 15 for 4 days, minimum. Cure Class C concrete placed between September 16 and May 31 for 6 days, minimum. Cure HES or alternate mixes in accordance with Materials Bureau requirements based on the Contractor-submitted mix design and the trial batch evaluation.

A. White Pigmented Membrane Curing Compound. Cure concrete with white pigmented membrane curing compound. Mix the curing compound before each use and continuously agitate during use. Uniformly coat all exposed surfaces (including slipformed edges and formed edges immediately after form removal) at a minimum rate of 150 sf/gal such that the coated surfaces are completely white. Check the application rate after every paving day, including exposed vertical slab faces in the calculations. Apply the curing compound in 2 direction passes with no longer than 15 minutes between passes.

Immediately reapply curing compound to any damaged coating areas before the curing compound sets. During curing equipment breakdown, cure the pavement in accordance with §502-3.11B, Curing Covers. Do not apply curing compound in the rain. If rain damages the curing compound before it sets, reapply curing compound after the pavement surface dries.

B. Curing Covers. Use of curing covers is subject to the approval of the Engineer. Use quilted covers, plastic coated fiber blankets, or polyethylene curing covers. Do not use covers with tears or holes. Cover all exposed surfaces and extend the covers a minimum of 12 inches beyond the pavement edges or beyond the forms, when used. Overlap successive covers 12 inches, minimum. Secure the covers to keep them in contact with the entire surface and maintain the overlap. Wet the entire surface of quilted covers and maintain them in a wetted condition until pavement is eligible to be opened to construction traffic.

C. Cold Weather Curing. Supply form insulating materials for winter concreting when the air temperature is going to fall below 40°F at any time until pavement is eligible to be opened to construction traffic. Use material capable of maintaining a surface temperature of 55°F and being easily removed and replaced to accommodate first-stage saw cuts. Apply the insulating material to
prevent newly placed concrete from being exposed to air temperatures below 35°F for the curing period. Secure the insulation tight to the concrete surface to prevent air intrusion beneath the insulation. Extend the insulation 12 inches beyond the newly placed concrete. Insulate the pavement vertical edge and/or forms as well.

Place recording surface thermometers between the pavement surface and insulating material 12 inches from one of the placement edges wherever insulation is used. Use 4 equally spaced thermometers for each day’s paving. Do not subject the concrete to a temperature drop in excess of 50°F during the first 24 hours after removing the insulation.

502-3.12 Sealing Joints. Seal joints in accordance with the Standard Sheets.

First-stage saw cuts may be temporarily left unfilled if a placement is only subjected to occasional construction traffic, such as pickup trucks or cars. In this case, ensure debris does not enter the joints. Temporarily fill unsealed first-stage cuts with jute or backer rod if a placement is:

- Subjected to consistent construction traffic.
- Used as a haul road for subsequent concrete placements.
- Temporarily opened to general traffic while final sealing has been delayed for convenience, such as to maximize sealing production.

Before cleaning, remove any temporary fillers and repair damaged joints in accordance with §502-3.14, Defective or Damaged Concrete, including chipped joints resulting from debris accumulation in an unfilled or unsealed joint.

A. Highway Joint Sealant. Widen joints to 1/4 - 3/8 inch for a depth of 1 inch to allow full-depth sealing. Immediately wash the widening cut slurry from the pavement such that it does not reenter the joint.

Clean the joints by abrasive blasting before sealing. Keep the nozzle within 2 inches of the joint surfaces. If the project does not allow abrasive blasting, The Engineer may allow pressure washing as an alternate preparation method. When pressure washing, use (1) a 900 psi minimum pressure and (2) a maximum pressure such that no damage occurs to the concrete. Manually dislodge debris remaining in the joint after cleaning, and reclean the joint. Immediately after pressure washing, air blast the joint to remove any debris from the cut and dry the exposed faces. Ensure the joint is completely dry before sealing.

Do not allow any traffic on the pavement between cleaning and sealing. Reclean the joint if it rains between cleaning and sealing or if any traffic is on the placement between cleaning and sealing.

Provide the Engineer a copy of the sealant Manufacturer’s written recommendations for heating and application at least 1 work day before sealing. Follow those recommendations. Unless stated otherwise, the recommended pouring temperature is 40°F below the manufacturer's designated safe heating temperature, with an allowable variation of 40°F.

Prior to sealing, discharge sealant from the applicator wand into a vessel and measure the sealant temperature. The temperature must be equal to or above the Manufacturer’s recommended minimum pouring temperature and equal to or below the Manufacturer’s recommended safe heating temperature.

Do not use sealant heated above the safe heating temperature. Sealant may be reheated or heated in excess of 6 hours if allowed by the Manufacturer’s heating and application recommendations. In these cases, recharge the melter with fresh sealant amounting to at least 20% of the sealant volume remaining in the melter.

Seal joints immediately after cleaning. Seal the joint from the bottom of the cut to within 1/2 inch of the pavement surface. Seal when the:

- Air and surface temperatures are 40°F or warmer.
- Air temperature is above the dew point.
Pavement surface and all joint surfaces are dry. Open to traffic after the sealant has cured to prevent tracking. Do not blot with fine aggregate.

**B. Sealing Joints - Preformed Joint Sealers.** Make second-stage saw cuts and/or bevels in accordance with the Standard Sheets and (1) no sooner than 72 hours after concrete placement and (2) after the curing period has ended if curing covers are used. Extend the second-stage saw cut vertically down the free concrete edges. Wash the resulting slurry from the pavement and joint immediately after making second-stage saw cuts and/or bevels.

Second-stage saw cuts may be delayed for convenience, but do not leave second-stage saw cuts unsealed or unfilled while open to any traffic. Temporarily fill second-stage saw cuts with jute or backer rod if (1) they are exposed to any traffic before cleaning and sealing or (2) weather conditions are not favorable for timely (within 2 calendar days) cleaning and sealing, whether or not they are exposed to any traffic.

Clean the joints by pressure washing before sealing. Use (1) a 900 psi minimum pressure and (2) a maximum pressure such that no damage occurs to the concrete. Manually dislodge debris remaining in the joint after cleaning, and reclean the joint. Within 24 hours of pressure washing, air blast the joint to remove any debris from the cut and dry the exposed faces. Reclean the joint if it rains between cleaning and sealing. Do not allow any traffic on the pavement between cleaning and sealing.

Install the sealant in accordance with the Manufacturer’s written instructions. Lubricate the concrete, the sealer, or both before installation such that the lubricant fully covers the sealer/concrete interface, but not the top of the sealer.

Install one piece of transverse joint sealer in a compressed condition across the full pavement width, including concrete shoulders, and down the vertical saw cut at the free edge. Cut the longitudinal sealer where it crosses a transverse joint. Do not splice the longitudinal sealer between transverse joints. Seal the intersection between longitudinal and transverse sealers with lubricant.

Install the sealer such that it is not stretched more than 5%, nor compressed more than 2%, of the minimum theoretical length. Check the installation for stretch and compression by installing sealers in 5 transverse joints and removing the sealer immediately after installation and checking the length. An alternate method for checking stretch and compression, where applicable, may be performed by premarking or precutting the sealer to length prior to installation. If the measurement of any of these 5 sealers exhibits stretching in excess of 5% or compression in excess of 2%, modify the installation method to meet the requirements or discontinue installation.

Once sealing operations begin, remove 1 joint per 100 in the presence of the Engineer to check stretch and compression. If the sealer is found to be stretched in excess of 5% or compressed in excess of 2%, remove the sealer material from successive joints in both directions until sealers are found that meet the stretch and compression requirements. Replace all joints sealers found with excess stretch or compression. Replace joint sealers removed and found to meet the stretch and compression requirements.

**502-3.13 Pavement Protection.** Protect the pavement and appurtenances from traffic and construction operations. Protect the work and provide for traffic as indicated in the contract documents.

**502-3.14 Damaged or Defective Concrete.** The Engineer will identify all areas of damaged and defective concrete. Submit a repair plan for the damaged or defective concrete to the Engineer for approval. Repair or replace all damaged or defective concrete in accordance with the approved repair plan. Damage and defects include, but are not limited to, cracking, spalling, poor consolidation, out of specification materials, or imperfections caused by inadequate pavement protection, traffic, and/or construction practices. Slipformed concrete with inadequate plastic thickness as described in §502-3.08, Plastic Thickness Determination, will be rejected in 150 foot segment lengths.
502-3.15 Hardened Surface Tolerance. After the concrete has hardened sufficiently, test each travel lane, including ramps, with straight edges laid both longitudinally and transversely. Do not measure transverse deviations across longitudinal joints. The Engineer will mark longitudinal deviations in the pavement surface exceeding 1/4 inch in 15 feet and transverse deviations exceeding 1/4 inch in 10 feet. Diamond grind these deviations in accordance with §505-3.02, Bump Grinding, such that they do not exceed these parameters when retested.

Shoulders and other areas not routinely exposed to traffic must meet 1/4 inch in 10 feet both longitudinally and transversely.

502-3.16 Opening to Traffic

A. Construction Traffic. Open Class C concrete pavement to construction traffic and paving equipment at least 7 days after placement. With the Engineer’s approval, the time may be shortened to 3 days if cylinders meet the requirements of Table 502-3 Pavement Opening Requirements. Any pavement damaged from opening to construction traffic in a reduced time frame will be treated in accordance with §502-3.14, Damaged or Defective Concrete.

B. General Traffic. Open Class C concrete pavement to general traffic placed between June 1 and September 15 at least 10 days after placement. Open Class C concrete pavement to general traffic placed outside of the above dates at least 15 days after placement.

With the Engineer’s approval, these times may be shortened to 4 days if cylinders meet the requirements of Table 502-3 Pavement Opening Requirements, and the joints are addressed in accordance with §502-3.12, Sealing Joints.

Any pavement damaged from opening to general traffic in a reduced time frame will be treated in accordance with §502-3.14, Damaged or Defective Concrete.

<table>
<thead>
<tr>
<th>TABLE 502-3 PAVEMENT OPENING REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>All the Following Must Apply:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Minimum Average compressive strength of all cylinder pairs</td>
</tr>
<tr>
<td>2500 psi</td>
</tr>
<tr>
<td>Minimum Average compressive strength of each cylinder pair</td>
</tr>
</tbody>
</table>

Note: Automobile only areas may be opened at 1500 psi.

C. Project Strength Determination. Provide an ACI Certified Concrete Field Testing Technician, Grade I, or higher, to cast all cylinders. Unless otherwise noted in the contract documents, use an agency accredited by the AASHTO Accreditation Program (AAP) in the field of construction materials testing of portland cement concrete to perform compressive strength testing. Cast and test in the presence of the Engineer, or the Engineer’s representative. Provide acceptable proof of ACI Certification and AASHTO Accreditation to the Engineer before placing any concrete.

The Engineer, or the Engineer’s representative, will complete the Concrete Cylinder Report as cylinders are cast and tested.

Cast a minimum of 3 cylinder pairs (6 total) from each 1000 feet of paving length, or fraction thereof, in accordance with Materials Method 9.2, Field Inspection of Portland Cement Concrete. Cast each pair from different delivery trucks. Develop an Engineer-approved marking system that allows a cylinder to be readily associated with the corresponding placement location and placement time. Mark the cylinders and place them adjacent to the pavement under similar curing conditions. Determine the concrete compressive strength at the desired time in accordance with ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. The pavement may be opened to construction (or general) traffic if all the cylinders meet the requirements of Table 502-3 Pavement Opening Requirements.
If these conditions are not met, test 3 additional cylinder pairs at a later time, provided the appropriate numbers of additional cylinders were cast. If the above conditions are not met after additional testing, or, if the required number of additional cylinders were not cast, open the pavement in accordance with the nonreduced time frames of §502-3.16A, Construction Traffic, and §502-3.16B, General Traffic.

**D. HES Concrete.** Open HES concrete pavements to construction traffic or general traffic based on the requirements of Table 502-3 Pavement Opening Requirements, and if the joints have been addressed in accordance with §502-3.12, Sealing or Filling Joints.

**E. Maturity.** ASTM C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method, may be used to open the pavement to traffic. Inform the Engineer of the intent to use this method at least 28 days before producing any pavement concrete. Submit a maturity curve development plan to the Engineer that includes an equipment list, the date and time of batching, the testing facility name and address, which must meet §502-3.16C, Project Strength Determination, requirements, and any variations to ASTM C1074. Perform all batching and testing related to developing the maturity curve with the Engineer and Regional Materials Engineer present. Open to traffic at the strengths identified in Table 502-3 Pavement Opening Requirements.

**502-4 METHOD OF MEASUREMENT.** The Engineer will measure the following quantities for items incorporated into the finished pavement:

**502-4.01 PCC Pavement, Unreinforced.** The work will be measured for payment as the number of cubic yards of unreinforced PCC pavement placed based on the payment lines shown in the contract documents, to the nearest cubic yard. Deductions will be made for catch basins, manholes, or other similar pavement obstructions requiring either mesh reinforced or heavily reinforced placements.

**502-4.02 PCC Pavement, Mesh or Heavily Reinforced.** The work will be measured for payment as the number of cubic yards of reinforced concrete placed. No deductions will be made for drainage and utility structures or other similar pavement obstructions within the placement.

**502-4.03 Transverse Joints.** The work will be measured for payment as the number of feet of transverse joints constructed that contain load transfer devices.

**502-4.04 Longitudinal Joints.** The work will be measured for payment as the number of feet of longitudinal joints satisfactorily constructed that contain longitudinal joint ties.

**502-4.05 Sealing Transverse Joints.** The work will be measured for payment as the number of feet of transverse joints sealed, excluding preformed sealers turned down at the pavement edges.

**502-4.06 Sealing Longitudinal Joints.** The work will be measured for payment as the number of feet of longitudinal joints satisfactorily sealed.

**502-5 BASIS OF PAYMENT**

**502-5.01 This subsection is intentionally blank.**

**502-5.02 PCC Pavement, Unreinforced.** Include the cost of all labor, material, and equipment necessary to perform the work, including first-stage saw cuts, in the unit price bid for PCC Pavement, Unreinforced. No payment will be made for areas that do not meet minimum plastic thickness requirements.
502-5.03 **PCC Pavement, Mesh or Heavily Reinforced.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work, including first-stage saw cuts, in the unit price bid for PCC Pavement, Mesh or Heavily Reinforced. No payment will be made for areas that do not meet minimum plastic thickness requirements.

502-5.04 **Transverse Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Transverse Joints.

502-5.05 **Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Longitudinal Joints. Placing the inside shoulder and inside lane simultaneously, at the Contractor’s option, will not generate a Significant Change in the Character of Work. No additional payment will be provided for the additional number of longitudinal joint ties associated with:
- Constructing butt joints between lanes placed separately in a slipform paving operation.
- Constructing longitudinal joints in wheelpaths.

502-5.06 **Sealing Transverse Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Sealing Transverse Joints.

502-5.07 **Sealing Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Sealing Longitudinal Joints. Placing the inside shoulder and inside lane simultaneously, at the Contractor’s option, will not generate a Significant Change in the Character of Work.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>502.RCFL</td>
<td>PCC Pavement</td>
<td>Cubic Yard</td>
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<td><strong>R – Pavement Reinf.</strong></td>
<td></td>
</tr>
<tr>
<td>0 – Unreinforced</td>
<td>1 – <strong>C – Concrete Class</strong></td>
<td>1 – <strong>F – Friction Type</strong></td>
</tr>
<tr>
<td>1 – Mesh Reinforced</td>
<td>2 – <strong>Performance</strong></td>
<td>2 – Type 2</td>
</tr>
<tr>
<td>2 – Heavily Reinforced</td>
<td>3 – <strong>HES</strong></td>
<td>3 – Type 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 – Type 9</td>
</tr>
<tr>
<td>502.91</td>
<td>Transverse Joints</td>
<td>Foot</td>
</tr>
<tr>
<td>502.9110</td>
<td>Longitudinal Joints</td>
<td>Foot</td>
</tr>
<tr>
<td>502.9201</td>
<td>Sealing Transverse Joints – Preformed Elastic Joint Sealer</td>
<td>Foot</td>
</tr>
<tr>
<td>502.9210</td>
<td>Sealing Transverse Joints – Highway Joint Sealant</td>
<td>Foot</td>
</tr>
<tr>
<td>502.9301</td>
<td>Sealing Longitudinal Joints – Preformed Elastic Joint Sealer</td>
<td>Foot</td>
</tr>
<tr>
<td>502.9310</td>
<td>Sealing Longitudinal Joints – Highway Joint Sealant</td>
<td>Foot</td>
</tr>
</tbody>
</table>

**SECTION 503 - PORTLAND CEMENT CONCRETE FOUNDATION FOR PAVEMENT**

*Last Revised May, 2019*

503-1 **DESCRIPTION.** Construct a portland cement concrete (PCC) foundation for pavements and shoulders, if required, as detailed in the contract documents.

503-2 **MATERIALS.**
Apply the requirements of §502-2 Materials.

503-3 CONSTRUCTION REQUIREMENTS. Apply the requirements of §502-3 Construction Details except as modified herein.

503-3.01 Placement of Reinforcement. Place bar reinforcement around utilities, drainage structures, and other projections into the pavement as depicted in the Standard Sheets for PCC Pavements. Use telescoping manholes when required by the contract documents in accordance with §502-3.06C, Utility and Drainage Structure Isolation Joint Systems and Telescoping Manholes.

503-3.02 Joints. Transverse joint supports are not required for contraction joints. Saw cut skewed contraction joints at a “6 on 1” skew across the pavement (approximately 10° from perpendicular to the centerline) before uncontrolled cracking occurs. Saw cut in accordance with the first-stage saw cut details in the Standard Sheets.

Use a maximum joint spacing of 20 feet and a minimum spacing that satisfies the geometric requirements of §502-3.06A, Transverse Joints. Center utilities and drainage structures between saw cuts. Skewed joints may be cut at the same angle across the pavement or chevron-shaped with the vertex at a longitudinal joint between separate placements. Maintain the same technique once selected. Construct transverse construction joints perpendicular to the centerline in accordance with §502-3.06A3, Transverse Construction Joints.

Construct longitudinal joints in accordance with §502-3.06B, Longitudinal Joints.

503-3.03 Finishing. Hand finish the pavement to correct surface irregularities.

503-3.04 Testing the Surface. Immediately after placement, test the entire longitudinal center of each travel lane with a 10 feet, minimum, long straight edge laid longitudinally. Immediately correct any surface irregularity exceeding 3/8 inches in 10 feet.

503-3.05 Texturing. Immediately after testing the surface, apply an aggressive transverse broom finish.

503-3.06 Curing. Cure in accordance with §502-3.11 Curing, except the impervious membrane method, i.e., curing compound, is not permitted.

503-3.07 Sealing Joints. Typically, no joint sealing is required in the PCC foundation course. Seal skewed contraction joints in accordance with §502-3.12A, Sealing Transverse Contraction Joints – Highway Joint Sealant, if a construction delay occurs that prevents the placement of the final pavement course until the subsequent construction season.

503-4 METHOD OF MEASUREMENT.

503-4.01 Portland Cement Concrete Foundation for Pavement. The work will be measured for payment as the number of cubic yards of Portland Cement Concrete Foundation for Pavement based on the payment lines shown in the contract documents. No deductions will be made for catch basins, manholes, or other similar pavement obstructions.

503-4.02 Constructing Longitudinal Joints. The work will be measured for payment as the number of feet of longitudinal joints constructed.

503-5 BASIS OF PAYMENT.
503-5.01 Portland Cement Concrete Foundation for Pavement. Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Portland Cement Concrete Foundation for Pavement. No payment will be made for areas that do not meet minimum plastic thickness requirements as described in §502-3.08, Plastic Thickness Determination. No additional payment will be made for Contractor-requested HES concrete mixes.

503-5.02 Constructing Longitudinal Joints. Include the cost of all labor, material, and equipment necessary to perform the work in the unit price bid for Constructing Longitudinal Joints.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>503.1010</td>
<td>PCC Foundation for Pavement, Class C</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>503.1011</td>
<td>PCC Foundation for Pavement, Class F</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>503.1012</td>
<td>PCC Foundation for Pavement, HES Concrete</td>
<td>Cubic Yard</td>
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<tr>
<td>503.9110</td>
<td>Constructing Longitudinal Joints in Foundation Pavement</td>
<td>Foot</td>
</tr>
</tbody>
</table>

SECTIONS 504 THRU 549 (VACANT)

SECTION 505 – DIAMOND GRINDING
(New Section May, 2019)

505-1 DESCRIPTION. Diamond grind portland cement concrete (PCC) or hot mix asphalt (HMA) surfaces in accordance with the contract documents.

505-2 MATERIALS. Provide the Engineer with a list of equipment and their specifications at least 7 days before the planned start of diamond grinding. Maintain the equipment in proper working order. Immediately replace any out-of-round wheels. Do not use equipment that causes raveling, aggregate fractures, or joint deterioration.

505-2.01 Production Diamond Grinding Equipment. For projects having grinding quantities over 3,000 yd², use a self-propelled machine specifically designed for grinding that meets the following:

- Equipped with 50 – 60 gang-mounted diamond saw blades per foot on a multi-blade arbor capable of producing a 3 foot wide, minimum, strip of ground surface.
- Having blade spacers with a minimum thickness of 0.105 inches.
- Equipped with a vacuum system capable of removing the grinding slurry from the surface, leaving the surface in a clean, near-dry condition.
- Weighing a minimum of 35,000 pounds with the grinding head.
- Having a minimum effective wheel base (distance between the transverse pivot points of the front wheel assembly and the profile/depth-control/ground drive wheels) of 12 feet.

505-2.02 Bump Grinding Equipment. Use equipment meeting §505-2.01 Production Diamond Grinding Equipment, except the equipment must weigh at least 17,000 pounds. This equipment may only be used for grinding quantities of 3,000 square yards, or less.

505-3 CONSTRUCTION DETAILS.

505-3.01 General. Provide at least one 10-foot straightedge and one 15-foot straightedge to the Engineer before paving begins. Diamond grind longitudinally, beginning and ending at lines normal to the centerline, and in full travel lane width increments. Provide surface drainage by maintaining the proper cross slope and by blending adjacent passes. Grind such that there is no unground area between passes and the passes...
do not overlap by more than 1 inch. Remove unbroken fins 3/16” high by 4” long or larger at no additional cost to the Department.

Continuously vacuum the slurry leaving a clean, near-dry condition. If roadside slurry discharge is not allowed, transfer the slurry into equipment capable of transporting it away without spills. Dispose of slurry in accordance with §107-10 Managing Surplus Material and Waste. Do not allow slurry to enter occupied travel lanes, drainage structures, wetlands, streams, estuaries, or sensitive environmental resources, or areas where it will become a public nuisance.

505-3.02 Bump Grinding. Use production grinding equipment or bump grinding equipment. Test the ground surface using a 15 foot straightedge laid longitudinally and a 10 foot straightedge laid transversely. Re-grind areas that exceed ¼ inch high in 15 feet longitudinally and/or ¼ inch high in 10 feet transversely. Grind such that there is no more than a 1/16 inch vertical differential between the adjacent sides of transverse joints and cracks.

505-3.03 Production Grinding – New PCC Pavement. Grind such that a minimum of 95% of the surface of new PCC pavement is ground. Grind the transitions between the travel lanes and shoulders, auxiliary lanes, ramps, and/or other unground areas, such that proper surface drainage is achieved and there are no longitudinal ridges exceeding 3/16 inch. After grinding, collect, analyze, and report pavement ride quality data in accordance with Section 653 Pavement Ride Quality. Grind such that each Pavement Ride Quality (PRQ) lot meets Table 505-1, New PCC Pavement Smoothness Requirements.

| TABLE 505-1 NEW PCC PAVEMENT SMOOTHNESS REQUIREMENTS |
|-----------------------------|------------------|
| International Roughness Index (IRI) | ≤ 70 inches per mile |
| Localized Roughness (LR)1 | ≤ 135 inches per mile |

Note 1: When determined using the ProVAL assurance module with a 25 foot baseline.

505-3.04 Production Grinding for Pavement Preservation. For pavements with posted speeds of 45 mph or greater, obtain a control profile in accordance with Section 653 Ride Quality before performing corrective work. Use the control profile to identify the maximum post-grind IRI for each PRQ lot as indicated in Table 505-2 Pavement Preservation Smoothness Requirements. Re-grind as necessary to achieve the smoothness.

Grind such that at least 95% of the surface is diamond ground and there is no more than a 1/16 inch vertical differential between the adjacent sides of transverse joints and cracks. Grind the transitions between the travel lanes and shoulders, auxiliary lanes, ramps, and/or other unground areas, such that proper surface drainage is achieved and there are no longitudinal ridges exceeding ¼ inch.

For pavements with posted speeds less than 45 mph, the Engineer will test the ground surface using a 15 foot straightedge laid longitudinally and a 10 foot straightedge laid transversely. Re-grind areas exceeding ¼ inch high in 15 feet longitudinally and/or ¼ inch high in 10 feet transversely. Do not test across longitudinal joints or outside the ground area.

After grinding, re-profile the surface using the same equipment, methods, and PRQ lots used to develop the control profile, ensuring that the profile PRQ lot locations match the control PRQ lot locations.

| TABLE 505-2, PAVEMENT PRESERVATION SMOOTHNESS REQUIREMENTS |
|-----------------------------|------------------|
| Control Profile PRQ Lot IRI | ≤ 180 | > 180 |
| Required Post-Grind IRI | ≤ 90 | ≤ 0.50 x (Control IRI) |
In addition to meeting the smoothness requirements of Table 505-2, grind such that:

- For pavements with posted speeds of 45 mph or more, the Localized Roughness (LR) will be less than or equal to 135 inches per mile when determined using the ProVAL Assurance Module with a 25 foot baseline.
- The post-grind cross slope mirrors the pre-grind cross slope with no depressions or misalignment exceeding ¼ inch in 10 feet when measured with a 10 foot straightedge placed perpendicular to the centerline.
- Wheelpath rutting is removed such that the texture is consistent across the lane.

Determine a smoothness quality adjustment for each PRQ lot if that item is included in the contract documents.

505-4 METHOD OF MEASUREMENT.

505-4.01 Bump Grinding. The quantity to be measured for payment will be in square yards of surface bump ground. Only bump grinding associated with pavement restoration repairs will be measured for payment.

505-4.02 Production Grinding of New Pavement. The quantity to be measured for payment will be in square yards of surface diamond ground.

505-4.03 Production Grinding for Pavement Preservation. The quantity to be measured for payment will be the number of square yards of surface ground. No deductions will be made for isolated, unrepaired settlements.

505-4.04 Smoothness Quality Adjustment. The quantity to be measured will be the number of Quality Units of Smoothness Quality Adjustment, if any, payable for each ground PRQ lot determined by the following:

\[
\text{Quality Units (per PRQ lot)} = (\text{SAF} - 1.00) \times \text{PRQ lot area}
\]

The Smoothness Adjustment Factor (SAF) from Table 505-3 Smoothness Adjustment Factors, is based on the percent improvement in IRI between the control profile and the post-grind profile.

<table>
<thead>
<tr>
<th>IRI Improvement (%)</th>
<th>Smoothness Adjustment Factor (SAF)</th>
</tr>
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<tbody>
<tr>
<td>≥ 65</td>
<td>1.10</td>
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<tr>
<td>60 – 64</td>
<td>1.07</td>
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<tr>
<td>55 – 59</td>
<td>1.05</td>
</tr>
<tr>
<td>50 – 54</td>
<td>1.00</td>
</tr>
</tbody>
</table>

505-5 BASIS OF PAYMENT.

505-5.01 Bump Grinding. The unit bid price shall include the cost of all labor, materials, and equipment necessary to complete the work.
505-5.02 Production Grinding of New Pavement. The unit bid price shall include the cost of all labor, materials, and equipment necessary to complete the work.

505-5.03 Production Grinding for Pavement Preservation. The unit bid price shall include the cost of all labor, materials, and equipment necessary to complete the work.

505-5.04 Smoothness Quality Adjustment. Quality Units for Smoothness Quality Adjustment are a fixed price in the bid documents.

Payment of Quality Adjustments will be made based on the Smoothness Adjustment Factor (SAF) multiplied by the fixed index price for Quality Adjustment Items listed in the contract documents for the quantity placed on the day the Quality Units represent.

Payment will be made under:

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<thead>
<tr>
<th>Item No.</th>
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<tr>
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<td>505.0102</td>
<td>Bump Grinding - PCC with Slurry Removal</td>
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<td>Production Grinding – New PCC Pavement</td>
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<td>505.0403</td>
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</table>
Section 550
STRUCTURES

SECTION 551 - PILES AND PILE DRIVING EQUIPMENT

551-1 DESCRIPTION

551-1.01 General. This work shall consist of furnishing and installing piles of the type and size and at the locations indicated in the contract documents, or as directed by the Engineer. Timber piles are not covered under this specification.

551-1.02 Steel H-Piles. This work shall consist of furnishing and installing steel H-Piles of the type and size and at the locations indicated in the contract documents, or as directed by the Engineer.

551-1.03 Cast-In-Place Concrete Piles. This work shall consist of furnishing and installing cast-in-place concrete piles of the type and size and at the locations indicated in the contract documents, or as directed by the Engineer.

551-1.04 Furnishing Equipment for Driving Piles. This work shall consist of furnishing equipment at the site for driving piles.

551-1.05 Dynamic Pile Load Testing. This work shall consist of furnishing equipment and personnel for dynamic pile tests conducted by the Department.

551-1.06 Splices. These are contingent items and shall apply only when the Engineer directs the Contractor to drive a pile more than 10 feet beyond the estimated length provided in the Contract Plans.

551-2 MATERIALS

551-2.01 General. Materials for piling shall conform to the requirements of the following subsections of Section 700 Materials and Manufacturing:

<table>
<thead>
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<th>Material Description</th>
<th>Section</th>
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<tr>
<td>Bar Reinforcement, Grade 60</td>
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<tr>
<td>Casings for Cast-in-Place Concrete Piles</td>
<td>720-03</td>
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<tr>
<td>Steel H-Piles</td>
<td>720-04</td>
</tr>
<tr>
<td>Pile Shoes</td>
<td>720-05</td>
</tr>
<tr>
<td>Mechanical Pile Splices</td>
<td>720-06</td>
</tr>
</tbody>
</table>

551-2.02 Steel H-Piles. Steel H-Piles shall meet the requirements of §720-04 Steel H-Piles.

551-2.03 Cast-In-Place Concrete Piles

A. Casings for Cast-In-Place Concrete Piles. Casings for Cast-In-Place Concrete Piles shall meet the requirements of §720-03 Casings for Cast-In-Place Concrete Piles.

B. Concrete for Cast-In-Place Piles. Concrete placed in the Cast-In-Place Piles shall comply with requirements specified for Class A Concrete in Section 501 Portland Cement Concrete.
C. Cast-In-Place Concrete Pile Dimensions. Pile dimensions, including the rate of taper for tapered piles, shall be as shown in the contract documents, or as approved by the DCES. In no case, however, shall the outside diameter at the toe be less than 8 inches nor shall the outside diameter at the section to be cut off be less than 12 inches.

The Contractor shall furnish the type of pile casing shown in the contract documents. No used pipe or shell will be permitted.

551-2.04 Furnishing Equipment for Driving Piles. None Specified

551-2.05 Dynamic Pile Load Testing. None Specified

551-2.06 Splices. Mechanical Pile Splices shall meet the requirements of §720-06 Mechanical Pile Splices

551-3 CONSTRUCTION DETAILS

551-3.01 General. The method of storing and handling of piles shall be such as to avoid damage to the piles. Piles shall not be driven until after the excavation is completed to the elevation required for the bottom of the footing or bottom of tremie. Unless otherwise shown on the Plans, any material forced up or depressions made by the driving shall be removed or filled and the correct elevation of foundation established before any concrete is placed.

The driving of piles shall be done with an air/steam, diesel, or hydraulic hammer. Piles shall be driven starting from the center of the foundation and proceeding outward from this point, or starting at the outside row and driving progressively across the foundation.

The length of piles will be determined in the field by driving to the driving criteria determined by the DCES. Piles may be completely driven in one operation or, if directed by the DCES, be partially driven and allowed to set from 2 to 24 hours (or as indicated on the Plans) before driving is resumed.

Piles shall be vertical or accurately battered as indicated on the Contract Plans. The top of any pile driven its full length into the ground shall not vary from the plan location by more than 4 inches, unless otherwise shown on the Plans. The top of any pile partially exposed or included in an integral abutment shall not vary from the plan location by more than 1 inch, unless otherwise shown on the Plans. Piles may have a variation at their tip of not more than ¼ inch per foot from the vertical or from the batter shown on the Plans or permitted by the DCES.

All piles forced up by any cause shall be driven again, at no additional cost to the State.

The following shall be causes for rejection of a pile:

- Pile location or batter is incorrect.
- Pile damaged from any cause whatsoever.
- Pile fails to attain the driving resistance determined by the DCES, or the driving resistance set forth in the contract documents.
- Pile tip elevation is not within the limits called for in the contract documents.
- Pile is unserviceable for other reasons related to the furnishing and installing of the pile.
- Cast-In-Place Concrete Pile Casing not free from water.

No footing concrete shall be placed until all piles within the footing are inspected by the Engineer. The Contractor shall remove rejected piles, or at the option of the Department, a second pile may be driven adjacent thereto, if this can be done without impairing the structure.

The tops of all piles and pile casings shall be cut off at the elevation indicated on the Plans, or as established by the Engineer. The cut shall be clean, level, and to a true plane, in accordance with the detail shown on the Plans.
All cavities left by the pile driving operation shall be backfilled.

551-3.02 Steel H-Piles. Steel H-Piles shall be furnished with a shoe, fabricated as detailed on the Plans, or as approved by the DCES. Substitution of commercial shoes for those detailed on the Plans may be permitted subject to the approval of the DCES. Unless shown on the Plans, the shoes shall be attached by a NYSDOT Certified Welder with a 5/16 inch minimum fillet weld along the entire outside edge of the flanges.

551-3.03 Cast-In-Place Concrete Piles. Pile casings which do not hold their original form during driving, which fracture, or fail during driving due to manufacturer defect, fabrication, or Contractor's operations, unless otherwise directed, shall be replaced at no additional cost to the State. If, at any time during the driving or placing of the pile casings, the DCES determines from the results of the driving that the pile casings of the type or thickness being used cannot be satisfactorily placed, the Contractor shall remove the casings, and replace them with casings of the type and thickness directed at the expense of the State.

All pile casings shall be equipped with a toe treatment as shown on the Plans. Cast-in-place concrete piles shall be reinforced as shown on the Plans and the reinforcement secured in such a manner as to ensure its proper location in the finished piles.

Cast-in-place concrete pile casings shall be inspected immediately prior to placing concrete in the casing. All casings in the footing shall be satisfactorily placed and dry before concrete is placed. Each casing shall be filled with a continuous pour of Class A concrete, mixed and placed in accordance with Section 555 Concrete for Structures, except that the slump of the concrete shall not exceed 5 inches.

Care shall be exercised in filling the piles to prevent honeycomb and air pockets from forming in the concrete. Internal vibrators and other means shall be used to the maximum depth practicable to consolidate the concrete.

All exposed pile or pile casing surfaces not embedded in concrete shall be painted in accordance with the Contract Documents.

551-3.04 Furnishing Equipment for Driving Piles. The Contractor shall submit to the DCES for approval Form BD 138 Pile Driving Equipment Data a minimum of 21 calendar days prior to beginning pile driving work. Each separate combination of pile and pile driving equipment proposed by the Contractor shall require the submission of a corresponding Form BD 138.

Piles shall be driven only with equipment which has the prior approval of the DCES. All malfunctioning equipment shall be removed from the site and be replaced with equipment which is satisfactory to the DCES. The minimum rated striking energy of the hammer to be used in driving Steel H-Piles and Cast-In-Place Concrete Piles shall be 13 kip-feet per blow.

Hammers having greater striking energy may be used upon approval by the DCES. These hammers shall produce a minimum of 20 blows/foot and a maximum of 120 blows/foot at the Nominal Pile Resistance shown on the Contract Plans. However, if, in the opinion of the DCES, satisfactory results are not obtained with the hammer furnished by the Contractor, a hammer meeting the approval of the DCES shall be furnished and used.

Water jets and vibratory hammers shall not be used in driving any pile, unless written approval is given by the DCES. Piles installed with a water jet or vibratory hammer shall be impact driven to secure the final penetration.

A. Air/Steam Hammers. Sufficient boiler or compressor capacity shall be provided at all times to maintain the rated speed of air/steam hammers during the full time of pile driving. The valve mechanism and other parts of a single or double-acting hammer shall be maintained such that the number of blows per minute for which the hammer is designated, is satisfied.
B. Diesel Hammers. Single acting hammers’ valves, pumps, ports, rings, and other hammer parts shall be maintained such that the length of stroke, or blows per minute is satisfied. All diesel hammers shall be provided with an acceptable means of measuring hammer energy.

C. Hydraulic Hammers. Hydraulic hammers that have enclosed rams, shall be equipped with an electronic printout. Those which have exposed rams, shall be visually inspected.

D. Hammer Cushion. An approved hammer cushion block shall be used to transfer pile hammer energy to the pile. Each hammer shall be equipped with a helmet/drive head to fit the type of pile to be driven. The hammer cushion will be inspected for compliance with the description in the BD 138 prior to driving the first pile, and thereafter every 100 hours of driving. The hammer cushion will be re-inspected if a hammer with a different serial number is brought to the project.

E. Pile Driving Leads. Pile driving leads shall be constructed in such a manner as to afford freedom of movement of the hammer. The use of either swinging or hanging leads will be permitted provided the pile or leads are properly supported during driving and the required final position and batter of pile is achieved. If the use of swinging or hanging leads produces unsatisfactory results, the Contractor shall hold the leads in position with guys or braces to give the required support or use equipment having fixed leads. Pile driving leads shall be of sufficient length so that the use of a follower will not be necessary. The driving of piles with followers will generally not be permitted and shall be done only with written permission and direction of the DCES. When directed by the Engineer, approved steel spuds shall be used to penetrate consolidated material or obstructions in the upper 10 feet in order to assist in driving the piles to the required depth and resistance. Augers may be used for this purpose with written approval from the DCES.

551-3.05 Dynamic Pile Load Testing. Dynamic pile load tests will be conducted by the Department under the direction of the DCES. The Contractor shall furnish a source of electrical power, a suitable test enclosure to perform field testing of piles and evaluate pile hammer efficiency and all incidental labor and material necessary to make the work area accessible. Tests shall be performed at the locations indicated on the Contract Plans and where directed by the Engineer. A Dynamic Pile Load Testing Procedure, known as the "Impact Driving Method", will be used. This procedure entails the following steps:

1. Prior to being struck with the pile driving hammer, each pile to be tested will be instrumented with strain and acceleration transducers by State personnel, aided by the Contractor's forces.
2. Dynamic measurements resulting from the pile hammer blows will be automatically recorded on a pile driving analyzer supplied by the State and operated by State personnel.
3. Upon determination by the Engineer that valid data has been recorded, State personnel, assisted by the Contractor's forces, will remove the instrumentation.

The Contractor will schedule equipment movements to ensure that testing is done as part of the normal driving schedule, insofar as it is possible.

551-3.06 Splices. Full length piles shall always be used where practicable. Pile splices shall be constructed as shown in the contract documents, or as approved by the DCES. Where splices are unavoidable, their number, locations, and details will be subject to the approval of the DCES. Pile splices at less than 10 feet beyond the estimated length shall be installed at no additional cost to the State. A second splice may be used at 30 feet beyond the estimated length, subject to DCES approval.
Splices to steel H-Piles, and steel pile casings shall be welded in conformance with the provisions of the Steel Construction Manual (SCM). These requirements include, but are not limited to, a NYS certified welder and a DCES approved welding procedure.

Where design considerations and soil characteristics permit, the DCES may approve the use of a mechanical splice in lieu of a welded splice. The mechanical couplings used for such splices shall be subject to the provisions of §715-01 Structural Steel. A seal weld shall be provided completely around the pile casing.

551-4 METHOD OF MEASUREMENT

551-4.01 General. The length of piles will be determined in the field by driving to the resistance required by the Contract Documents, or DCES at the time of driving. The pile lengths indicated on the Plans are for estimating purposes only.

551-4.02 Steel H-Piles. The quantity of Steel H-Piles to be measured for payment will be in feet of acceptable piles driven, measured to the nearest 1 foot below the cut off elevation.

551-4.03 Cast-In-Place Concrete Piles. The quantity of Cast-in-Place Concrete Piles to be measured for payment will be in feet of acceptable piles driven, measured to the nearest 1 foot below the cut off elevation.

551-4.04 Furnishing Equipment for Driving Piles. The work under Furnishing Equipment for Driving Piles will be measured on a lump sum basis.

551-4.05 Dynamic Pile Load Testing. The quantity of Dynamic Pile Tests to be measured for payment will be the number of pile tests performed. If the pile requires re-driving within 28 hours after the initial test, this shall be considered as one Dynamic Pile Test. If re-driving is more than 28 hours after the initial test, this shall be considered as an additional test.

551-4.06 Splices. The quantity of splices to be measured for payment will be the number of splices installed, which meet the requirements of §551-1.06 and §551-3.06.

551-5 BASIS OF PAYMENT

551-5.01 General. The unit price bid per foot for piles shall include the cost of removal of any material forced up above the bottom of footing by the driving of piles, backfilling of all cavities left by the extraction of damaged piles or from auger holes or soil deformations necessary to place piles, and furnishing and using pile shoes, followers, augers, or spuds.

No payment will be made for piles rejected in accordance with requirements under §551-3.01.

551-5.02 Steel H-Piles. The unit price bid per foot for steel H-Piles shall include the cost of furnishing all labor, including the manipulation of pile driving equipment, materials and equipment necessary to satisfactorily complete the work.

551-5.03 Cast-in-Place Concrete Piles. The unit price bid per foot for cast-in-place concrete piles shall include the cost of furnishing all labor, including the manipulation of pile driving equipment, materials and equipment necessary to satisfactorily complete the work, including concrete, reinforcement, and steel casings. Progress payments will be made, at the unit price bid, for 60% of the quantity after the casings have been satisfactorily driven. The balance of the quantity will be paid for after completion of the work, including cutting off piles, placing concrete in the pile, and painting of exposed pile and pile casings.
551-5.04 Furnishing Equipment for Driving Piles. The lump sum price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

Progress payments will be made at seventy-five percent (75%) of the lump sum bid when the equipment for driving piles is furnished and driving of satisfactory piles has commenced. The remainder will be paid when pile driving is completed.

551-5.05 Dynamic Pile Load Testing. The unit price bid shall include the cost of furnishing labor, materials and equipment necessary to satisfactorily support the performance of Dynamic Pile Load Tests.

551-5.06 Splices. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

Payment will be made under:

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<th>Item No.</th>
<th>Item Description</th>
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<td>551.15</td>
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SECTION 552 - EXTERNALLY STABILIZED CUT STRUCTURES

(Last Revised May, 2016)

552-1 DESCRIPTION

552-1.01 Permanent Sheeting. Under this work, the Contractor shall furnish and install permanent sheeting of the type, at the locations and to the elevation(s) shown in the contract documents or as directed by the Engineer.

All the sheeting and supports will be left in place as a finished structure unless removal of waling and bracing is called for in the contract documents.
552-1.02 Temporary Sheeting. Under this work, the Contractor shall furnish, install, maintain and remove temporary sheeting of the type, at the locations and to the elevation(s) shown in the contract documents or as directed by the Engineer. It may be left in place only with the written permission of the Engineer.

552-1.03 Interim Sheeting. Under this work, the Contractor shall furnish, install, maintain, cut off and remove sheeting of the type, at the locations and to the elevation(s) shown in the contract documents or as directed by the Engineer.

The interim sheeting shall be cut off and removed only to the elevation shown in the contract documents. The remaining material shall be left in place.

552-1.04 Shields and Shoring. Under this work, the Contractor shall design, furnish, place, maintain and remove a shields and shoring system at locations shown in the contract documents or as directed by the Engineer. Details of the shields and shoring system must conform to the requirements of 29 CFR 1926. It may be left in place only with the written permission of the Engineer.

A. Shields and Shoring (S&S) System. An S&S system is a pre-engineered, protective/support system used in trenches to provide direct support of the trench sidewalls in addition to protecting workers within the trench. An S&S system may consist of sheeting, shoring, shield systems, trench box, trench shield or other pre-engineered protective systems.

552-1.05 Soldier Pile and Lagging Wall. Under this work, the Contractor shall furnish and place a soldier pile and lagging wall in accordance with the contract documents; cut off walls located within the roadway limits to the elevation shown in the contract documents and leave the remainder in place unless removal is granted, in writing, by the Engineer; completely remove walls outside the roadway limits if noted on the plans; and dispose of removed material.

552-1.06 Alternate Design. The Contractor may submit to the Department a construction alternate other than that presented in the contract documents as a Value Engineering Change Proposal. A simple material substitution involving a sheeting section modulus or soldier pile designation greater than that shown in the contract documents will be considered for acceptance. All proposed changes to details shown in the contract documents must be approved, in writing, by the Deputy Chief Engineer for Technical Services.

Any geotechnical analysis for a flexible support system shall be done in accordance with the procedures contained in the geotechnical design procedure “Geotechnical Design Procedure for Flexible Wall Systems”.

552-2 MATERIALS

552-2.01 Permanent Sheeting

A. Permanent Timber Sheeting. Permanent timber sheeting shall be new and unused and consist of any acceptable species which can be placed satisfactorily in accordance with the requirements of §712-14 Stress Graded Timber and Lumber. Timber sheeting shall be treated in accordance with §708-31 Wood Preservative - Waterborne and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B. The timbers shall meet or exceed the actual cross section or stress grade shown in the contract documents. The timbers shall be sound and free from any defects which might impair its strength or tightness. The materials shall include all necessary waling and bracing required.
B. Permanent Steel Sheeting. Steel sheeting shall be new and unused conforming to the provisions of §715-17 Steel Sheeting. Waling and bracing shall be new and unused conforming to the provisions of §715-01 Structural Steel. Stock steel may be used.

552-2.02 Temporary Sheeting

A. Temporary Timber Sheeting. Temporary timber sheeting shall consist of any acceptable species which can be placed satisfactorily in accordance with the requirements of §712-14 Stress Graded Timber and Lumber.

Temporary timber sheeting shall consist of new or used, treated or untreated material in satisfactory condition and suitable for the intended use. The Engineer will reject unsatisfactory materials.

B. Temporary Steel Sheeting. The steel sheeting, waling and bracing shall consist of new or used material in satisfactory condition and suitable for the intended use. The materials shall include all necessary waling and bracing required. The Engineer will reject unsatisfactory materials.

552-2.03 Interim Sheeting

A. Interim Timber Sheeting. Interim timber sheeting shall consist of any acceptable species which can be placed satisfactorily in accordance with the requirements of §712-14 Stress Graded Timber and Lumber.

Interim timber sheeting shall consist of new or used, treated or untreated material but shall be in satisfactory condition and suitable for the intended use. The Engineer will reject unsatisfactory materials.

B. Interim Steel Sheeting. Steel sheeting and any steel waling and bracing to remain in place shall be new and unused conforming to the provisions of §715-17 Steel Sheeting. Steel sheeting, steel waling and bracing which is removed after use shall consist of new or used material in satisfactory condition and suitable for the intended use. The materials shall include all necessary waling and bracing required. The Engineer will reject unsatisfactory materials.

552-2.04 Shields and Shoring. The selection of S&S systems and materials shall be the Contractor's option. The Engineer will reject unsatisfactory materials.

552-2.05 Soldier Pile and Lagging Wall.

A. Soldier Pile. Soldier piles shall be as shown on the contract documents and conform to the requirements of §715-18 Soldier Piles. Waling and bracing shall be as shown in the contract documents and conform to the requirements of §715-01 Structural Steel. No pile splices will be allowed unless approved, in writing, by the Deputy Chief Engineer for Technical Services.

Used material is permitted for temporary walls unless otherwise noted on the plans, provided the material is in conformance with the specification and is acceptable for use.

B. Lagging. Lagging type(s) shall be as shown in the contract documents:

1. Treated Wood. Treated wood shall meet or exceed the full dimension thickness shown in the contract documents and graded for an extreme fiber stress of at least 1000 psi conforming to the material requirements of §712-14 Stress Graded Timber and Lumber. Timbers shall be treated in accordance with §708-31 Wood Preservative - Waterborne. The treatment shall be applied in
conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

2. **Untreated Wood.** Untreated wood shall be graded for an extreme fiber stress of at least 1000 psi conforming to the provisions of §712-14 Stress Graded Timber and Lumber and shall meet or exceed the full dimension thickness shown in the contract documents.

3. **Precast Concrete Panels.** Precast concrete panels shall conform to the provisions of §704-24 Precast Concrete Panels.

4. **Steel Sheet.** Steel sheeting shall conform to the provisions of §552-2.01 B. Permanent Steel Sheet.

C. **Backfill for Holes.** Backfill material shall be as shown in the contract documents:

1. **Concrete Backfill.** Concrete backfill shall be Class G concrete conforming to the provisions of Section 555 Structural Concrete.

2. **Grout Backfill.** Grout backfill shall be a workable mixture capable of stabilizing the hole being excavated. The Contractor shall use either:

   i. **Controlled Low Strength Material.** Material meeting the requirements for Controlled Low Strength Material as stated in §733-01 Flowable Fill.

   ii. **Controlled Low Strength Material (No Fly Ash).** Material meeting the requirements for Controlled Low Strength Material (No Fly Ash) as stated in §733-01 Flowable Fill.

   iii. **Grout.** Cement, concrete sand and water conforming to Table 552-1 Grout Backfill Requirements.

<table>
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<th>TABLE 552-1 GROUT BACKFILL REQUIREMENTS</th>
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<td>Concrete Sand</td>
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<td>Water</td>
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**552-3 CONSTRUCTION DETAILS**

552-3.01 **General.** The Contractor shall install sheeting having a section modulus not less than that shown in the contract documents. The Contractor shall install soldier piles meeting the size designation shown in the contract documents.

Any material which stops the driving of sheeting or soldier piles within a depth of 10 feet from the ground surface at the time of driving shall be removed by the Contractor. Payment for removal of such material and any backfill required to fill the resulting void will be made under the appropriate pay items. If very compact material or boulders prevent the progression of the sheeting or soldier piles to the design tip elevation at a greater depth, the Contractor shall notify the Engineer.

The Contractor shall perform work in a manner that causes no subsidence of the surrounding ground surface. If subsidence should occur, the Contractor shall cease work and provide a written plan to prevent subsidence for approval by the Engineer. The Contractor shall repair all damage that resulted from the subsidence at no additional cost to the State.
552-3.02 Temporary Sheeting. The Contractor shall install temporary sheeting having a section modulus which meets or exceed that shown in the contract documents.

After its function is no longer required, the Contractor shall remove the sheeting placed under this work, or with the written permission of the Engineer, leave it in place after cutting off the tops at an agreed elevation.

552-3.03 Interim Sheeting. The Contractor shall install interim sheeting having a section modulus which meets or exceed that shown in the contract documents.

The Contractor shall cut off the interim sheeting and remove it to the elevation shown in the contract documents. The remaining material shall be left in place.

552-3.04 Shields and Shoring. The Contractor shall install a S&S system in accordance with the contract documents.

The S&S installed under this work shall be of sufficient size and strength to meet the requirements of 29 CFR 1926 and the Live Load requirement as contained in the AASHTO Standard Specifications for Highway Bridges. Prior to use, the Contractor shall supply the Engineer with documentation of compliance. The S&S may be left in place only with the written permission of the Engineer.

All damage to the adjacent pavement or ground caused by the use of the chosen S&S (e.g. voids beneath the pavement or shoulder, pavement or shoulder cracking or subsidence, ground settlement) shall be repaired at no additional cost to the State. Severe damage which directly affects the safety of the public shall be immediately repaired. The operation shall be halted until a satisfactory prevention method is instituted.

552-3.05 Soldier Pile and Lagging Wall. The Contractor shall install Soldier Piles meeting the size designation shown in the contract documents either by driving or by placing them in holes as indicated on the plans in accordance with Table 552-2 Soldier Pile and Lagging Wall Pile Tolerances. For each pile out of tolerance, provide a satisfactory replacement or provide a modification approved by the Engineer prior to proceeding. No pile splices will be allowed unless approved, in writing, by the Deputy Chief Engineer of the Office of Technical Services.

<table>
<thead>
<tr>
<th>Survey Location</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>3 inches at the top of pile.</td>
</tr>
<tr>
<td>Vertical</td>
<td>Vertical tolerance of ( \frac{3}{8} ) inch per foot on each axis of the soldier pile shown on the plans. Verify the axis on the top 5 feet of the soldier pile with a straight edge (5 feet minimum length) and a level (4 feet minimum length).</td>
</tr>
</tbody>
</table>

A. Driving Piles. Soldier piles shall be equipped with shoes in conformance with provisions of §551-3.02 Steel H-Piles, and driven in conformance with provisions of §551-3.04 Furnishing Equipment for Driving Piles, except that submission of Form BD 138 is not required and the use of a vibratory hammer is an acceptable means of pile driving.

B. Creating Holes for Pile Installation. The Contractor shall provide equipment capable of establishing and maintaining holes of the minimum diameter and to the depth or elevation shown in the contract documents. Temporary sleeves or casings are permitted and may be required as per the plans. Jetting is not permitted.
If the top of socket elevation shown in the contract documents varies by more than 2 feet, the Contractor shall stop work and notify the Engineer. The Engineer will notify the Geotechnical Engineering Bureau and obtain written recommendations prior to allowing the work to proceed.

Upon completion of the hole, the Contractor shall install the soldier pile in accordance with Table 552-2 Soldier Pile and Lagging Wall Pile Tolerances.

C. Backfilling. After placing the piles, the Contractor shall backfill holes with the backfill(s) indicated in the contract documents.

1. Concrete Backfill. The Contractor shall place backfill in accordance with the provisions of §555-3.04 Handling and Placing Concrete and §555-3.05 Depositing Structural Concrete Under Water as shown in the contract documents. The Contractor shall allow a minimum curing time of one day before placing any lagging.

2. Grout Backfill. The Contractor shall place backfill in accordance with the provisions of §555-3.04 Handling and Placing Concrete and §555-3.05 Depositing Structural Concrete Under Water. The Contractor shall allow a minimum curing time of one day before placing any lagging.

D. Lagging. The Contractor shall install horizontal lagging so that the unsupported soil height does not exceed 3 feet at any time. If the method chosen for attaching the lagging to the soldier piles requires reattachment of lagging to the soldier piles due to planned excavation on both sides of the wall, the Contractor shall reattach the lagging at no additional cost to the State.

The Contractor shall fabricate the precast concrete lagging to the shape and size shown in the contract documents.

E. Wall Removal. The Contractor shall cut off soldier piles placed within the roadway limits at the subgrade surface unless otherwise noted in the contract documents. Soldier piles placed outside the roadway limits may be removed or cut off a minimum of 2 feet below final ground surface unless otherwise noted in the contract documents.

If lagging is to be removed, the Contractor shall remove the lagging so that the unsupported soil height does not exceed a maximum of 3 feet at any time. This maximum height may be reduced, based on specific site conditions, in order to prevent collapse and loss of ground.

552-4 METHOD OF MEASUREMENT

552-4.01 General. When a support system is used in stage construction, the quantity of support system will be the maximum number of square feet satisfactorily installed between the payment lines shown in the Contract Documents measured on only one side of adjacent construction stages.

552-4.02 Permanent Sheeting. The quantity of sheeting will be in square feet, measured to the nearest square foot. The upper payment line will be at the intersection of the sheeting and the ground surface at the time of commencing work or at the completion of backfilling operations, whichever is higher. The lower payment line will be the minimum embedment depth shown in the contract documents.

The horizontal length will be measured along a projection of the sheeting on a plane parallel to and midway between the front and rear face of the sheeting wall.

552-4.03 Temporary Sheeting. The quantity of sheeting will be in square feet, measured to the nearest square foot. The upper payment line will be the original ground at the time of commencing work. The lower payment line will be the minimum embedment depth shown in the contract documents.

The horizontal length will be measured along a projection of the sheeting on a plane parallel to and midway between the front and rear face of the sheeting wall.
552-4.04 Interim Sheeting. The quantity of sheeting will be in square feet, measured to the nearest square foot. The upper payment line will be the original ground at the time of commencing work. The lower payment line will be the minimum embedment depth shown in the contract documents.

The horizontal length will be measured along a projection of the sheeting on a plane parallel to and midway between the front and rear face of the sheeting wall.

552-4.05 Shields and Shoring. The quantity of shields and shoring will be in square feet, measured to the nearest square foot, obtained by multiplying the vertical length between the payment lines herein described, measured on both sides of the excavation, by the horizontal length of S&S actually used. The upper payment line will be the ground surface existing at the site prior to the beginning of the work. The lower payment line will be the bottom of the excavation immediately adjacent to the protection system. The horizontal length will be the length of protection system installed measured along the payment lines as shown in the contract documents. Both sides of the excavation will be measured and computed for payment.

552-4.06 Soldier Pile and Lagging Wall.

A. Holes in Earth. The quantity to be measured for payment will be in feet of holes in earth installed. The upper payment limit is the intersected grade or ground line whichever is lower. For holes requiring rock sockets, the lower payment limit is the top of rock. For holes without rock sockets, the lower payment limit is the pile tip elevation.

B. Rock Sockets. The quantity to be measured for payment will be in feet of sockets in rock installed. The upper payment limit is the top of rock as shown on the plans. The lower payment limit is the pile tip elevation.

C. Soldier Piles. The quantity to be measured for payment will be in feet of soldier piles installed. The upper payment limit is the pile top elevation. The lower payment limit is the pile tip elevation.

D. Lagging. The quantity of lagging to measure for payment will be the number of square feet, to the nearest square foot, between the payment lines shown in the contract documents.

552-5 BASIS OF PAYMENT

552-5.01 Permanent Sheeting. The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including driving equipment, waling, and bracing. The cost of maintaining the excavated area free from earth, water, ice, and snow will be included in the price bid for the appropriate excavation item.

552-5.02 Temporary Sheeting. The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including driving equipment, waling, and bracing. The cost of maintaining the excavated area free from earth, water, ice, and snow will be included in the price bid for the appropriate excavation item. Progress payments in the amount of 75% of the bid amount will be made upon installation of the sheeting with the remainder paid upon its satisfactory removal. If the Contractor leaves all or part of the sheeting in place, it will be at no additional cost to the State and the remaining 25% of the bid amount will be paid after its function is no longer required.

552-5.03 Interim Sheeting. The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including driving equipment,
waling, and bracing. The cost of maintaining the excavated area free from earth, water, ice, and snow will be included in the price bid for the appropriate excavation item. Progress payments in the amount of 75% of the bid amount will be made upon installation of the sheeting with the remainder paid upon satisfactory removal of that portion specified in the contract documents. If the support system is to be left in place in its entirety, the remainder will be paid after its function is no longer required. The cost of any work necessary to cut off and remove the specified portion shall be included in the unit price bid.

552-5.05 Shields and Shoring. The unit price bid for this work shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, including equipment, waling, bracing, and design services when employed.

If the Engineer directs, in writing, that the S&S be left in place, this will be classified as extra work.

552-5.05 Soldier Pile and Lagging Wall.

A. Holes in Earth. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including progressing the hole through obstructions.

B. Rock Sockets. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

C. Soldier Piles. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including pile driving equipment, pile shoes, backfilling the hole and cutting off the soldier pile where required. No additional payment will be made for complete pile removal, where allowed. Splices approved, in writing, by the Deputy Chief Engineer for Technical Services will be paid for under the appropriate pay item.

D. Lagging. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work, including waling, bracing, connections and lagging removal, where required. No additional payment will be made when a wall is excavated on both sides. No additional payment will be made if wood lagging is placed behind concrete.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
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<td>552.10</td>
<td>Permanent Timber Sheeting</td>
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<tr>
<td>552.11</td>
<td>Permanent Steel Sheeting</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.12</td>
<td>Temporary Timber Sheeting</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.13</td>
<td>Temporary Steel Sheeting</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.14</td>
<td>Interim Timber Sheeting</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.15</td>
<td>Interim Steel Sheeting</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.17</td>
<td>Shields and Shoring</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.20nn</td>
<td>Holes in Earth for Soldier Pile and Lagging Wall</td>
<td>Foot</td>
</tr>
<tr>
<td>552.21nn</td>
<td>Rock Sockets for Soldier Pile and Lagging Wall</td>
<td>Foot</td>
</tr>
<tr>
<td>552.22nn</td>
<td>Soldier Piles for Soldier Pile and Lagging Wall</td>
<td>Foot</td>
</tr>
<tr>
<td>552.2301nn</td>
<td>Treated Wood Lagging for Soldier Pile and Lagging Wall</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.2302nn</td>
<td>Untreated Wood Lagging for Soldier Pile and Lagging Wall</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.2303nn</td>
<td>Precast Concrete Panel Lagging for Soldier Pile and Lagging Wall</td>
<td>Square Foot</td>
</tr>
<tr>
<td>552.2304nn</td>
<td>Steel Sheeting Lagging for Soldier Pile and Lagging Wall</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

Note: nn denotes serialized pay item. Each wall and its associated components will be serialized.
SECTION 553 - COFFERDAMS AND WATERWAY DIVERSION STRUCTURES

553-1 DESCRIPTION

553-1.01 General. All work done under this Section shall conform to all Federal, State, County and Local Regulations and permit conditions.

553-1.02 Cofferdam. Under this work, the Contractor shall design, furnish, place, maintain, and remove cofferdams together with all necessary waling and bracing, and dewatering equipment within the limits shown on the plans. The Contractor shall also construct, maintain, stabilize, backfill and restore adequate sediment removal area(s) for water discharge control at location(s) shown on the plans or where allowed by the Engineer in accordance with all applicable permits.

If a waterway diversion structure is proposed as a substitution, approval of the Engineer must be obtained. A review by the appropriate permitting agency(ies) will be required. Any delay due to this review and approval process will not be a basis for an extension of time.

553-1.03 Temporary Waterway Diversion Structure. Under this work, the Contractor shall design, furnish, install, maintain, and remove a temporary water diversion structure at the location(s) shown on the plans or as ordered by the Engineer.

553-1.04 Submittals

A. Cofferdams Cofferdams shall be designed by a Professional Engineer licensed and registered to practice in New York State. All systems submitted shall be designed for the static water pressure plus stream pressure and ice pressures as appropriate. Stresses shall not exceed the allowable given in AASHTO Standard Specifications for Highway Bridges. The Contractor shall indicate the water elevation above which the system should be flooded to avoid overloading. The Contractor’s Engineer shall design the cofferdam to conform to all Federal, State, County and Local Regulations and Permits.

1. Cofferdams (Type 1). The Contractor shall submit the design, including computations and method of installation, to the Engineer for review by the Deputy Chief Engineer Structures (DCES). The DCES shall be allowed 20 working days for review. Permission to proceed must be received, prior to beginning construction of any cofferdam. The furnishing of such information and receipt of permission to proceed shall not serve to relieve the Contractor of its responsibility for the safety of the workers, the need to meet permit conditions, and the successful completion of the work.

2. Cofferdams (Type 2). Prior to beginning construction of any cofferdam, the Contractor shall submit the methods to be employed to the Engineer for review and approval. Ten working days shall be allowed for review. Construction shall not be started prior to receipt of approval.

B. Temporary Waterway Diversion Structure. Prior to beginning construction/installation of any temporary waterway diversion structure, the Contractor shall submit the methods to be employed to the Engineer for review and approval. Ten working days shall be allowed for review. Construction shall not be started prior to receipt of approval.

553-2 MATERIALS. The materials shall be timber or steel sheeting of a quality equivalent to that specified in §552-2.02 Temporary Sheetig of Support and Protection Systems, tightly sealed impermeable earth filled bags, precast concrete, a commercially designed system manufactured
specifically for the control of water, or other material as indicated in the cofferdam design submitted for review.

553-3 CONSTRUCTION DETAILS

553-3.01 Cofferdams. Cofferdams shall be constructed so as to keep the excavations free from earth, water, ice, or snow, and to permit excavations to be carried to the depths indicated on the plans. Cofferdams, when used in conjunction with a tremie pour, shall be designed and constructed to automatically flood by non-mechanical means such as over topping or flooding ports. The automatic flooding elevation shall be as indicated by note in the plans.

In the event that permanent or temporary sheeting is required by the plans at the location of the cofferdam, the Contractor may elect to incorporate this material into the cofferdam system. Additional bracing may be required to satisfactorily perform excavation, dewatering, and other required construction operations. The permanent sheeting system shall be returned to its intended condition after all cofferdam equipment and material, including any additional bracing, has been removed. All damage done to the temporary system, if still required, or permanent sheeting, shall be repaired at the Contractor's expense, to the satisfaction of the Engineer.

Unless otherwise indicated on the plans, cofferdams shall be maintained in a dewatered condition during foundation construction. The placement of foundation concrete shall not be impeded by water standing or flowing within the cofferdam.

If a waterway diversion structure is approved as a substitution, all of the requirements of §553-3.02 Temporary Waterway Diversion Structure shall apply.

Dewatering equipment and any additional bracing shall be of adequate quality and capacity and shall be so arranged as to permit their proper functioning in connection with the cofferdam. Dewatering equipment and bracing shall be so located to permit construction of the structure in accordance with the plans.

All damage caused by the failure of a cofferdam to perform its proper functions shall be the responsibility of the Contractor. It shall also be the Contractor's responsibility to protect all stream banks from erosion by reason of restriction of the channel caused by the erection of the cofferdam to limits greater than that shown on the plans for the Contractor's own convenience. In that situation, all material which erodes from the banks during that time the cofferdam is in place shall be replaced by the Contractor at the Contractor's own expense. The Engineer, in consultation with the regulatory permit agency(ies) representative(s), will be the sole determiner of the nature and extent of all damages and mitigation requirements. The Engineer shall approve all repair methods proposed by the Contractor prior to the Contractor beginning any remedial activities for which they are liable.

It shall be the Contractor's responsibility to place the cofferdam so that it will not interfere with any batter piles.

The Contractor shall establish and maintain a sediment removal area(s) to retain the discharge for a sufficient period of time using equivalent best management practices as approved by the Engineer, in order that the discharge entering the stream will be as clear as the flowing stream.

553-3.02 Temporary Waterway Diversion Structure. Waterway diversion structures shall be constructed at the locations(s) as shown on the plans so as to divert the flow of water. The structure shall be continuous and constructed in accordance with any regulatory agency permit conditions.

If a system commercially designed and manufactured specifically for the control of water is used, it shall be installed and maintained in accordance with the manufacturer's recommendations.

All damage caused by the failure of the temporary water diversion structure to perform its proper function shall be repaired by the Contractor at no cost to the State.

553-3.03 Removal. The Contractor shall remove the temporary portion of the cofferdam installation or the waterway diversion structure, including anchor spuds if used, after such time that it is determined by
the Engineer to be no longer necessary. The removal shall be sequenced to minimize turbidity and the discharge of materials into the waterway. Additional temporary erosion control measures, as determined by the Engineer, may need to be employed to facilitate removal.

553-4 METHOD OF MEASUREMENT

553-4.01 Cofferdams. Measurement will be for each cofferdam actually established where indicated on the plans.

In those cases where approval is given to construct a waterway diversion structure in lieu of a cofferdam, the cost of the diversion will be paid at the unit price bid for the cofferdam work.

553-4.02 Temporary Waterway Diversion Structure. Measurement will be for each temporary waterway diversion structure actually constructed in accordance with the requirements of the contract documents and to the satisfaction of the Engineer.

553-5 BASIS OF PAYMENT

553-5.01 Cofferdams. The unit price bid for each cofferdam shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, including pile driving equipment, waling, and bracing, anchor spudding, maintaining in a dewatered condition, and final removal. No separate payment will be made for any additional temporary erosion control measures required to facilitate removal. In addition, all costs associated with the removal of any sediment deposited in the waterway due to the Contractor’s operations shall be included. When a cofferdam is installed incorporating permanent or temporary sheeting required by the plans, payment will be made for each cofferdam established, including any miscellaneous sheeting, additional bracing, anchor spudding, or other material necessary to complete the work. The permanent or temporary sheeting, if used as part of the cofferdam, will be paid for under a separate item. The cost of establishing, maintaining, stabilizing, backfilling and restoring the sediment removal area(s) shall also be included in the price bid. No separate payment will be made for any repairs of damage required due to the failure of a cofferdam to perform its proper function.

Progress payments will be made. Seventy-five percent of the bid price will be paid after cofferdam installation, construction of the sediment removal area(s) and initial dewatering. The remaining percentage will be paid upon satisfactory removal of the cofferdam and restoration of the sediment removal area(s).

553-5.02 Temporary Waterway Diversion Structures. The unit price bid for each diversion structure shall include the cost of furnishing all labor, equipment, and materials necessary to satisfactorily install, maintain, and remove the diversion structure and any additional temporary erosion control measures required to facilitate removal.

No separate payment will be made for any repairs of damage required due to the failure of a waterway diversion structure to perform its proper function.

In the event that the Contractor is required to extend the temporary waterway diversion structure beyond the limits shown in the contract documents, changes to the diversion structure will be considered extra work.

When the waterway diversion structure is satisfactorily installed, 75 percent of the bid price will be paid. The remaining percentage will be paid when all temporary equipment and material have been removed and the waterway satisfactorily restored to its permanent location.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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</tr>
<tr>
<td>553.02nnn</td>
<td>Cofferdams (Type 2)</td>
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</tbody>
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SECTION 554 - FILL TYPE RETAINING WALLS

(First Revised January, 2020)

554-1 DESCRIPTION. This work shall consist of furnishing and installing a fill type retaining wall at the location(s) and to the elevation(s) shown in the contract documents.

554-1.01. General. The fill type classification refers to the construction method used for the installation of the wall. Fill type retaining walls are retaining structures constructed from the base of the wall to the top (i.e. “bottom-up” construction).

The fill type retaining walls are further classified according to the basic mechanism of lateral load support. These classifications include internally stabilized fill structures and externally stabilized fill structures.

The specification is supplemented with an Approved List which provides a listing of available designers and their corresponding fill type retaining walls. Fill type retaining walls are further defined in the pertinent subsequent sections. For proprietary fill type retaining wall systems, approved designers, wall systems, and the components of each wall system appear on the Approved List, available on the Department’s web site. Designers wishing to have their wall systems reviewed for placement on the Approved List shall follow the procedural directives of the Geotechnical Engineering Bureau as contained in Highway Design Manual Appendix 9A.

554-1.02 Definitions. Internally stabilized fill structures are structures which rely on friction developed between closely-spaced reinforcing elements and the backfill to resist lateral soil pressure and are subcategorized in the retaining wall subsections of this specification. Externally stabilized fill structures are structures which utilize the weight of the wall system elements and the weight of the infill to resist lateral soil pressure.

A. Wall System. A wall system is either a series of open top face units assembled to form bins which are connected in unbroken sequence or a combination of specific solid face units with a characteristic alignment and connection method, which utilize the weight of the wall system elements and the weight of the infill to resist lateral soil pressure. As indicated, the bin volume is infilled with backfill material to supplement the face unit geometry, adding to the stability of the system.

B. Internally Stabilized Wall System. A wall system which, when constructed beyond wall heights exceeding the maximum allowable unreinforced height per the Approved List, relies on reinforcing elements within the backfill to provide stability.

C. Internally Stabilized Earth System. A series of tensile reinforcing elements which, when placed in multiple layers within the backfill volume, improves the strength such that the vertical face of the stabilized earth volume is essentially self supporting.

D. Internally Stabilized Fill Structures.

1. Fill Structure. A fill type retaining wall as described in §554-1.01 Fill Type Retaining Walls which consists of either an internally stabilized wall system or an internally stabilized earth system.
i. Mechanically Stabilized Earth System (MSES). An MSES is an internally stabilized fill structure comprised of an unreinforced concrete leveling pad, precast concrete face panel units and coping units, earth backfill, subsurface drainage system, and reinforcing elements used to stabilize the backfill. Only MSES designers appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, leveling pad, and subsurface drainage system, are obtained from the approved wall system designer.

ii. Mechanically Stabilized Wall System (MSWS). An MSWS is an internally stabilized fill structure comprised of an unreinforced concrete or compacted granular fill leveling pad, face units (solid or open top) and coping units, earth backfill, subsurface drainage system, and reinforcing elements used to stabilize the backfill. Only MSWS designers with face units appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, face unit infill, leveling pad material, backfill drainage materials, and cast-in-place concrete, are obtained from the designer.

iii. Geosynthetically Reinforced Soil System (GRSS). A GRSS is an internally stabilized fill structure comprised of earth backfill, geosynthetic reinforcing elements used for internal stabilization and surface protection to resist erosion.

   a. GRSS Wall. For wall applications, the surface protection is the permanent facing elements (excluding precast units) or a geotextile face wrap which typically includes welded wire forms remaining from the installation operation.

   b. GRSS Slope. For slope applications, the surface protection consists of a secondary reinforcing element to aid in stability of the slope face between primary reinforcing layers. To protect against erosion, the GRSS slope is covered by either a non-degradable erosion control mat or a granular fill slope protection blanket.

Although GRSS is a fill type retaining wall, it is not a part of the selection process outlined in §554-3.01A. Fill Type Retaining Wall Selection or supplemented by the Approved List for Fill Type Retaining Walls, as it is not a proprietary system. A GRSS will be designed and detailed in the contract documents by the Department or its representatives.

2. Leveling Pad. A compact surface which serves as a flat, level area for placing the initial course of face units.

   i. Concrete. An unreinforced concrete slab.

   ii. Granular. A compacted granular fill pad.

3. Face Unit. A structural unit incorporating a means for attaching the backfill reinforcing element, which restrains the alignment of the wall system during installation compaction operations and provides support for the front edge of the backfill for the life of the wall system.

   i. Panel Unit. A precast concrete panel incorporating a means for attaching the backfill reinforcing element, forming part of the face area of the MSES.

   ii. Solid Unit. A face unit which has a solid mass and incorporates a means for attaching the backfill reinforcing element, forming part of the face area of the MSWS.
**iii. Open Top Unit.** A face unit which has an open structure, to allow placement of infill material, and incorporates a means for attaching the backfill reinforcing element, forming part of the face area of the MSWS.

**iv. Corner Unit.** A corner unit is a face unit having two faces.

**v. Geotextile Face Wrap.** A layer of geotextile used to prevent loss of backfill, typically employed in a temporary wall application in conjunction with welded wire forms. In applications where a geotextile is used as the primary reinforcing element, it may be designed to also function as the face wrap.

   **a. Welded Wire Forms.** A non-structural system used in temporary walls to aid in compaction near the face of the wall.

**vi. Geocells.** A three-dimensional, permeable polymeric honeycomb or web structure expandable panels used to confine fill materials to create structural stability.

**vii. Timbers.** A dressed piece of wood used as a building material.

**viii. Gabions.** A partitioned, wire fabric container filled with stone to form a flexible and permeable structure.

**4. Alignment and Connection Device.** Any device that is either built into or specially manufactured for the face units, such as shear keys, leading/trailing lips, or pins. The device is used to provide alignment and maintain positive location for a face unit and also provide a means for connecting the reinforcing elements.

**5. Fastener.** Hardware used to connect the reinforcing element to the attaching device.

**6. Coping.** A precast or cast-in-place element placed on and attached to the top of the finished wall system to form a protective cap against the weather.

**7. Joint Filler.** Material used to fill the joints between face units.

**8. Slip Joint.** A vertical joint specific to the wall system used as a stress relief at wall step locations.

**9. Geotextile.** A permeable, planar polymeric textile material used to promote drainage, prevent infill and/or backfill material from releasing through the joints, or separating dissimilar granular materials.

**10. Reinforcing Element.** An inclusion connected to the face unit and extending into the backfill for the purpose of backfill stabilization.

   **i. Inextensible Reinforcement.** A metal strip typically incorporating ribs on the top and bottom, or metal grids with design specific mesh openings.

   **ii. Extensible Reinforcement.** Geogrid or geotextile sheets typically made from high density polyethylene/polypropylene geogrids or high tenacity polyester geogrids, or high strength geotextiles.
11. **Unit Infill.** Granular material placed within the open structure of an open top face unit or contiguous to the bevel sides of a solid face unit.

12. **Backfill.** Granular material placed and compacted in conjunction with the reinforcing elements and face units.

13. **Geomembrane.** An impermeable geosynthetic composed of one or more synthetic sheets used to isolate the backfill material from surface water and deicing salt infiltration as a means to prevent corrosion of the reinforcing elements.

14. **Subsurface Drainage System.** A system for removing water from behind the wall and channeling it to a point of positive drainage.

15. **Identification Markers.** Signs and marking tape, buried near the finished grade, to identify and prohibit excavation of the reinforced backfill.

**E. Externally Stabilized Fill Structures.**

1. **Fill Structure.** A fill type retaining wall as described in §554-1.01 *Fill Type Retaining Walls* which consists of a prefabricated face unit.

   i. **Prefabricated Wall System (PWS).** A PWS is an externally stabilized fill structure comprised of prefabricated face units & coping units, including leveling pads, unit infill, earth backfill, joint filler material and geotextile, and a subsurface drainage system to reduce hydrostatic pressure on the wall system. Only PWS designers appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, unit infill, backfill drainage materials, and cast-in-place concrete, are obtained from the designer.

   When reinforcement is introduced to a PWS, they shall be reclassified as Mechanically Stabilized Wall Systems and the pertinent sections of the specification shall apply.

2. **Leveling Pad.** A compact surface which serves as a flat, level area for placing the initial course of face units.

   i. **Concrete.** An unreinforced concrete slab.

   ii. **Granular.** A compacted granular fill pad.

3. **Face Unit.** A prefabricated concrete element, incorporating alignment and connection devices, that is able to be arranged, stacked, placed, combined, or interchanged easily into an assembled wall system.

   i. **Solid Unit.** A face unit which has a solid mass, utilizing the weight of the wall system elements to resist lateral soil pressure. A solid unit may require some infill material depending on the geometric bevel of the units.

   ii. **Open Top Unit.** A face unit which has an open structure to allow placement of infill material, utilizing the weight of the wall system elements and the weight of the infill to resist lateral soil pressure.
4. **Bin.** Any volumetric space which is designated to be infilled, as defined in this section, and is encompassed within the dimensions of the open top unit.

5. **Alignment and Connection Device.** Any device that is either built into or specially manufactured for the face units, such as shear keys, leading/trailing lips, or pins. The device is used to provide alignment and maintain a positive location.

6. **Coping.** A precast or cast-in-place element placed on and attached to the top of the finished wall system to form a protective cap against the weather.

7. **Joint Filler.** Material used to fill the joints between face units.

8. **Slip Joint.** A vertical joint specific to the wall system used as a stress relief at wall step locations.

9. **Geotextile.** A permeable, planar polymeric textile material used to promote drainage, prevent infill and/or backfill material from releasing through the joints, or separating dissimilar granular materials.

10. **Unit Infill.** Granular material placed within the bin, such as the open structure of an open top face unit or contiguous to the bevel sides of a solid face unit.

11. **Backfill.** Granular material placed directly behind and/or above the bins in conjunction with the wall assembly.

12. **Subsurface Drainage System.** A system for removing water from behind the wall and channeling it to a point of positive drainage.

**F. Aesthetic Treatment.** A treatment applied to the face either during or after the manufacture of the face units to modify the appearance of the units and of the wall as a whole. Aesthetic treatment can include modifications to color, texture, architectural pattern, the addition of exposed surface aggregate (real or artificial), the addition of simulated joints or cracks, or any other treatment or material that modifies the appearance, provided that the structural integrity, function, or life span of the wall is not negatively impacted.

554-2 MATERIALS.

554-2.01. **Fill Type Retaining Walls.** Provide materials for the selected fill type retaining wall as outlined in the pertinent subsequent section.

554-2.02. **Mechanically Stabilized Earth System.** Not all materials listed below are required for each MSES. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

A. **MSES Leveling Pad.** Provide leveling pad material meeting the requirements of Section 501 Portland Cement Concrete - General, Class A concrete.

1. **Leveling Pad Placement.** For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 Cushion Sand, in lieu of MSES backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.
B. MSES Facing Panel Units. Fabricate precast concrete face panel units and incidental precast units in accordance with the requirements of §704-14 Precast Concrete Panel Units. The default aesthetic treatment for an MSES facing panel is a plain, smooth concrete finish of natural concrete (gray) color.

1. Coping Unit. Fabricate precast concrete coping units, and incidental precast units in accordance with the requirements of §704-14 Precast Concrete Panel Units.

C. MSES Fasteners and Attaching Devices. The fasteners and attaching devices are specific to each wall system and provided by the wall system manufacturer. The fasteners and attaching devices associated with each approved wall system appear on the Approved List under wall system components.

D. MSES Joint Fillers. Fill joints with material approved by DCES and approved by the wall system designer.

E. MSES Geotextile. Provide a geotextile meeting the requirements of §737-01B Geotextile Separation.

F. MSES Slip Joints. The type of slip joints is specific to each wall system and are designed and supplied by the wall system manufacturer.

G. MSES Metal Reinforcing Strips. Provide reinforcing strips of ASTM Designated metal grades and galvanize in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type I. The reinforcing strips associated with each approved wall system appear on the Department’s Approved List under wall system components.

H. MSES Metal Reinforcing Mesh. Fabricate the reinforcing mesh from cold drawn steel wire conforming to the requirements of §709-09 Cold Drawn Wire for Concrete Reinforcement, and weld into the finished mesh fabric in accordance with the requirements of §709-02 Wire Fabric for Concrete Reinforcement. Galvanize in accordance with §719-01 Galvanized Coatings and Repair Methods, Type I. The reinforcing mesh associated with each approved wall system appears on the Department’s Approved List under wall system components.

I. MSES Geogrid Reinforcing Element. Provide geogrid reinforcing elements meeting the requirements of §737-07 Geogrids. The grid(s) associated with each approved wall system appear on the Approved List under wall system components.

J. MSES Backfill. Provide backfill material meeting the requirements of §733-02 Mechanically Stabilized Earth System Backfill Material.

1. MSES Backfill – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for MSES Backfill.

K. MSES Geomembrane. Provide a geomembrane meeting the requirements of §737-02 Geomembranes.

L. MSES Subsurface Drainage System. Provide underdrain and geotextile material for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual.
1. **Underdrain Pipe.** Provide optional underdrain pipe conforming to Section 605 *Underdrains*.

2. **Geotextile Drainage.** Provide geotextile conforming to the requirements of §737-01 *Geotextiles*, Geotextile Drainage, Strength Class 2, Drainage Class B.

### M. MSES Identification Markers

1. **Signs.** These will be 7 in. x 10 in. (minimum) fiberglass. Include warning information as follows:

   **WARNING**
   Internally Stabilized Fill Structure
   **DO NOT EXCAVATE**
   Call Regional Office of NYS DOT

   For signs installed on concrete units, provide ¼ in. diameter by 1 ½ in. long stainless-steel nail drive expansion anchors meeting GSA Specifications FF-S-325.
   For signs installed on timbers, provide ¼ in. diameter by 1 ½ in. long stainless-steel wood screws.

2. **Marking Tape.** This will be polyethylene material 3 in. wide, 4 mil. thick. Include warning markings.

#### 554-2.03. Mechanically Stabilized Wall System.** Not all materials listed below are required for each MSWS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

**A. MSWS Leveling Pad.** MSWS height is measured from the top of the leveling pad to the top of the face coping unit.

1. **Wall Heights Taller Than or Equal to 15 ft.** For MSWS taller than or equal to 15 ft. in total height, provide a leveling pad of unreinforced Class A concrete - Section 501 *Portland Cement Concrete – General*.

2. **Wall Heights Shorter Than 15 ft.** For MSWS shorter than 15 ft. in total height, provide a leveling pad conforming to one of the following:
   
   **i. Concrete.** Unreinforced Class A concrete - Section 501 *Portland Cement Concrete – General*, or
   

3. **Leveling Pad Placement.** For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 *Cushion Sand*, in lieu of MSWS backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

**B. MSWS Facing System.** Provide a facing system in accordance with the requirements below
1. **Solid Face Units.** Provide face units fabricated and conforming to §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The default treatment for a MSWS face unit is a split face finish of natural concrete (gray) color.

   i. **Coping Unit.** Provide coping units fabricated and conforming to §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

2. **Open Top Face Unit.** Provide face units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The default treatment for a MSWS face unit is a plain, smooth concrete finish of natural concrete (gray) color.

   i. **Coping Unit.** Provide coping units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

C. **MSWS Alignment and Connection Devices.** Provide devices conforming to the designers Installation Manual.

D. **MSWS Joint Fillers.** Fill joints with material meeting the requirements of §705-07 Premolded Resilient Joint Filler and approved by the wall system designer.

E. **MSWS Geotextile.** Provide a geotextile meeting the requirements of §737-01B Geotextile Separation.

F. **MSWS Slip Joints.** The type of slip joints is specific to each wall system and are designed and supplied by the wall system manufacturer.

G. **MSWS Reinforcing Element.** Provide geogrid or geotextile reinforcing elements meeting the requirements of §737-07 Geogrids.

H. **MSWS Unit Infill.** Provide infill material meeting the requirements of §733-02 Mechanically Stabilized Earth System Backfill Material.

   1. **MSWS Unit Infill – Coarse Aggregate Option.** For units where the shape impedes the compaction procedures within the area of the bin, provide unit infill material meeting the requirements of §733-02 Mechanically Stabilized Earth System Backfill Material that consists of crushed stone with a gradation conforming to §703-02 Coarse Aggregate, Size Designation 2 with the percent passing the No. 200 sieve requirement in Table 703-4 adjusted to 0 – 2%.

   2. **MSWS Unit Infill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for MSES Backfill.

I. **MSWS Backfill.** Provide backfill material meeting the requirements of §733-02 Mechanically Stabilized Earth System Backfill Material.

   1. **MSWS Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for MSES Backfill.

J. **MSWS Geomembrane.** Provide a geomembrane meeting the requirements of §737-02 Geomembranes.
**K. MSWS Subsurface Drainage System.** Provide underdrain, geotextile material, and prefabricated structural drain for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual:

1. **Underdrain Pipe.** Provide optional underdrain pipe conforming to Section 605 Underdrains.

2. **Geotextile Drainage.** Provide geotextile conforming to the requirements of §737-01 Geotextiles, Geotextile Drainage, Strength Class 2, Drainage Class B.

3. **Prefabricated Composite Structural Drain.** Provide structural drain conforming to the requirements of §737-04 Prefabricated Composite Structural Drain.

**L. MSWS Identification Markers.** Provide identification markers conforming to §554-2.02 M. MSES Identification Markers.

554-2.04. **Geosynthetically Reinforced Soil System.** Not all materials listed below are required for each GRSS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

A. **GRSS Geosynthetic Reinforcing Element.** Provide a geogrid or geotextile primary and secondary reinforcing elements meeting the requirements of §737-07 Geogrids.

B. **GRSS Backfill.** Provide backfill material conforming to the following:

1. **Walls.** Provide backfill material meeting the requirements of §733-14 Select Structural Fill with the exception that the pH requirements are waived.

   i. **GRSS Wall Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Structural Fill.

2. **Slopes.** Provide backfill material meeting the requirements of §733-03 Geosynthetically Reinforced Soil System Slope Backfill Material.

   i. **GRSS Slope Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Structural Fill.

C. **GRSS Wall Facing Foundation.** Provide a pad of material meeting the requirements of §703-02 Crushed Stone, Size Designation 2.

D. **GRSS Facing System.** Provide a facing system shown in the contract documents and in accordance with the requirements below.

1. **Welded Wire Forms.** Provide welded wire forms and wire struts as shown in the contract documents, conforming to the material requirements of §709-02 Wire Fabric for Concrete Reinforcement. For applications other than staging walls, provide galvanization to the forms in accordance with the requirements of ASTM A 641 Class 3 for zinc coating (including the zinc coating on the Style 2 fabric), ASTM A 856M Class 3 for Zn-5Al-MM coating, or ASTM A 809 for aluminum coating.
Provide geotextile face wrap material meeting the requirements of §737-01B Geotextile Separation and as shown in the contract documents.

Proposed alternate, non-structural facing systems used to aid in compaction near the face of the wall shall be included in the submittal outlined in §554-3.03 A. GRSS Submittal.

2. **Geocells.** Provide geocells, anchoring devices, and staples as shown in the contract documents, conforming to the material requirements of §737-08 Geocells.

Provide infill material conforming to §733-14 Select Structural Fill, with the added stipulation that the maximum particle size is 2 in. Where a vegetated face is called for, the outermost cells are to be filled with topsoil meeting the material requirements of §713-01 Topsoil.

3. **Timbers.** Provide timbers as shown in the contract documents, graded for an extreme fiber stress of at least 1000 psi conforming to the material requirements of §712-14 Stress Graded Timber and Lumber. Treat timbers in accordance with §708-31 Wood Preservative - Waterborne and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

4. **As Shown in the Contract Documents.** Provide materials in accordance with the contract documents. Precast units are excluded as a design-specific GRSS facing system.

**E. GRSS Surface Protection.** Provide erosion resistant covering of the finished GRSS slope surface meeting the requirements of §713-07 Rolled Erosion Control Products and Soil Stabilizers Class III Type C.

**F. GRSS Subsurface Drainage System.** Provide underdrain and geotextile material for a backfill drainage system conforming to §554-2.02 L. MSES Subsurface Drainage System.

**G. GRSS Identification Markers.** Provide identification markers conforming to §554-2.02 M. MSES Identification Markers.

**554-2.05. Prefabricated Wall System.** Not all materials listed below are required for each PWS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

**A. PWS Leveling Pad.** Provide a leveling pad conforming to the following:

1. **Open Top Face Units.** For PWS utilizing open top face units, provide a leveling pad of unreinforced Class A concrete - Section 501 Portland Cement Concrete – General.

   For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 Cushion Sand, in lieu of PWS backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

2. **Solid Face Units.** For PWS utilizing solid face units, provide a leveling pad conforming to the requirements of §733-11 Select Granular Fill or §501-2.02, B.1.b. Coarse Aggregate Type CA-2 in Table 501-2 Coarse Aggregate Gradations.

**B. PWS Face Unit.** Provide face units meeting the following:

1. **Open Top Face Units.** For PWS utilizing open top face units, provide units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The
default treatment for a PWS open top face unit is a plain, smooth concrete finish of natural concrete (gray) color.

**i. Coping Unit.** Provide coping units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

**2. Solid Face Units.** For PWS utilizing solid face units, provide units meeting the requirements of §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The default treatment for a PWS solid face unit is a split face finish of natural concrete (gray) color.

**i. Coping Unit.** Provide coping units fabricated and conforming to §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

**C. PWS Joint Fillers.** Fill joints with material meeting the requirements of §705-07 Premolded Resilient Joint Filler and approved by the wall system designer.

**D. PWS Geotextile.** Provide a geotextile meeting the requirements of §737-01B Geotextile Separation.

**E. PWS Slip Joints.** The type of slip joints is specific to each wall system and are designed and supplied by the wall system manufacturer.

**F. PWS Backfill.** Provide backfill material meeting the requirements of §733-14 Select Structural Fill.

**1. PWS Backfill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Structural Fill.

**G. PWS Unit Infill.** Provide unit infill material meeting the requirements of §733-14 Select Structural Fill.

For systems which allow plantings to integrate the structure into the surrounding environment, the front pocket of the unit shall be filled with a minimum of 8 in. of topsoil conforming to the material requirements as specified in §713-01 Topsoil.

**1. PWS Unit Infill – Coarse Aggregate Option.** For units where the shape impedes the compaction procedures within the area of the bin, provide unit infill material consisting of crushed stone conforming to §703-02 Coarse Aggregate, Size Designation 2 with the percent passing the No. 200 sieve requirement in Table 703-4 adjusted to 0 – 2%.

**2. PWS Unit Infill – Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Structural Fill.

**H. PWS Subsurface Drainage System.** Provide underdrain, geotextile material, and prefabricated structural drain for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual:

**1. Underdrain Pipe.** Provide optional underdrain pipe conforming to Section 605 Underdrains.
2. Geotextile Drainage. Provide geotextile conforming to the requirements of §737-01 *Geotextiles*, Geotextile Drainage, Strength Class 2, Drainage Class B.

3. Prefabricated Composite Structural Drain. Provide structural drain conforming to the requirements of §737-04 *Prefabricated Composite Structural Drain*.

**554-2.06 Fill Type Retaining Wall Aesthetic Treatment.** The requirements for color, texture and pattern will be described in the contract documents using industry-standard descriptions and terminology. Other requirements will be vividly described in the contract documents using special notes and sketches, as needed.

### 554-3 CONSTRUCTION DETAILS

#### 554-3.01. General.

**A. Fill Type Retaining Wall Selection.** Approved designers of proprietary Fill Type Retaining Walls, wall systems, and the components of each wall system appear on the Approved List, available on the Department’s web site. Proprietary Fill Type Retaining Walls include Mechanically Stabilized Earth Systems, Mechanically Stabilized Wall Systems, and Prefabricated Wall Systems. Select a designer appearing on the Approved List for Fill Type Retaining Walls. The selection shall be based on the maximum wall height shown in the contract documents.

**B. Fill Type Retaining Wall Submittal.** Obtain from the chosen designer a Fill Type Retaining Wall design stamped by a Professional Engineer. Submit the design package, including working drawings of the wall design, design calculations, and the designers Installation Manual at least 30 work days before starting work to the following:

1. **Mechanically Stabilized Earth System.** Submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Materials Bureau in accordance with the requirements for Drawing in §704-03 *Precast Concrete – General*. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. The design package shall also include identification of backfill material gradation type(s) (outlined in §733-02B *Gradation*) suitable for the construction of the wall system, fabrication drawings for precast panels and coping and, for treatments applied to the face panel units other than the default treatment, a face panel unit sample for color and texture approval by the Regional Landscape Architect.

2. **Mechanically Stabilized Wall System.** Submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Geotechnical Engineering Bureau. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. The design package shall also include identification of backfill material gradation type(s) (outlined in §733-02B *Gradation*), infill material gradation change, if necessary (outlined in §554-2.03 H.1. *MSWS Unit Infill – Coarse Aggregate Option*) suitable for the construction of the wall system and, for treatments applied to the face units other than the default treatment, a face unit sample for color and texture approval by the Regional Landscape Architect.

3. **Prefabricated Wall System.**
### i. Open Top Face Units
For PWS utilizing open top face units, submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Materials Bureau in accordance with the requirements for Drawing in §704-03 Precast Concrete – General. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. The design package shall also include infill material gradation change, if necessary (outlined in §554-2.05 G.1. PWS Unit Infill – Coarse Aggregate Option), fabrication drawings for the face units and, for treatments applied to the face units other than the default treatment, a face unit sample for color and texture approval by the Regional Landscape Architect.

### ii. Solid Face Units
For PWS utilizing solid face units, submit the design package to the Engineer for approval. For solid face units consisting of units manufactured via the wet-casting process, submit the design package in accordance with the requirements for Drawing in §704-03 Precast Concrete – General. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. For treatments applied to the face units other than the default treatment, the design package submittal shall also include a face unit sample for color and texture approval by the Regional Landscape Architect.

### 4. Additional Requirements for Internally Stabilized Fill Structures
Due to the dependency on the construction methods, progression of panel/unit placement, compaction of reinforced volume, and sequence of panel/unit loading, if an MSES or MSWS is chosen from the Approved List, the following additional requirements are to be included in the Fill Type Retaining Wall design submittal to ensure the successful installation, evaluation, and long-term performance:

#### i. Leveling Pad Steps
Vertical steps in the leveling pad for MSES walls shall not be greater than half the standard panels height and the minimum length of wall between leveling pad elevation changes shall be the width of two standard panels.

Vertical steps in the leveling pad for MSWS shall not be greater than 2.5 ft. and the minimum length of wall between leveling pad elevation changes shall be 10 ft.

#### ii. Geomembrane
If the Contractor elects to provide an Internally Stabilized Fill Structure (either MSES or MSWS) which utilizes inextensible (metallic) reinforcing elements, the design submittal shall include a geomembrane barrier above the top layer of metallic reinforcements to protect the reinforcements from accelerated corrosion rates due to the infiltration of runoff containing deicing salts. If the design requires the geomembrane barrier to be installed at a lower elevation than the top layer of metallic reinforcements, design the reinforcements situated above the geomembrane for an exaggerated service life (and supplied with identification markers for the Inspection Staff).

The details of the geomembrane barrier, including details showing the geomembrane tied into a drainage system to collect and discharge runoff, shall be included in the shop drawings submitted for review and approval. Ensure that the geomembrane will isolate the reinforced mass, will drain away from the MSES face panels/MSWS face units, and that all subsurface drainage has a positive outlet.

The geomembrane shall extend a minimum distance of 5 ft. beyond the length of the reinforcement.

#### iii. LiDAR Survey
After installation, the MSES or MSWS shall be surveyed using terrestrial LiDAR (Light Detection And Ranging) system. The following data should be submitted in duplicate on 2 USB drives:
Report identifying the established permanent survey control indicating the control method (i.e. RTK GPS, etc.) control locations, registration residuals and control values.

- Raw point cloud in proprietary file format for each laser scan setup.
- Individual scan setup data shall overlap the next scan setup data by no less than 15 ft.
- Individual points in a point cloud shall have less than 0.1 ft. separation horizontally for area of mapping.
- Point cloud with first returns and digital camera overlay.
- Point cloud as a Leica PTS file or ASCII comma delimited file with values X, Y, Z, and intensity for the whole project. The X, Y values should be in the project’s mapping horizontal datum projected to the proper state plane coordinate system zone and the Z values shall be in the project’s vertical datum. All coordinate values shall have thousandths of a foot precision.

The following data accuracies are required:

- Vertical and Horizontal Point cloud accuracy of 0.08 feet or better on hard surfaces at 95% confidence level using National Spatial Data Accuracy standards as defined in Geospatial Positioning Accuracy Standard for Spatial Data Accuracy Part 3: National Standards for Spatial Data Accuracy.

After receipt of all pertinent information, the Department requires 10 work days or 2 work days per drawing sheet, whichever is greater, to review the submission.

C. Winter Earthwork. For Contractors choosing to proceed with earthwork construction operations requiring soil compaction from November 1st thru April 1st, provide the Engineer with a Winter Earthwork submittal, with a copy to the Regional Geotechnical Engineer, in accordance with §203-3.01 A. Winter Earthwork Submittal. In all work incorporated into the final product, the Contractor shall not place material that is frozen, or place fill material on ground that is frozen to any depth.

Winter earthwork restrictions state that if the air temperature, ground temperature, or material temperature is at or below 32° F, earthwork will only proceed using material that meets the requirements of §733-16 Winter Earthwork and/or standard earthwork material placement utilizing the modified methods and procedures. Therefore, the Winter Earthwork submittal shall provide details of whether a material change will be used or if methods and procedures will be modified to adjust for the weather influence on the compaction operations. If a material change is proposed, the submittal shall provide details of when the change will occur and how many times the material will change within the construction of the wall.

554-3.02. Mechanically Stabilized Earth System.

A. Pre-Operation Meeting. A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate Department representatives to discuss the Contractors proposed construction methods. Begin work only after receiving the DCES written approval and holding the Pre-Operation Meeting.

Supply technical assistance, by a Professional Engineer from the designated Wall System, for consultation throughout the installation of the wall. The technical assistant shall be on-site during the initial installation of the wall panels, during critical installation phases designated at the Pre-Operation Meeting, and as requested by the Engineer. This requirement shall apply for all wall locations depicted in the contract documents.

Subsequent to the completion of the wall but before the start of the work elements above the final top of wall elevation, the technical assistant shall conduct an engineering survey of the wall and provide a report to the Engineer. The report shall contain the following elements:
1. A summary of the work procedures used to construct the wall, including backfill material moisture content, compactive effort/equipment specifications, lift thicknesses, initial panel back-batter, initial bracing techniques.
2. A description of any procedures that deviated from the designers Installation Manual, including the reasoning for the change.
3. An inspection of the wall joints, including offset per panel, gap tolerance, spacers (appropriate use of, and subsequent removal of, temporary wooden wedges, bearing pad placement), and joint fillers/geotextile.
4. An inspection of the wall system, including alignment and overall plumbness of the wall.
5. An account of the wall reinforcing elements, including storage and handling methods, procedures used to attach and fasten reinforcements, methods used to minimize disturbance to compacted material at attachment locations, and technique employed to remove slack.
6. A summary of the field conditions and drainage control, including installation of subsurface drainage system, methods for positive control and discharge of all surface drainage during the walls construction, and any adverse weather impacts to the wall system.
7. An account of the geomembrane installation, including the elevation in relation to the reinforced mass, placement technique, details/materials used at connections to vertical projections extending through the geomembrane, seam sealing method/equipment specifications, installation of subsurface drainage system.
8. Identification of any approved field changes.
9. Remarks on the construction procedure and a conclusion regarding whether or not the completed wall construction has met the designated Wall Systems design and installation requirements.

B. MSES Excavation and Disposal. Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation and the details specified in the contract documents.

C. MSES Foundation. Prior to erection of the wall system, the foundation shall be inspected and approved by the Engineer.

1. Placement Area. Grade the area under the MSES, level for a width equal to, or in excess of, the distance from a minimum of 3 ft. extending past the MSES face to the end of the reinforcing element length. Prior to wall system construction, compact this area to a minimum of 90% of Standard Proctor Maximum Density. Treat all soils found to be unsuitable, or incapable of being satisfactorily compacted because of moisture content, in a manner directed by the Engineer, in conjunction with the recommendations of the Regional Geotechnical Engineer.

D. MSES Subsurface Drainage System. Install the subsurface drainage system simultaneously with the erection and backfill of the MSES to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

E. MSES Facing Panel Unit Inspection, Storage, and Handling

1. Face Panel Units. An inspection will be made prior to installation to determine if any damage has occurred to the panel unit(s). Handle and store the panel units with care to prevent damage.

2. Damaged Panel Units. Repair damaged panel units in a manner approved by the Engineer. Replace panel units that are not repairable at no additional cost to the State.
F. MSES Leveling Pad. Provide an unreinforced concrete leveling pad as required by the contract documents. Cast the concrete, in accordance with the requirements Section 555 Structural Concrete, or place the precast leveling pad for the foundation of the MSES to ensure a flat surface for placing the initial course of precast facing panel units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.

G. MSES Erection

1. Methods and Equipment. Install panel units in accordance with the designers approved shop drawings and Installation Manual, unless otherwise modified by the contract documents. Prior to installation of the panel units, furnish the Engineer with detailed information concerning the proposed construction method, as well as the equipment planned for use. Erection is to begin on the leveling pad at the lowest elevation and proceed in horizontal lifts.

2. Panel Unit Installation

   i. Place panel units such that, after completion of compaction, the tolerances of Table 554-1 *MSES Facing Panel Unit Alignment and Joint Offset Tolerances* are not exceeded. After placement, maintain each panel unit in position. If wedges are used, do not allow them to remain in place below three panel unit heights during installation, and compaction. Remove all wedges remaining in the top three panel unit heights upon completion of the MSES. External braces may be required for initial placements. Install joint fillers in the manner indicated by the Installation Manual.

   ii. Correct all misalignments of installed panel units in excess of the tolerances allowed by Table 554-1 *MSES Facing Panel Unit Alignment and Joint Offset Tolerances*, at no additional cost to the State.

<table>
<thead>
<tr>
<th>TABLE 554-1 MSES FACING PANEL UNIT ALIGNMENT AND JOINT OFFSET TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Alignment</td>
</tr>
<tr>
<td>Joint Offset per Panel Unit</td>
</tr>
<tr>
<td>Overall Vertical Plumbness (Top to Bottom of Wall System)</td>
</tr>
</tbody>
</table>

H. MSES Backfill. Do not mix backfill material from different sources behind any wall without the written permission of the Director, Geotechnical Engineering Bureau.

1. Moisture Content. Place backfill materials, other than Type B, at or within 2% dry of the Optimum Moisture Content. Rework or replace all backfill material which is at a moisture content in excess of the Optimum Moisture content. Determine the Optimum Moisture Content in conformance with the latest Geotechnical Test Methods for compaction that incorporate moisture content determination. Rework or replace backfill material at no additional cost to the State.

2. Backfill Placement. Prior to placement of the reinforcing element, backfill and compact the area within 3 ft. of the panel units horizontally to 2 in. above the required reinforcing element elevation. Roughly grade the backfill beyond the 3 ft. line to the reinforcing element elevation.

   i. Place granular backfill material in uniform layers not exceeding 12 in. loose lift thickness per layer. Compact each layer to a minimum of 95% of Standard Proctor Maximum Density.
ii. Place Type B backfill in uniform layers not exceeding 16 in. loose lift thickness. Compact in accordance with requirements determined by the Engineer.

iii. Place any backfill material in the area within 3 ft. of the panel units in uniform layers not exceeding 6 in. loose lift thickness per layer. Compact in accordance with requirements determined by the Engineer.

3. Surface Drainage Control. Provide positive control and discharge of all surface drainage that will affect the installation of the MSES throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

4. QA Program. The Department will sample and test backfill from the grade in accordance with the Quality Assurance Program outlined in §733-02 Mechanically Stabilized Earth System Backfill Material. If the material is determined to not meet the specification requirements, the material will be rejected.

5. Geomembrane. As outlined in §554-3.01.B.4.i Geomembrane, if the MSES reinforced mass requires a geomembrane, install the geomembrane in accordance with §207-3.02 Geomembranes.

I. MSES Reinforcing Elements. Place reinforcing elements in accordance with the designer’s recommendations or as described in the designer’s Installation Manual. Before attaching the reinforcing elements to the panel units, repair all damage to the zinc coating in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type I.

1. Placement. Place reinforcing elements normal to the panel units unless indicated otherwise by the contract documents or approved shop drawings. Take care to avoid breaking, distorting, or disturbing the reinforcing elements. Replace reinforcing elements which are broken or distorted.

2. Connections. Prior to the attachment of the reinforcing elements, as required, fill all openings, or attachment locations, with grease, or other protective material. Obtain the grease or other protective materials from the chosen designer.

Remove only enough backfill material placed in accordance with §554-3.02 H.2 Backfill Placement to properly join and secure the connection. Connect reinforcing elements to the face panel unit before placement of subsequent face panel units, or as directed by the approved shop drawings.

3. Reinforcing Elements. All soil reinforcing elements shall be vertically separated from other reinforcing elements by a minimum of 3 in.

J. MSES Identification Markers. Install MSES identification markers.

Place the marking tape at the highest possible elevation that will not damage the tape. For walls supporting a pavement section, install the tape 6 in. below top of subbase elevation. For walls supporting earth, install the tape 6 in. below finished grade. Install the marking tape on top of the reinforced backfill area, parallel to the wall face in rows at 5 ft. intervals until the back edge of the reinforced backfill area is reached.

Drill two, 5/16 in. diameter, holes for mounting, located ½ in. from the ends of the sign and 3 ½ in. from the top of the sign. Secure the sign using anchorage appropriate for the supporting material.
K. Equipment Movement. Movement of construction equipment and all other vehicles and loads over and adjacent to MSES shall be done at the Contractor's risk. Govern the operations and procedures to prevent misalignment of the installed panel units. Precautionary measures include, but are not limited to, keeping vehicular equipment a minimum of 3 ft. from the panel units. Within 3 ft. of the panel units use compaction equipment meeting the requirements of **Compaction Equipment for Confined Areas** in Section 203 Excavation and Embankment. Operate rubber-tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in strict accordance with the designers written instructions at no additional cost to the State.

554-3.03. Mechanically Stabilized Wall System.

A. Pre-Operation Meeting. A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate Department representatives to discuss the Contractors proposed construction methods. Begin work only after receiving the DCETS written approval and holding the Pre-Operation Meeting.

Supply on-site technical assistance and an engineering survey report on the wall in accordance with §554-3.02 A. Pre-Operation Meeting.

B. MSWS Excavation and Disposal. Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation and the details specified in the contract documents.

C. MSWS Foundation. Prepare the foundation in accordance with the requirements of §554-3.02 C. MSES Foundation.

D. MSWS Subsurface Drainage System. Install the subsurface drainage system simultaneously with the erection and infill/backfill of the MSWS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

E. MSWS Leveling Pad. Provide an unreinforced concrete leveling pad or compacted granular fill leveling pad as shown in the contract documents to ensure a flat surface for placing the initial course of face units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.

1. Concrete. Cast the concrete leveling pad, in accordance with the requirements of Section 555 Structural Concrete, or place the precast leveling pad, for the foundation of the MSWS.

2. Granular. Place and compact granular fill in conformance with Section 203 Excavation and Embankment.

F. MSWS Facing Unit Erection

1. Methods and Equipment. Install face units in accordance with the designers approved shop drawings and Installation Manual, unless otherwise modified by the contract documents. Prior to installation of the face units, furnish the Engineer with detailed information concerning the proposed construction method, as well as the equipment planned for use. Erection is to begin on the leveling pad at the lowest elevation and proceed in horizontal lifts.
2. Solid Face Unit Erection

i. Install by placing, positioning, and aligning face units in conformance with the designers Installation Manual and within the tolerances in Table 554-2 MSWS Solid Face Unit Alignment Tolerances.

ii. Correct all misalignments of installed face units that exceed the tolerances allowed in Table 554-2 MSWS Solid Facing Unit Alignment Tolerances.

<table>
<thead>
<tr>
<th>TABLE 554-2 MSWS SOLID FACE UNIT ALIGNMENT TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Control</td>
</tr>
<tr>
<td>Horizontal Control</td>
</tr>
<tr>
<td>Rotation from established plan wall batter</td>
</tr>
</tbody>
</table>

2. Open Top Face Unit Erection. During erection, any face unit damaged beyond repair shall be removed and replaced by the Contractor with approved face units at no additional cost to the State.

i. All face units shall be assembled and handled in accordance with the designer’s instructions and the contract documents. Erect the face units conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer’s installation manual.

ii. Place the face units side by side and in full contact with the installed leveling pad.

iii. Maintain the minimum face unit tolerances shown in Table 554-3 MSWS Open Top Face Unit Tolerances. Correct all misalignments of installed face units that exceed the tolerances allowed in a manner satisfying the Engineer:

<table>
<thead>
<tr>
<th>TABLE 554-3 MSWS OPEN TOP FACE UNIT ALIGNMENT TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Control (plumbness)</td>
</tr>
<tr>
<td>Horizontal Location Control (alignment)</td>
</tr>
<tr>
<td>Vertically overall (plumbness from top to bottom)</td>
</tr>
</tbody>
</table>

iv. Adjust face unit spacing for curved sections according to the manufacturer's installation recommendations.

G. MSWS Facing Unit Bin Infill

1. Solid Face Unit Bin Infill

i. Placement. Place unit infill to the limits indicated in the contract documents. Before installing the next course of face units, compact the unit infill and brush the tops of the face units clean to ensure an even placement area.

ii. Protection. Protect unit infill from contamination during construction.

2. Open Top Face Unit Bin Infill.
i. Placement. Place and compact backfill and face unit infill simultaneously with the erection of the PWS and in accordance with Compaction in Section 203 Excavation and Embankment. Placement of infill in the wall and backfill behind the wall shall closely follow the erection of successive courses of face units.

ii. Protection. Protect unit infill from contamination during construction.

H. MSWS Backfill. Do not mix backfill material from different sources behind any wall without the written permission of the Director, Geotechnical Engineering Bureau.

1. Moisture Content. Place backfill materials (other than Types B and D) at or within 2% dry of the Optimum Moisture Content. Rework or replace all material which is at a moisture content exceeding the Optimum Moisture Content. Determine Optimum Moisture Content in conformance with Geotechnical Test Methods (excluding GTM-6) for compaction that incorporates moisture content determination. Rework or replace backfill material at no additional cost to the State.

2. Backfill Placement. Prior to placement of the reinforcing element, backfill and compact the area within 3 ft. of the face units horizontally to 2 in. above the required reinforcing element elevation. Roughly grade the backfill beyond the 3 ft. line to the reinforcing element elevation.

   i. Place granular backfill material in uniform layers so that the compacted thickness of each layer does not exceed 10 in. or one unit height, whichever is less. Compact each layer to a minimum of 95% of Standard Proctor Maximum Density.

   ii. Place Type B backfill in uniform layers so that the compacted thickness of each layer does not exceed 10 in. or one unit height, whichever is less. Compact each layer in conformance with Compaction in Section 203 Excavation and Embankment.

3. Separation Geotextile. Place the geotextile separation, if required, loosely but in intimate contact with the soil so that placement of the overlying material will not stretch or tear the geotextile.

4. Surface Drainage Control. Provide positive control and discharge of all surface drainage that will affect the installation of the MSWS throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

5. QA Program. The Department will sample and test backfill from the grade in accordance with the Quality Assurance Program outlined in §733-02 Mechanically Stabilized Earth System Backfill Material. If the material is determined to not meet the specification requirements, the material will be rejected.

6. Geomembrane. As outlined in §554-3.01.B.4.ii Geomembrane, if the MSWS reinforced mass requires a geomembrane, install the geomembrane in accordance with §207-3.02 Geomembranes.

I. MSWS Reinforcing Element
1. **Reinforcing Element Placement.** Place the reinforcing element normal to face units unless otherwise indicated in the contract documents. Replace all broken, damaged or distorted reinforcing elements at no additional cost to the State.

2. **Reinforcing Element Connection.** Install the reinforcing element within/between courses of face units conforming to the designers Installation Manual. Pull taut and secure the reinforcing element before placing the backfill.

**J. MSWS Identification Markers.** Install MSWS identification markers in accordance with the requirements of §554-3.02 J. **MSES Identification Markers.**

**K. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to MSWS shall be done at the Contractor's risk. Control all operations and procedures to prevent misalignment of the face units. Precautionary measures include, but are not limited to, keeping vehicular equipment at least 3 ft. behind the back of the face units. Compaction equipment used within 3 ft. of the back of the face units must conform to *Compaction Equipment for Confined Areas* in Section 203 Excavation and Embankment. Operate rubber-tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in strict accordance with the designers written instructions at no additional cost to the State.

**554-3.04. Geosynthetically Reinforced Soil System.**

**A. GRSS Submittal.** Submit the geogrid or geotextile reinforcing element certifications, verifying that the material meets the requirements of §737-07 *Geogrids* for the specified long-term design tensile strength shown in the contract documents, to the Engineer prior to start of work. Begin work only after receiving the Engineer’s approval.

**B. GRSS Storage of Geosynthetic.** Store and protect geosynthetic materials in accordance with the manufacturer’s recommendations prior to installation.

**C. GRSS Excavation and Disposal.** Excavation shall be conducted in accordance with the applicable requirements of Section 206 *Trench, Culvert and Structure Excavation* and the details specified in the contract documents.

**D. GRSS Foundation.** Prior to erection of the GRSS system, the foundation shall be inspected and approved by the Engineer.

- Grade the area under the GRSS level for the width shown in the contract documents. A minimum of 90% of Standard Proctor Maximum Density will be required.

- For GRSS wall systems, a pad of crushed stone shall be incorporated into the foundation directly below the wall facing.

**E. GRSS Subsurface Drainage System.** Install the subsurface drainage system simultaneously with the erection and backfill of the GRSS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

**F. GRSS Placement of Materials.**
1. Geosynthetic Reinforcing Element. Place and secure the primary and secondary reinforcing element in accordance with the manufacturer’s recommendations, in continuous strips without joints, seams or connections throughout the embedment length, to the line, grade and orientation shown in the contract documents. Place reinforcing elements to lay flat with no creases and pull taut to remove any slack prior to placement of backfill.

2. Welded Wire Forms. Place welded wire forms where required, as shown in the contract documents. Position and connect the welded wire forms to overlap 2 in. with adjacent forms and connect with wire ties. Install wire struts as shown in the contract documents and as required to stiffen the welded wire forms.

3. Geotextile Face Wrap. Place geotextile face wrap as shown in the contract documents. If used in conjunction with welded wire forms, place the geotextile face wrap so as to conform closely to the welded wire forms.

4. Backfill. Replace any damaged geosynthetic prior to placement of any overlying material at no cost to the State. Place the backfill onto the geosynthetic reinforcing elements in such a manner that no damage occurs. Progress placement of backfill materials so as to minimize the development of slack in the reinforcing element. The thickness of a compacted lift of backfill is not to exceed 12 in. or the measured vertical distance between geosynthetic layers, whichever is less. Compact the backfill to a minimum of 95% of Standard Proctor Maximum Density in accordance with the requirements contained in Compaction in Section 203 Excavation and Embankment. Only hand operated equipment is allowed within 3 ft. of the face. Lift thickness may have to be reduced to achieve required compaction.

5. Surface Protection. Place and secure erosion control material in accordance with Section 209 Soil Erosion and Sediment Control and as shown in the contract documents.

6. Permanent Facing. Place and connect permanent facing as shown in the contract documents.

7. Surface Drainage Control. Provide positive control and discharge of all surface drainage that will affect the installation of the GRSS throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

G. GRSS Construction Monitoring. Monitor the system face during fill placement and compaction. If verticality or the required batter of a system is not being maintained, stop work until compaction equipment and/or operational procedures are modified.

H. GRSS Identification Markers. For applications other than staging walls, install GRSS identification markers in accordance with the requirements of §554-3.02 J. MSES Identification Markers.

I. Equipment Movement. Movement of construction equipment and all other vehicles and loads over and adjacent to GRSS shall be done at the Contractor’s risk. Operate rubber-tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in accordance with the manufacturer’s written instructions at no additional cost to the State.
554-3.05. Prefabricated Wall System.

A. PWS Excavation and Disposal. Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation and the contract documents.

B. PWS Foundation. Prior to erection of the wall system, the foundation shall be inspected and approved by the Engineer.
   - Grade the area under the PMWS level for the width shown in the contract documents. A minimum of 90% of Standard Proctor Maximum Density will be required.
   - Construct the wall system to meet the line and grade shown in the contract documents.

C. PWS Subsurface Drainage System. Install the subsurface drainage system simultaneously with the erection and infill/backfill of the PWS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, install the subsurface drainage system to drain all intercepted water to a point of positive drainage.

D. PWS Leveling Pad. Provide an unreinforced concrete leveling pad or compacted granular fill leveling pad as shown in the contract documents to ensure a flat surface for placing the initial course of face units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.
   1. Concrete. Cast the concrete leveling pad, in accordance with the requirements of Section 555 Structural Concrete, or place the precast leveling pad, for the foundation of the PWS.
   2. Granular. Place and compact granular fill in conformance with Section 203 Excavation and Embankment.

E. PWS Erection. During erection, remove and replace any face units damaged beyond repair with approved face units at no additional cost to the State.
   1. Assembly. All PWS shall be assembled and handled in accordance with the designer’s instructions and the contract documents. Erect the PWS conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer's installation manual.
   2. Placement. Place the PWS side by side and in full contact with the installed leveling pad.
   3. Tolerances. Maintain the minimum PWS tolerances shown in Table 554-2 MSWS Solid Face Unit Alignment Tolerances or Table 554-3 MSWS Open Top Face Unit Alignment Tolerances as appropriate. Correct all misalignments of installed face units that exceed the tolerances allowed in a manner satisfying the Engineer:
   4. Adjustments. Adjust PWS spacing for curved sections according to the manufacturer's installation recommendations.
   5. Coping. Apply the coping unit to the top of the wall using mastic adhesive, in accordance with, and conforming to the unit manufacturer's installation recommendations.
**F. PWS Infill and Backfill.** Immediately prior to backfilling, the Engineer will inspect the face units for damage. Face units which are damaged beyond repair shall be removed and replaced by the Contractor with approved face units at no additional cost to the State.

Place and compact backfill and unit infill simultaneously with the erection of the PWS and in accordance with *Compaction* in Section 203 Excavation and Embankment. Placement of infill in the wall and backfill behind the wall shall closely follow the erection of successive courses of face units.

**G. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to PWS shall be done at the Contractor's risk. Control all operations and procedures to prevent misalignment of the PWS. Precautionary measures include, but are not limited to, keeping vehicular equipment at least 3 ft. behind the back of the face units. Compaction equipment used within 3 ft. of the back of the face units must conform to the *Compaction Equipment for Confined Areas* in Section 203 Excavation and Embankment. Any damage to face units from any cause shall be repaired or replaced by the Contractor at no additional cost to the State.

**554-3.06 Fill Type Retaining Wall Aesthetic Treatment.** Provide aesthetic treatment as specified in the contract documents. Any damage to the treatment shall be repaired to the satisfaction of the Engineer at no additional cost to the State.

**554-4 METHOD OF MEASUREMENT.**

**554-4.01. General.** Vacant.

**554-4.02. Mechanically Stabilized Earth System.** A MSES will be measured in square feet of face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.03. Mechanically Stabilized Wall System.** A MSWS will be measured in square feet of face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.04. Geosynthetically Reinforced Soil System.** A GRSS will be measured in square feet of vertical face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.05 Prefabricated Wall System.** A PWS will be measured in square feet of vertical face area, measured to the nearest square foot from the payment lines shown in the contract documents.

**554-4.06 Fill Type Retaining Wall Aesthetic Treatment.** Aesthetic treatment will be measured in square feet of treated face area, measured to the nearest square foot from the payment lines shown in the contract documents. Include only those visual standards incorporated into the finished wall into the measurements.

**554-5 BASIS OF PAYMENT**

**554-5.01. General.** Vacant.

**554-5.02 Mechanically Stabilized Earth System.** Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, reinforcing elements, leveling pads, fasteners, joint fillers, geotextiles, face panel and coping units, subsurface drainage system, geomembrane, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.
554-5.03 Mechanically Stabilized Wall System. Include in the unit price bid the cost of all labor, material, and equipment, including backfill, infill, reinforcing elements, leveling pads, fasteners, geotextiles, face units and coping units, subsurface drainage system, geomembrane, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

554-5.04 Geosynthetically Reinforced Soil System. Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, geosynthetic reinforcing elements, facing system, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

554-5.05 Prefabricated Wall System. Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, infill, leveling pads, joint fillers, geotextiles, face units and coping units, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

554-5.06 Fill Type Retaining Wall Aesthetic Treatment. Include in the unit price bid the cost of all labor, material, and equipment needed to provide aesthetic treatment for the wall and the cost of production and transportation of visual standards from the precast facility to the project site for Region approval and back to the precast facility for use during production.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>554.30XX</td>
<td>Geosynthetically Reinforced Soil System Wall</td>
<td>Square Feet</td>
</tr>
<tr>
<td>XX</td>
<td>Facing System</td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>Welded Wire Forms</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>Geocells</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Timbers</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>Other; As Shown in the Contract Documents</td>
<td></td>
</tr>
<tr>
<td>554.31</td>
<td>Geosynthetically Reinforced Soil System Slope</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.40</td>
<td>Fill Type Retaining Wall (0 – 6 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.41</td>
<td>Fill Type Retaining Wall (Greater than 6 ft. – 12 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.42</td>
<td>Fill Type Retaining Wall (Greater than 12 ft. – 18 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.43</td>
<td>Fill Type Retaining Wall (Greater than 18 ft. – 24 ft.) Square Feet</td>
<td>Square Feet</td>
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<tr>
<td>554.44</td>
<td>Fill Type Retaining Wall (Greater than 24 ft. – 30 ft.)</td>
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<td>554.45</td>
<td>Fill Type Retaining Wall (Greater than 30 ft.)</td>
<td>Square Feet</td>
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<td>Fill Type Retaining Wall Aesthetic Treatment - Textured Surface (Hand Tooled, Raked, etc.), No Color</td>
<td>Square Feet</td>
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<td>Fill Type Retaining Wall Aesthetic Treatment - Textured Surface (Hand Tooled, Raked, etc.), Integral Color</td>
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<td>Fill Type Retaining Wall Aesthetic Treatment - Exposed Aggregate Finish, No Color</td>
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<tr>
<td>554.5102</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Exposed Aggregate Finish, Integral Color</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.5201</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Architectural Pattern, No Color</td>
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<td>554.5202</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Architectural Pattern, Integral Color</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.53</td>
<td>Fill Type Retaining Wall Aesthetic Treatment -</td>
<td></td>
</tr>
</tbody>
</table>
554-1 DESCRIPTION. This work shall consist of furnishing and installing a fill type retaining wall at the location(s) and to the elevation(s) shown in the contract documents.

554-1.01. General. The fill type classification refers to the construction method used for the installation of the wall. Fill type retaining walls are retaining structures constructed from the base of the wall to the top (i.e., “bottom-up” construction).

The fill type retaining walls are further classified according to the basic mechanism of lateral load support. These classifications include internally stabilized fill structures and externally stabilized fill structures.

The specification is supplemented with an Approved List which provides a listing of available designers and their corresponding fill type retaining walls. Fill type retaining walls are further defined in the pertinent subsequent section. For proprietary fill type retaining wall systems, approved designers, wall systems, and the components of each wall system appear on the Approved List, available on the Department’s web site. Designers wishing to have their wall systems reviewed for placement on the Approved List shall follow the procedural directives of the Geotechnical Engineering Bureau as contained in Highway Design Manual Appendix 9A.

554-1.02 Definitions. Internally stabilized fill structures are structures which rely on friction developed between closely-spaced reinforcing elements and the backfill to resist lateral soil pressure and are subcategorized in the retaining wall subsections of this specification. Externally stabilized fill structures are structures which utilize the weight of the wall system elements and the weight of the infill to resist lateral soil pressure.

A. Wall System. A wall system is either a series of open top face units assembled to form bins which are connected in unbroken sequence or a combination of specific solid face units with a characteristic alignment and connection method, which utilize the weight of the wall system elements and the weight of the infill to resist lateral soil pressure. As indicated, the bin volume is infilled with backfill material to supplement the face unit geometry, adding to the stability of the system.

B. Internally Stabilized Wall System. A wall system which, when constructed beyond wall heights exceeding the maximum allowable unreinforced height per the Approved List, relies on reinforcing elements within the backfill to provide stability.

C. Internally Stabilized Earth System. A series of tensile reinforcing elements which, when placed in multiple layers within the backfill volume, improves the strength such that the vertical face of the stabilized earth volume is essentially self-supporting.

D. Internally Stabilized Fill Structures.

1. Fill Structure. A fill type retaining wall as described in §554-1.01 Fill Type Retaining Walls which consists of either an internally stabilized wall system or an internally stabilized earth system.

i. Mechanically Stabilized Earth System (MSES). An MSES is an internally stabilized fill structure comprised of an unreinforced concrete leveling pad, precast concrete face panel units and coping units, earth backfill, subsurface drainage system, and reinforcing elements used to stabilize the backfill. Only MSES designers appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, leveling pad, and subsurface drainage system, are obtained from the approved wall system designer.
ii. **Mechanically Stabilized Wall System (MSWS).** An MSWS is an internally stabilized fill structure comprised of an unreinforced concrete or compacted granular fill leveling pad, face units (solid or open top) and coping units, earth backfill, subsurface drainage system, and reinforcing elements used to stabilize the backfill. Only MSWS designers with face units appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, face unit infill, leveling pad material, backfill drainage materials, and cast-in-place concrete, are obtained from the designer.

iii. **Geosynthetically Reinforced Soil System (GRSS).** A GRSS is an internally stabilized fill structure comprised of earth backfill, geosynthetic reinforcing elements used for internal stabilization and surface protection to resist erosion.

   a. **GRSS Wall.** For wall applications, the surface protection is the permanent facing elements (excluding precast units) or a geotextile face wrap which typically includes welded wire forms remaining from the installation operation.

   b. **GRSS Slope.** For slope applications, the surface protection consists of a secondary reinforcing element to aid in stability of the slope face between primary reinforcing layers. To protect against erosion, the GRSS slope is covered by either a non-degradable erosion control mat or a granular fill slope protection blanket.

--- Although GRSS is a fill type retaining wall, it is not a part of the selection process outlined in §§554-3.01A, *Fill Type Retaining Wall Selection* or supplemented by the Approved List for Fill Type Retaining Walls, as it is not a proprietary system. A GRSS will be designed and detailed in the contract documents by the Department or its representatives.

2. **Leveling Pad.** A compact surface which serves as a flat, level area for placing the initial course of face units.

   i. **Concrete.** An unreinforced concrete slab.

   ii. **Granular.** A compacted-granular-fill pad.

3. **Face Unit.** A structural unit incorporating a means for attaching the backfill reinforcing element, which restrains the alignment of the wall system during installation compaction operations and provides support for the front edge of the backfill for the life of the wall system.

   i. **Panel Unit.** A precast concrete panel incorporating a means for attaching the backfill reinforcing element, forming part of the face area of the MSWS.

   ii. **Solid Unit.** A face unit which has a solid mass and incorporates a means for attaching the backfill reinforcing element, forming part of the face area of the MSWS.

   iii. **Open Top Unit.** A face unit which has an open structure, to allow placement of infill material, and incorporates a means for attaching the backfill reinforcing element, forming part of the face area of the MSWS.

   iv. **Corner Unit.** A corner unit is a face unit having two faces.

   v. **Geotextile Face Wrap.** A layer of geotextile used to prevent loss of backfill, typically employed in a temporary wall application in conjunction with welded wire forms. In
applications where a geotextile is used as the primary reinforcing element, it may be designed to also function as the face wrap.

3. **Welded Wire Forms.** A non-structural system used in temporary walls to aid in compaction near the face of the wall.

vi. **Geocells.** A three-dimensional, permeable polymeric honeycomb or web structure expandable panels used to confine fill materials to create structural stability.

vii. **Timbers.** A dressed piece of wood used as a building material.

viii. **Gabions.** A partitioned, wire fabric container filled with stone to form a flexible and permeable structure.

4. **Alignment and Connection Device.** Any device that is either built into or specially manufactured for the face units, such as shear keys, leading/trailing lips, or pins. The device is used to provide alignment and maintain positive location for a face unit and also provide a means for connecting the reinforcing elements.

5. **Fastener.** Hardware used to connect the reinforcing element to the attaching device.

6. **Coping.** A precast or cast-in-place element placed on and attached to the top of the finished wall system to form a protective cap against the weather.

7. **Joint Filler.** Material used to fill the joints between face units.

8. **Slip Joint.** A vertical joint specific to the wall system used as a stress relief at wall step locations.

9. **Geotextile.** A permeable, planar polymeric textile material used to promote drainage, prevent infill and/or backfill material from releasing through the joints, or separating dissimilar granular materials.

10. **Reinforcing Element.** An inclusion connected to the face unit and extending into the backfill for the purpose of backfill stabilization.

   i. **Inextensible Reinforcement.** A metal strip typically incorporating ribs on the top and bottom, or metal grids with design specific mesh openings.

   ii. **Extensible Reinforcement.** Geogrid or geotextile sheets typically made from high density polyethylene/polypropylene geogrids or high tenacity polyester geogrids, or high strength geotextiles.

11. **Unit Infill.** Granular material placed within the open structure of an open top face unit or contiguous to the bevel sides of a solid face unit.

12. **Backfill.** Granular material placed and compacted in conjunction with the reinforcing elements and face units.

13. **Subsurface Drainage System.** A system for removing water from behind the wall and channeling it to a point of positive drainage.
14. Identification Markers.—Signs and marking tape, buried near the finished grade, to identify and prohibit excavation of the reinforced backfill.

E. Externally Stabilized Fill Structures.

1. Fill Structure. A fill type retaining wall as described in §554-1.01 Fill Type Retaining Walls which consists of a prefabricated face unit.

   i. Prefabricated Wall System (PWS). A PWS is an externally stabilized fill structure comprised of prefabricated face units & coping units, including leveling pads, unit infill, earth backfill, joint filler material and geotextile, and a subsurface drainage system to reduce hydrostatic pressure on the wall system. Only PWS designers appearing on the Approved List will be acceptable for use. All necessary materials, except backfill, unit infill, backfill drainage materials, and cast-in-place concrete, are obtained from the designer.

   — When reinforcement is introduced to a PWS, they shall be reclassified as Mechanically Stabilized Wall Systems and the pertinent sections of the specification shall apply.

2. Leveling Pad. A compact surface which serves as a flat, level area for placing the initial course of face units.

   i. Concrete. An unreinforced concrete slab.

   ii. Granular. A compacted granular fill pad.

3. Face Unit. A prefabricated concrete element, incorporating alignment and connection devices, that is able to be arranged, stacked, placed, combined, or interchanged easily into an assembled wall system.

   i. Solid Unit. A face unit which has a solid mass, utilizing the weight of the wall system elements to resist lateral soil pressure. A solid unit may require some infill material depending on the geometric bevel of the units.

   ii. Open Top Unit. A face unit which has an open structure to allow placement of infill material, utilizing the weight of the wall system elements and the weight of the infill to resist lateral soil pressure.

4. Bin. Any volumetric space which is designated to be infilled, as defined in this section, and is encompassed within the dimensions of the open top unit.

5. Alignment and Connection Device. Any device that is either built into or specially manufactured for the face units, such as shear keys, leading/trailing lips, or pins. The device is used to provide alignment and maintain a positive location.

6. Coping. A precast or cast-in-place element placed on and attached to the top of the finished wall system to form a protective cap against the weather.

7. Joint Filler. Material used to fill the joints between face units.
8. **Slip Joint.** A vertical joint specific to the wall system used as a stress relief at wall step locations.

9. **Geotextile.** A permeable, planar polymeric textile material used to promote drainage, prevent infill and/or backfill material from releasing through the joints, or separating dissimilar granular materials.

10. **Unit Infill.** Granular material placed within the bin, such as the open structure of an open top face unit or contiguous to the bevel sides of a solid face unit.

11. **Backfill.** Granular material placed directly behind and/or above the bins in conjunction with the wall assembly.

12. **Subsurface Drainage System.** A system for removing water from behind the wall and channeling it to a point of positive drainage.

**F. Aesthetic Treatment.** A treatment applied to the face either during or after the manufacture of the face units to modify the appearance of the units and of the wall as a whole. Aesthetic treatment can include modifications to color, texture, architectural pattern, the addition of exposed surface aggregate (real or artificial), the addition of simulated joints or cracks, or any other treatment or material that modifies the appearance, provided that the structural integrity, function, or life span of the wall is not negatively impacted.

**554-2 MATERIALS.**

**554-2.01. Fill Type Retaining Walls.** Provide materials for the selected fill type retaining wall as outlined in the pertinent subsequent section.

**554-2.02. Mechanically Stabilized Earth System.** Not all materials listed below are required for each MSES. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

A. **MSES Leveling Pad.** Provide leveling pad material meeting the requirements of Section 501 Portland Cement Concrete—General, Class A concrete.

1. **Leveling Pad Placement.** For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 Cushion Sand, in lieu of MSES backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

B. **MSES Facing Panel Units.** Fabricate precast concrete face panel units and incidental precast units in accordance with the requirements of §704-14 Precast Concrete Panel Units. The default aesthetic treatment for an MSES facing panel is a plain, smooth concrete finish of natural concrete (gray) color.

1. **Coping Unit.** Fabricate precast concrete coping units, and incidental precast units in accordance with the requirements of §704-14 Precast Concrete Panel Units.

C. **MSES Fasteners and Attaching Devices.** The fasteners and attaching devices are specific to each wall system and provided by the wall system manufacturer. The fasteners and attaching devices associated with each approved wall system appear on the Approved List under wall system components.
D. MSES Joint Fillers. Fill joints with material approved by DCES and approved by the wall system designer.

E. MSES Geotextile. Provide a geotextile meeting the requirements of §737-01B Geotextile Separation.

F. MSES Slip Joints. The type of slip joints are specific to each wall system and are designed and supplied by the wall system manufacturer.

G. MSES Metal Reinforcing Strips. Provide reinforcing strips of ASTM Designated metal grades and galvanize in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type I. The reinforcing strips associated with each approved wall system appear on the Department’s Approved List under wall system components.

H. MSES Metal Reinforcing Mesh. Fabricate the reinforcing mesh from cold drawn steel wire conforming to the requirements of §709-09 Cold Drawn Wire for Concrete Reinforcement, and weld into the finished mesh fabric in accordance with the requirements of §709-02 Wire Fabric for Concrete Reinforcement. Galvanize in accordance with §719-01 Galvanized Coatings and Repair Methods, Type I. The reinforcing mesh associated with each approved wall system appears on the Department’s Approved List under wall system components.

I. MSES Geogrid Reinforcing Element. Provide geogrid reinforcing elements meeting the requirements of §737-07 Geogrids. The grid(s) associated with each approved wall system appear on the Approved List under wall system components.

J. MSES Backfill. Provide backfill material meeting the requirements of §733-02 Mechanically Stabilized Earth System Backfill Material.

1. MSES Backfill – Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for MSES Backfill.

K. MSES Subsurface Drainage System. Provide underdrain and geotextile material for a backfill drainage system as shown in the contract documents or conforming to the designer’s Installation Manual:

1. Underdrain Pipe. Provide optional underdrain pipe conforming to Section 605 Underdrains.

2. Geotextile Drainage. Provide geotextile conforming to the requirements of §737-01 Geotextiles, Geotextile Drainage, Strength Class 2, Drainage Class B.

L. MSES Identification Markers

1. Signs. These will be 7 in. x 10 in. (minimum) fiberglass. Include warning information as follows:

   **WARNING**
   Internally Stabilized Fill Structure
   **DO NOT EXCAVATE**
   Call Regional Office of NYS DOT
For signs installed on concrete units, provide ¼ in. diameter by 1 ½ in. long stainless steel nail drive expansion anchors meeting GSA Specifications FF-S-325.

For signs installed on timbers, provide ¼ in. diameter by 1 ½ in. long stainless steel wood screws.

2. **Marking Tape.** This will be polyethylene material 3 in. wide, 4 mil. thick. Include warning markings.

554-2.03. **Mechanically Stabilized Wall System.** Not all materials listed below are required for each MSWS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

A. **MSWS Leveling Pad.** MSWS height is measured from the top of the leveling pad to the top of the face coping unit.

1. **Wall Heights Taller Than or Equal to 15 ft.** For MSWS taller than or equal to 15 ft. in total height, provide a leveling pad of unreinforced Class A concrete—Section 501 Portland Cement Concrete—General.

2. **Wall Heights Shorter Than 15 ft.** For MSWS shorter than 15 ft. in total height, provide a leveling pad conforming to one of the following:

   i. **Concrete.** Unreinforced Class A concrete—Section 501 Portland Cement Concrete—General, or

   ii. **Granular.** Select Granular Fill—§733-11 Select Granular Fill, or Crushed Stone—§501-2.02, B.1.b. Coarse Aggregate Type CA-2 in Table 501-2 Coarse Aggregate Gradations.

3. **Leveling Pad Placement.** For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 Cushion Sand, in lieu of MSWS backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

B. **MSWS Facing System.** Provide a facing system in accordance with the requirements below.

1. **Solid Face Units.** Provide face units fabricated and conforming to §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The default treatment for a MSWS face unit is a split face finish of natural concrete (gray) color.

   i. **Coping Unit.** Provide coping units fabricated and conforming to §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

2. **Open Top Face Unit.** Provide face units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The default treatment for a MSWS face unit is a plain, smooth concrete finish of natural concrete (gray) color.

   i. **Coping Unit.** Provide coping units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

C. **MSWS Alignment and Connection Devices.** Provide devices conforming to the designers Installation Manual.
D. MSWS Joint Fillers. Fill joints with material meeting the requirements of §705-07 Premolded Resilient Joint Filler and approved by the wall system designer.

E. MSWS Geotextile. Provide a geotextile meeting the requirements of §737-01B Geotextile Separation.

F. MSWS Slip Joints. The type of slip joints are specific to each wall system and are designed and supplied by the wall system manufacturer.

G. MSWS Reinforcing Element. Provide geogrid or geotextile reinforcing elements meeting the requirements of §737-07 Geogrids.

H. MSWS Unit Infill. Provide infill material meeting the requirements of §733-02 Mechanically Stabilized Earth System Backfill Material.

1. MSWS Unit Infill—Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for MSES Backfill.

I. MSWS Backfill. Provide backfill material meeting the requirements of §733-02 Mechanically Stabilized Earth System Backfill Material.

1. MSWS Backfill—Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for MSES Backfill.

J. MSWS Drainage System. Provide underdrain, geotextile material, and prefabricated structural drain for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual:

1. Underdrain Pipe. Provide optional underdrain pipe conforming to Section 605 Underdrains.

2. Geotextile Drainage. Provide geotextile conforming to the requirements of §737-01 Geotextiles, Geotextile Drainage, Strength Class 2, Drainage Class B.

3. Prefabricated Composite Structural Drain. Provide structural drain conforming to the requirements of §737-04 Prefabricated Composite Structural Drain.

K. MSWS Identification Markers. Provide identification markers conforming to §554-2.02 L. MSES Identification Markers.

554-2.04. Geosynthetically Reinforced Soil System. Not all materials listed below are required for each GRSS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

A. GRSS Geosynthetic Reinforcing Element. Provide a geogrid or geotextile primary and secondary reinforcing elements meeting the requirements of §737-07 Geogrids.

B. GRSS Backfill. Provide backfill material conforming to the following:
1. **Walls.** Provide backfill material meeting the requirements of §733-14 *Select Structural Fill* with the exception that the pH requirements are waived.

   i. **GRSS Wall Backfill—Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Structural Fill*.

2. **Slopes.** Provide backfill material meeting the requirements of §733-03 *Geosynthetically Reinforced Soil System Slope Backfill Material*.

   i. **GRSS Slope Backfill—Winter Earthwork.** If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 *Winter Earthwork Material for Select Structural Fill*.

C. **GRSS Wall Facing Foundation.** Provide a pad of material meeting the requirements of §703-02 *Crushed Stone, Size Designation 2*.

D. **GRSS Facing System.** Provide a facing system shown in the contract documents and in accordance with the requirements below.

   1. **Welded Wire Forms.** Provide welded wire forms and wire struts as shown in the contract documents, conforming to the material requirements of §709-02 *Wire Fabric for Concrete Reinforcement*. For applications other than staging walls, provide galvanization to the forms in accordance with the requirements of ASTM A 641 Class 3 for zinc coating (including the zinc coating on the Style 2 fabric), ASTM A 856M Class 3 for Zn-5Al-MM coating, or ASTM A 809 for aluminum coating.

   — Provide geotextile face wrap material meeting the requirements of §737-01B *Geotextile Separation* and as shown in the contract documents.

   Proposed alternate, non-structural facing systems used to aid in compaction near the face of the wall shall be included in the submittal outlined in §554-3.03 A. *GRSS Submittal*.

   2. **Geocells.** Provide geocells, anchoring devices, and staples as shown in the contract documents, conforming to the material requirements of §737-08 *Geocells*.

   — Provide infill material conforming to §733-14 *Select Structural Fill*, with the added stipulation that the maximum particle size is 2 in. Where a vegetated face is called for, the outermost cells are to be filled with topsoil meeting the material requirements of §713-01 *Topsoil*.

   3. **Timbers.** Provide timbers as shown in the contract documents, graded for an extreme fiber stress of at least 1000 psi conforming to the material requirements of §712-14 *Stress Graded Timber and Lumber*. Treat timbers in accordance with §708-31 *Wood Preservative—Waterborne* and applied in conformance with American Wood Preservers Association (AWPA) Use Category Designation UC4B.

   4. **As Shown in the Contract Documents.** Provide materials in accordance with the contract documents. Precast units are excluded as a design-specific GRSS facing system.

E. **GRSS Surface Protection.** Provide erosion resistant covering of the finished GRSS slope surface meeting the requirements of §713-07 *Rolled Erosion Control Products and Soil Stabilizers Class III Type C*. 
F. GRSS Drainage System. Provide underdrain and geotextile material for a backfill drainage system conforming to §554-2.02 K. MSES Drainage System.

G. GRSS Identification Markers. Provide identification markers conforming to §554-2.02 L. MSES Identification Markers.

554-2.05. Prefabricated Wall System.- Not all materials listed below are required for each PWS. Ensure that the proper materials are supplied for the chosen system design. Provide materials meeting the following requirements:

A. PWS Leveling Pad. Provide a leveling pad conforming to the following:

1. Open Top Face Units. For PWS utilizing open top face units, provide a leveling pad of unreinforced Class A concrete — Section 501 Portland Cement Concrete — General. For precast leveling pad installations, a substitution of cushion sand, meeting the requirements of §703-06 Cushion Sand, in lieu of PWS backfill material directly beneath the leveling pad may be made to facilitate placement of the pad.

2. Solid Face Units. For PWS utilizing solid face units, provide a leveling pad conforming to the requirements of §733-11 Select Granular Fill or §501-2.02, B.1.b. Coarse Aggregate Type CA-2 in Table 501-2 Coarse Aggregate Gradations.

B. PWS Face Unit. Provide face units meeting the following:

1. Open Top Face Units. For PWS utilizing open top face units, provide units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The default treatment for a PWS open top face unit is a plain, smooth concrete finish of natural concrete (gray) color.

   i. Coping Unit. Provide coping units meeting the requirements of §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

2. Solid Face Units. For PWS utilizing solid face units, provide units meeting the requirements of §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing. The default treatment for a PWS solid face unit is a split face finish of natural concrete (gray) color.

   i. Coping Unit. Provide coping units fabricated and conforming to §704-07 Dry Cast Concrete Wall Units or §704-06 Precast Concrete Wall Units and Precast Concrete Cribbing.

C. PWS Joint Fillers. Fill joints with material meeting the requirements of §705-07 Premolded Resilient Joint Filler and approved by the wall system designer.

D. PWS Geotextile. Provide a geotextile meeting the requirements of §737-01B Geotextile Separation.

E. PWS Slip Joints. The type of slip joints are specific to each wall system and are designed and supplied by the wall system manufacturer.
F. PWS Backfill. Provide backfill material meeting the requirements of §733-14 Select Structural Fill.

1. PWS Backfill—Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Structural Fill.

G. PWS Unit Infill. Provide unit infill material meeting the requirements of §733-14 Select Structural Fill.

For systems which allow plantings to integrate the structure into the surrounding environment, the front pocket of the unit shall be filled with a minimum of 8 in. of topsoil conforming to the material requirements as specified in §713-01 Topsoil.

1. PWS Unit Infill—Winter Earthwork. If modified methods and procedures are not outlined in the Winter Earthwork Submittal, provide backfill material meeting the requirements of §733-16 Winter Earthwork Material for Select Structural Fill.

H. PWS Drainage System. Provide underdrain, geotextile material, and prefabricated structural drain for a backfill drainage system as shown in the contract documents or conforming to the designers Installation Manual:

1. Underdrain Pipe. Provide optional underdrain pipe conforming to Section 605 Underdrains.

2. Geotextile Drainage. Provide geotextile conforming to the requirements of §737-01 Geotextiles, Geotextile Drainage, Strength Class 2, Drainage Class B.

3. Prefabricated Composite Structural Drain. Provide structural drain conforming to the requirements of §737-04 Prefabricated Composite Structural Drain.

554-2.06 Fill Type Retaining Wall Aesthetic Treatment. The requirements for color, texture and pattern will be described in the contract documents using industry-standard descriptions and terminology. Other requirements will be vividly described in the contract documents using special notes and sketches, as needed.

554-3 CONSTRUCTION DETAILS

554-3.01. General.

A. Fill Type Retaining Wall Selection. Approved designers of proprietary Fill Type Retaining Walls, wall systems, and the components of each wall system appear on the Approved List, available on the Department’s web site. Proprietary Fill Type Retaining Walls include Mechanically Stabilized Earth Systems, Mechanically Stabilized Wall Systems, and Prefabricated Wall Systems.

Select a designer appearing on the Approved List for Fill Type Retaining Walls. The selection shall be based on the maximum wall height shown in the contract documents.

B. Fill Type Retaining Wall Submittal. Obtain from the chosen designer a Fill Type Retaining Wall design stamped by a Professional Engineer. Submit the design package, including working drawings of the wall design, design calculations, and the designers Installation Manual at least 30 work days before starting work to the following:
1. **Mechanically Stabilized Earth System.** Submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Materials Bureau in accordance with the requirements for Drawing in §704-03 Precast Concrete—General. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. The design package shall also include identification of backfill material gradation type(s) (outlined in §733-02B Gradation) suitable for the construction of the wall system, fabrication drawings for precast panels and coping and, for treatments applied to the face panel units other than the default treatment, a face panel unit sample for color and texture approval by the Regional Landscape Architect.

2. **Mechanically Stabilized Wall System.** Submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Geotechnical Engineering Bureau. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. The design package shall also include identification of backfill material gradation type(s) (outlined in §733-02B Gradation) suitable for the construction of the wall system and, for treatments applied to the face units other than the default treatment, a face unit sample for color and texture approval by the Regional Landscape Architect.

3. **Prefabricated Wall System.**

   i. **Open Top Face Units.** For PWS utilizing open top face units, submit the design package to the Deputy Chief Engineer Technical Services (DCETS) Attn: Materials Bureau in accordance with the requirements for Drawing in §704-03 Precast Concrete—General. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. The design package shall also include fabrication drawings for the face units and, for treatments applied to the face units other than the default treatment, a face unit sample for color and texture approval by the Regional Landscape Architect.

   ii. **Solid Face Units.** For PWS utilizing solid face units, submit the design package to the Engineer for approval. For solid face units consisting of units manufactured via the wet-casting process, submit the design package in accordance with the requirements for Drawing in §704-03 Precast Concrete—General. The design shall be consistent with the design methods employed in obtaining acceptance to appear on the Department’s Approved List. For treatments applied to the face units other than the default treatment, the design package submittal shall also include a face unit sample for color and texture approval by the Regional Landscape Architect.

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After receipt of all pertinent information, the Department requires 10 work days or 2 work days per drawing sheet, whichever is greater, to review the submission.

C. **Winter Earthwork.** For Contractors choosing to proceed with earthwork construction operations requiring soil compaction from November 1st thru April 1st, provide the Engineer with a Winter Earthwork submittal, with a copy to the Regional Geotechnical Engineer, in accordance with §203-3.01 A. Winter Earthwork Submittal. In all work incorporated into the final product, the Contractor shall not place material that is frozen, or place fill material on ground that is frozen to any depth. Winter earthwork restrictions state that if the air temperature, ground temperature, or material temperature is at or below 32° F, earthwork will only proceed using material that meets the requirements of §733-16 Winter Earthwork and/or standard earthwork material placement utilizing the modified methods and procedures. Therefore, the Winter Earthwork submittal shall provide details of whether a material change will be used or if methods and procedures will be modified to...
adjust for the weather influence on the compaction operations. If a material change is proposed, the submittal shall provide details of when the change will occur and how many times the material will change within the construction of the wall.

554-3.02. Mechanically Stabilized Earth System.

A. Pre-Operation Meeting. A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate Department representatives to discuss the Contractor's proposed construction methods. Begin work only after receiving the DCES written approval and holding the Pre-Operation Meeting.

B. MSES Excavation and Disposal. Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation and the details specified in the contract documents.

C. MSES Foundation. Prior to erection of the wall system, the foundation shall be inspected and approved by the Engineer.

1. Placement Area. Grade the area under the MSES, level for a width equal to, or in excess of, the reinforcing element length. Prior to wall system construction, compact this area to a minimum of 90% of Standard Proctor Maximum Density. Treat all soils found to be unsuitable, or incapable of being satisfactorily compacted because of moisture content, in a manner directed by the Engineer, in conjunction with the recommendations of the Regional Geotechnical Engineer.

D. MSES Subsurface Drainage System. Install the subsurface drainage system simultaneously with the erection and backfill of the MSES to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

E. MSES Facing Panel Unit Inspection, Storage, and Handling

1. Face Panel Units. An inspection will be made prior to installation to determine if any damage has occurred to the panel unit(s). Handle and store the panel units with care to prevent damage.

2. Damaged Panel Units. Repair damaged panel units in a manner approved by the Engineer. Replace panel units that are not repairable at no additional cost to the State.

F. MSES Leveling Pad. Provide an unreinforced concrete leveling pad as required by the contract documents. Cast the concrete, in accordance with the requirements Section 555 Structural Concrete, or place the precast leveling pad for the foundation of the MSES to ensure a flat surface for placing the initial course of precast facing panel units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.

G. MSES Erection

1. Methods and Equipment. Install panel units in accordance with the designers approved shop drawings and Installation Manual, unless otherwise modified by the contract documents. Prior to
installation of the panel units, furnish the Engineer with detailed information concerning the proposed construction method, as well as the equipment planned for use.

2. Panel Unit Installation

i. Place panel units such that, after completion of compaction, the tolerances of Table 554-1 MSES Facing Panel Unit Alignment and Joint Offset Tolerances are not exceeded. After placement, maintain each panel unit in position. If wedges are used, do not allow them to remain in place below three panel unit heights during installation, and compaction. Remove all wedges remaining in the top three panel unit heights upon completion of the MSES. External braces may be required for initial placements. Install joint fillers in the manner indicated by the Installation Manual.

ii. Correct all misalignments of installed panel units in excess of the tolerances allowed by Table 554-1 MSES Facing Panel Unit Alignment and Joint Offset Tolerances, at no additional cost to the State.

<table>
<thead>
<tr>
<th>TABLE 554-1 MSES FACING PANEL UNIT ALIGNMENT AND JOINT OFFSET TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Alignment                              ± ¾ in. / 10 ft.</td>
</tr>
<tr>
<td>Joint Offset per Panel Unit                       ± ¾ in.</td>
</tr>
<tr>
<td>Overall Vertical Plumbness (Top to Bottom of Wall System) ± ½ in. / 10 ft.</td>
</tr>
</tbody>
</table>

H. MSES Backfill. Do not mix backfill material from different sources behind any wall without the written permission of the Director, Geotechnical Engineering Bureau.

1. Moisture Content. Place backfill materials, other than Type B and Type D, at or within 2% dry of the Optimum Moisture Content. Rework or replace all backfill material which is at a moisture content in excess of the Optimum Moisture content. Determine the Optimum Moisture Content in conformance with the latest Geotechnical Test Methods for compaction that incorporate moisture content determination. Rework or replace backfill material at no additional cost to the State.

2. Backfill Placement. Prior to placement of the reinforcing element, backfill and compact the area within 3 ft. of the panel units horizontally to 2 in. above the required reinforcing element elevation. Roughly grade the backfill beyond the 3 ft. line to the reinforcing element elevation.

   i. Place granular backfill material in uniform layers not exceeding 12 in. loose lift thickness per layer. Compact each layer to a minimum of 95% of Standard Proctor Maximum Density.

   ii. Place Type B and Type D backfill in uniform layers not exceeding 16 in. loose lift thickness. Compact in accordance with requirements determined by the Engineer.

3. Surface Drainage Control. Provide positive control and discharge of all surface drainage that will affect the installation of the MSES throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.
4. **QA Program.** The Department will sample and test backfill from the grade in accordance with the Quality Assurance Program outlined in §733-02 *Mechanically Stabilized Earth System Backfill Material*. If the material is determined to not meet the specification requirements, the material will be rejected.

1. **MSES Reinforcing Elements.** Place reinforcing elements in accordance with the designer’s recommendations or as described in the designer’s Installation Manual. Before attaching the reinforcing elements to the panel units, repair all damage to the zinc coating in accordance with the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

   1. **Placement.** Place reinforcing elements normal to the panel units unless indicated otherwise by the contract documents or approved shop drawings. Take care to avoid breaking, distorting, or disturbing the reinforcing elements. Replace reinforcing elements which are broken or distorted.

   2. **Connections.** Prior to the attachment of the reinforcing elements, as required, fill all openings, or attachment locations, with grease, or other protective material. Obtain the grease or other protective materials from the chosen designer. Connect reinforcing elements to the face panel unit before placement of subsequent face panel units, or as directed by the approved shop drawings.

2. **MSES Identification Markers.** Install MSES identification markers.

   — Place the marking tape at the highest possible elevation that will not damage the tape. For walls supporting a pavement section, install the tape 6 in. below top of subbase elevation. For walls supporting earth, install the tape 6 in. below finished grade. Install the marking tape on top of the reinforced backfill area, parallel to the wall face in rows at 5 ft. intervals until the back edge of the reinforced backfill area is reached.

   — Drill two, 5/16 in. diameter, holes for mounting, located ½ in. from the ends of the sign and 3 ½ in. from the top of the sign. Secure the sign using anchorage appropriate for the supporting material.

3. **Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to MSES shall be done at the Contractor’s risk. Govern the operations and procedures to prevent misalignment of the installed panel units. Precautionary measures include, but are not limited to, keeping vehicular equipment a minimum of 3 ft. from the panel units. Within 3 ft. of the panel units use compaction equipment meeting the requirements of *Compaction Equipment for Confined Areas* in Section 203 Excavation and Embankment. Operate rubber tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in strict accordance with the designer’s written instructions at no additional cost to the State.

554-3.03, **Mechanically Stabilized Wall System.**

   **A. Pre-Operation Meeting.** A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate Department representatives to discuss the Contractor’s proposed construction methods. Begin work only after receiving the DCETS written approval and holding the Pre-Operation Meeting.

   — Supply on-site technical assistance from a representative of the designated designer during the beginning of the installation until such time as outside consultation is no longer required.
B. MSWS Excavation and Disposal. Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation and the details specified in the contract documents.

C. MSWS Foundation. Prepare the foundation in accordance with the requirements of §554-3.02 C. MSES Foundation.

D. MSWS Subsurface Drainage System. Install the subsurface drainage system simultaneously with the erection and infill/backfill of the MSWS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

E. MSWS Leveling Pad. Provide an unreinforced concrete leveling pad or compacted granular fill leveling pad as shown in the contract documents to ensure a flat surface for placing the initial course of face units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.

1. Concrete. Cast the concrete leveling pad, in accordance with the requirements of Section 555 Structural Concrete, or place the precast leveling pad, for the foundation of the MSWS.

2. Granular. Place and compact granular fill in conformance with Section 203 Excavation and Embankment.

F. MSWS Facing Unit Erection

1. Solid Face Unit Erection

i. Methods and Equipment. Install face units in accordance with the designers approved shop drawings and Installation Manual, unless otherwise modified by the contract documents. Prior to installation of the face units, furnish the Engineer with detailed information concerning the proposed construction method, as well as the equipment planned for use.

ii. Face Unit Installation.

a. Install by placing, positioning, and aligning face units in conformance with the designers Installation Manual and within the tolerances in Table 554-2 MSWS Solid Face Unit Alignment Tolerances.

b. Correct all misalignments of installed face units that exceed the tolerances allowed in Table 554-2 MSWS Solid Facing Unit Alignment Tolerances.

<table>
<thead>
<tr>
<th>TABLE 554-2 MSWS SOLID FACE UNIT ALIGNMENT TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Control</td>
</tr>
<tr>
<td>Horizontal Control</td>
</tr>
<tr>
<td>Rotation from established plan wall batter</td>
</tr>
</tbody>
</table>

2. Open Top Face Unit Erection. During erection, any face unit damaged beyond repair shall be removed and replaced by the Contractor with approved face units at no additional cost to the State.
i. All face units shall be assembled and handled in accordance with the designer’s instructions and the contract documents. Erect the face units conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer’s installation manual.

ii. Place the face units side by side and in full contact with the installed leveling pad.

iii. Maintain the minimum face unit tolerances shown in Table 554-3 MSWS Open Top Face Unit Tolerances. Correct all misalignments of installed face units that exceed the tolerances allowed in a manner satisfying the Engineer:

<table>
<thead>
<tr>
<th>TABLE 554-3 MSWS OPEN TOP FACE UNIT ALIGNMENT TOLERANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical control (plumbness)</td>
</tr>
<tr>
<td>Horizontal location control (alignment)</td>
</tr>
<tr>
<td>Vertically overall (plumbness from top to bottom)</td>
</tr>
</tbody>
</table>

iv. Adjust face unit spacing for curved sections according to the manufacturer’s installation recommendations.

G. MSWS Facing Unit Bin Infill

1. Solid Face Unit Bin Infill

   i. Placement. Place unit infill to the limits indicated in the contract documents. Before installing the next course of face units, compact the unit infill and brush the tops of the face units clean to ensure an even placement area.

   ii. Protection. Protect unit infill from contamination during construction.

2. Open Top Face Unit Bin Infill

   i. Placement. Place and compact backfill and face unit infill simultaneously with the erection of the PWS and in accordance with Compaction in Section 203 Excavation and Embankment. Placement of infill in the wall and backfill behind the wall shall closely follow the erection of successive courses of face units.

   ii. Protection. Protect unit infill from contamination during construction.

H. MSWS Backfill. Do not mix backfill material from different sources behind any wall without the written permission of the Director, Geotechnical Engineering Bureau.

1. Moisture Content. Place backfill materials (other than Types B and D) at or within 2% dry of the Optimum Moisture Content. Rework or replace all material which is at a moisture content exceeding the Optimum Moisture Content. Determine Optimum Moisture Content in conformance with Geotechnical Test Methods (excluding GTM-6) for compaction that incorporates moisture content determination. Rework or replace backfill material at no additional cost to the State.

2. Backfill Placement. Prior to placement of the reinforcing element, backfill and compact the area within 3 ft. of the face units horizontally to 2 in. above the required reinforcing element elevation. Roughly grade the backfill beyond the 3 ft. line to the reinforcing element elevation.
1. **Place granular backfill material in uniform layers so that the compacted thickness of each layer does not exceed 10 in. or one unit height, whichever is less. Compact each layer to a minimum of 95% of Standard Proctor Maximum Density.**

2. **Place Types B and D backfill in uniform layers so that the compacted thickness of each layer does not exceed 10 in. or one unit height, whichever is less. Compact each layer in conformance with Compaction in Section 203 Excavation and Embankment.**

3. **Separation Geotextile.** Place the geotextile separation, if required, loosely but in intimate contact with the soil so that placement of the overlying material will not stretch or tear the geotextile.

4. **Surface Drainage Control.** Provide positive control and discharge of all surface drainage that will affect the installation of the MSWS throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

5. **QA Program.** The Department will sample and test backfill from the grade in accordance with the Quality Assurance Program outlined in §733-02 Mechanically Stabilized Earth System Backfill Material. If the material is determined to not meet the specification requirements, the material will be rejected.

**I. MSWS Reinforcing Element**

1. **Reinforcing Element Placement.** Place the reinforcing element normal to face units unless otherwise indicated in the contract documents. Replace all broken, damaged or distorted reinforcing elements at no additional cost to the State.

2. **Reinforcing Element Connection.** Install the reinforcing element within/between courses of face units conforming to the designer’s Installation Manual. Pull taut and secure the reinforcing element before placing the backfill.

**J. MSWS Identification Markers.** Install MSWS identification markers in accordance with the requirements of §554-3.02 J. MSES Identification Markers.

**K. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to MSWS shall be done at the Contractor’s risk. Control all operations and procedures to prevent misalignment of the face units. Precautionary measures include, but are not limited to, keeping vehicular equipment at least 3 ft. behind the back of the face units. Compaction equipment used within 3 ft. of the back of the face units must conform to Compaction Equipment for Confined Areas in Section 203 Excavation and Embankment. Operate rubber tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in strict accordance with the designers written instructions at no additional cost to the State.

**554-3.04. Geosynthetically Reinforced Soil System.**
A. GRSS Submittal. Submit the geogrid or geotextile reinforcing element certifications, verifying that the material meets the requirements of §737-07 Geogrids for the specified long-term design tensile strength shown in the contract documents, to the Engineer prior to start of work. Begin work only after receiving the Engineer’s approval.

--- Supply on-site technical assistance from a representative of the geosynthetic reinforcing element manufacturer until such time as outside consultation is no longer required.

B. GRSS Storage of Geosynthetic. Store and protect geosynthetic materials in accordance with the manufacturer’s recommendations prior to installation.

C. GRSS Excavation and Disposal. Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation and the details specified in the contract documents.

D. GRSS Foundation. Prior to erection of the GRSS system, the foundation shall be inspected and approved by the Engineer.

--- Grade the area under the GRSS level for the width shown in the contract documents. A minimum of 90% of Standard Proctor Maximum Density will be required.

--- For GRSS wall systems, a pad of crushed stone shall be incorporated into the foundation directly below the wall facing.

E. GRSS Subsurface Drainage System. Install the subsurface drainage system simultaneously with the erection and backfill of the GRSS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, the subsurface drainage system will be installed to drain all intercepted water to a point of positive drainage.

F. GRSS Placement of Materials.

1. Geosynthetic Reinforcing Element. Place and secure the primary and secondary reinforcing element in accordance with the manufacturer’s recommendations, in continuous strips without joints, seams or connections throughout the embedment length, to the line, grade and orientation shown in the contract documents. Place reinforcing elements to lay flat with no creases and pull taut to remove any slack prior to placement of backfill.

2. Welded Wire Forms. Place welded wire forms where required, as shown in the contract documents. Position and connect the welded wire forms to overlap 2 in. with adjacent forms and connect with wire ties. Install wire struts as shown in the contract documents and as required to stiffen the welded wire forms.

3. Geotextile Face Wrap. Place geotextile face wrap as shown in the contract documents. If used in conjunction with welded wire forms, place the geotextile face wrap so as to conform closely to the welded wire forms.

4. Backfill. Replace any damaged geosynthetic prior to placement of any overlying material at no cost to the State. Place the backfill onto the geosynthetic reinforcing elements in such a manner that no damage occurs. Progress placement of backfill materials so as to minimize the development of slack in the reinforcing element. The thickness of a compacted lift of backfill is not to exceed 12 in. or the measured vertical distance between geosynthetic layers, whichever is less. Compact the backfill to a minimum of 95% of Standard Proctor Maximum Density in accordance with the requirements contained in Compaction in Section 203 Excavation and...
Embankment. Only hand operated equipment is allowed within 3 ft. of the face. Lift thickness may have to be reduced to achieve required compaction.

5. **Surface Protection.** Place and secure erosion control material in accordance with Section 209 Soil Erosion and Sediment Control and as shown in the contract documents.

6. **Permanent Facing.** Place and connect permanent facing as shown in the contract documents.

7. **Surface Drainage Control.** Provide positive control and discharge of all surface drainage that will affect the installation of the GRSS throughout the construction of the wall. Maintain all vertical drains, weeps, ditches, pipes, or conduits used to control surface water during construction. Repair damage caused by surface water at no additional cost.

G. **GRSS Construction Monitoring.** Monitor the system face during fill placement and compaction. If verticality or the required batter of a system is not being maintained, stop work until compaction equipment and/or operational procedures are modified.

H. **GRSS Identification Markers.** For applications other than staging walls, install GRSS identification markers in accordance with the requirements of §554.3.02 J. MSES Identification Markers.

I. **Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to GRSS shall be done at the Contractor’s risk. Operate rubber tired equipment on top of reinforcing elements only at low speeds (less than 5 mph) and without making sharp turns or braking sharply. Do not operate tracked equipment directly on reinforcing elements. Cover reinforcing elements with a minimum 6 in. thick soil layer prior to operating tracked equipment over reinforced areas. Repair or replace damaged reinforcing elements in accordance with the manufacturer’s written instructions at no additional cost to the State.

### 554.3.05 Prefabricated Wall System

**A. PWS Excavation and Disposal.** Excavation shall be conducted in accordance with the applicable requirements of Section 206 Trench, Culvert and Structure Excavation and the contract documents.

**B. PWS Foundation.** Prior to erection of the wall system, the foundation shall be inspected and approved by the Engineer.

- Grade the area under the PMWS level for the width shown in the contract documents. A minimum of 90% of Standard Proctor Maximum Density will be required.
- Construct the wall system to meet the line and grade shown in the contract documents or approved Shop Drawings.

**C. PWS Subsurface Drainage System.** Install the subsurface drainage system simultaneously with the erection and infill/backfill of the PWS to ensure a continuous, uninterrupted system to prevent the accumulation of destabilizing water pressure on the wall. In all cases, install the subsurface drainage system to drain all intercepted water to a point of positive drainage.

**D. PWS Leveling Pad.** Provide an unreinforced concrete leveling pad or compacted granular fill leveling pad as shown in the contract documents to ensure a flat surface for placing the initial course of face units. Step the leveling pad to conform to grade changes as shown in the contract documents or approved Shop Drawings.
1. **Concrete.** Cast the concrete leveling pad, in accordance with the requirements of Section 555 Structural Concrete, or place the precast leveling pad, for the foundation of the PWS.

2. **Granular.** Place and compact granular fill in conformance with Section 203 Excavation and Embankment.

**E. PWS Erection.** During erection, remove and replace any face units damaged beyond repair with approved face units at no additional cost to the State.

1. **Assembly.** All PWS shall be assembled and handled in accordance with the designer’s instructions and the contract documents. Erect the PWS conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer's installation manual.

2. **Placement.** Place the PWS side by side and in full contact with the installed leveling pad.

3. **Tolerances.** Maintain the minimum PWS tolerances shown in Table 554-2 MSWS Solid Face Unit Alignment Tolerances or Table 554-3 MSWS Open Top Face Unit Alignment Tolerances as appropriate. Correct all misalignments of installed face units that exceed the tolerances allowed in a manner satisfying the Engineer.

4. **Adjustments.** Adjust PWS spacing for curved sections according to the manufacturer’s installation recommendations.

5. **Coping.** Apply the coping unit to the top of the wall using mastic adhesive, in accordance with and conforming to the unit manufacturer's installation recommendations.

**F. PWS Infill and Backfill.** Immediately prior to backfilling, the Engineer will inspect the face units for damage. Face units which are damaged beyond repair shall be removed and replaced by the Contractor with approved face units at no additional cost to the State.

Place and compact backfill and unit infill simultaneously with the erection of the PWS and in accordance with Compaction in Section 203 Excavation and Embankment. Placement of infill in the wall and backfill behind the wall shall closely follow the erection of successive courses of face units.

**G. Equipment Movement.** Movement of construction equipment and all other vehicles and loads over and adjacent to PWS shall be done at the Contractor’s risk. Control all operations and procedures to prevent misalignment of the PWS. Precautionary measures include, but are not limited to, keeping vehicular equipment at least 3 ft. behind the back of the face units. Compaction equipment used within 3 ft. of the back of the face units must conform to the Compaction Equipment for Confined Areas in Section 203 Excavation and Embankment. Any damage to face units from any cause shall be repaired or replaced by the Contractor at no additional cost to the State.

**554-3.06 Fill Type Retaining Wall Aesthetic Treatment.** Provide aesthetic treatment as specified in the contract documents. Any damage to the treatment shall be repaired to the satisfaction of the Engineer at no additional cost to the State.

**554-4. METHOD OF MEASUREMENT.**

**554-4.01. General.** Vacant.
554-4.02 Mechanically Stabilized Earth System. A MSES will be measured in square feet of face area, measured to the nearest square foot from the payment lines shown in the contract documents.

554-4.03 Mechanically Stabilized Wall System. A MSWS will be measured in square feet of face area, measured to the nearest square foot from the payment lines shown in the contract documents.

554-4.04 Geosynthetically Reinforced Soil System. A GRSS will be measured in square feet of vertical face area, measured to the nearest square foot from the payment lines shown in the contract documents.

554-4.05 Prefabricated Wall System. A PWS will be measured in square feet of vertical face area, measured to the nearest square foot from the payment lines shown in the contract documents.

554-4.06 Fill Type Retaining Wall Aesthetic Treatment. Aesthetic treatment will be measured in square feet of treated face area, measured to the nearest square foot from the payment lines shown in the contract documents. Include only those visual standards incorporated into the finished wall into the measurements.

554-5 BASIS OF PAYMENT

554-5.01 General. Vacant.

554-5.02 Mechanically Stabilized Earth System. Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, reinforcing elements, leveling pads, fasteners, joint fillers, geotextiles, face panel and coping units, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

554-5.03 Mechanically Stabilized Wall System. Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, infill, reinforcing elements, leveling pads, fasteners, geotextiles, face units and coping units, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

554-5.04 Geosynthetically Reinforced Soil System. Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, geosynthetic reinforcing elements, facing system, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

554-5.05 Prefabricated Wall System. Include in the unit price bid the cost of all labor, materials, and equipment, including backfill, infill, leveling pads, joint fillers, geotextiles, face units and coping units, subsurface drainage system, and the cost of adding water for backfill compaction, unless items for Furnishing Water Equipment and Applying Water are included in the contract, necessary to satisfactorily complete the work.

554-5.06 Fill Type Retaining Wall Aesthetic Treatment. Include in the unit price bid the cost of all labor, material, and equipment needed to provide aesthetic treatment for the wall and the cost of production and transportation of visual standards from the precast facility to the project site for Region approval and back to the precast facility for use during production.
### Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>554.30XX</td>
<td>Geosynthetically Reinforced Soil System Wall</td>
<td>Square Feet</td>
</tr>
<tr>
<td></td>
<td><strong>Facing System</strong></td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>Welded Wire Forms</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>Geocells</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Timbers</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>Other; As Shown in the Contract Documents</td>
<td></td>
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<tr>
<td>554.31</td>
<td>Geosynthetically Reinforced Soil System Slope</td>
<td>Square Feet</td>
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<tr>
<td>554.40</td>
<td>Fill Type Retaining Wall (0 – 6 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.41</td>
<td>Fill Type Retaining Wall (Greater than 6 ft. – 12 ft.)</td>
<td>Square Feet</td>
</tr>
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<td>554.42</td>
<td>Fill Type Retaining Wall (Greater than 12 ft. – 18 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.43</td>
<td>Fill Type Retaining Wall (Greater than 18 ft. – 24 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.44</td>
<td>Fill Type Retaining Wall (Greater than 24 ft. – 30 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.45</td>
<td>Fill Type Retaining Wall (Greater than 30 ft.)</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.5001</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Textured Surface</td>
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<td>(Hand Tooled, Raked, etc.), No Color</td>
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<td>554.5002</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Textured Surface</td>
<td>Square Feet</td>
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<tr>
<td></td>
<td>(Hand Tooled, Raked, etc.), Integral Color</td>
<td></td>
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<tr>
<td>554.5101</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Exposed Aggregate Finish, No Color</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.5102</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Exposed Aggregate Finish, Integral Color</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.5201</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Architectural Pattern, No Color</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.5202</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Architectural Pattern, Integral Color</td>
<td>Square Feet</td>
</tr>
<tr>
<td>554.53</td>
<td>Fill Type Retaining Wall Aesthetic Treatment - Other; As Shown in the Contract Documents</td>
<td>Square Feet</td>
</tr>
</tbody>
</table>

### SECTION 555 - STRUCTURAL CONCRETE

**555-1 DESCRIPTION.** This work shall consist of furnishing and placing portland cement concrete for structures as indicated in the contract documents and as directed by the Engineer.

**555-2 MATERIALS**

**555-2.01 General.** The materials used for structural concrete shall comply with the material requirements of Section 501, Portland Cement Concrete, General.

Additional materials, listed below, required specifically for use in conjunction with structural concrete items shall meet the requirements of the following subsections:

- Concrete Grout Material 701-05
- Vertical and Overhead Patching Material 701-08
- Rapid Hardening Concrete Repair Material 701-09
- Concrete Repair Material - High Early Strength 701-12
- Preformed Cork Joint Filler 705-01
- Preformed Rubber Joint Filler 705-03
- Caulking Compound for Structures 705-06
- Preformed Elastic Bridge Joint Sealer 705-09
- Polyvinyl Chloride Extruded Shapes and Sheet Material 705-11
Lubricant for Preformed Elastic Joint Sealer 705-13
Bar Reinforcement, Grade 60 709-01
Wire Fabric for Concrete Reinforcement 709-02
Quilted Covers (for curing) 711-02
Plastic Coated Fiber Blankets (for curing) 711-03
Polyethylene Curing Cover (White Opaque) 711-04
Membrane Curing Compound 711-05
Burlap 711-06
Form Insulating Materials for Cold Weather Concreting 711-07
Admixtures 711-08
Water 712-01
Asphalt Roofing Felt 712-12
Epoxy Resin System 721-01
Epoxy Polysulfide Grout 721-03
Copper Flashing 725-01
Sheet Gasket (treated both sides) 728-06
Concrete Cylinder Curing Box 735-01

555-2.02 Concrete for Structures. The class of concrete required for the various structural concrete items will be indicated in the contract documents. Mixtures using a CA2 gradation shall be used when the minimum placement dimension is 5 inches or greater, except for pedestal repairs, where Class D or DP concrete may be used when placement dimensions are greater than 1½ inches but do not exceed 12 inches. The same source of aggregates shall be used for all faces and surfaces of concrete exposed to view.

555-3 CONSTRUCTION DETAILS

555-3.01 Concrete Manufacturing and Transportation. Unless otherwise specified in the contract documents, the construction details for manufacturing and transporting concrete shall comply with §501-3, Portland Cement Concrete - Construction Details.

555-3.02 Falsework. Falsework plans shall be submitted by the Contractor and approved by the Engineer before falsework construction is started. Falsework or centering shall be designed for the dead load of the concrete forms, the dead load of the plastic concrete (based on 150 pcf) and a live load resulting from a weight of 50 psf applied to all horizontal surfaces.

Falsework which cannot be founded upon a solid footing, shall be supported by falsework piling.

Screw jacks or hardwood wedges may be required for falsework centering or to take up any slight settlement in the form work, either before or during the placing of concrete.

Falsework shall be set to give the finished structure the specified camber, plus allowance for shrinkage and settlement.

555-3.03 Forms.

A. General. All forms shall be well constructed, carefully aligned, substantial, and firm, securely braced, and fastened together in their final position. They shall be strong enough to prevent the fresh concrete from bulging the forms between supports and to withstand the action of mechanical vibrators. If required by the Engineer, form work plans shall be submitted by the Contractor and approved by the Engineer before forms can be used on the work.

Forms shall be designed to resist a dead load resulting from a weight of 150 pcf for the plastic concrete and a live load resulting from a weight of 50 psf on horizontal surfaces. The form and
falsework design shall provide for the loads resulting from any conveyance system in addition to the live load.

When concrete is transported by buggies, conveyor belt, or other approved methods of conveyance, the forms shall be capable of supporting the distribution equipment and any concentrations of concrete which may occur during transportation and distribution. Buggy runways and other supporting platforms shall be supported directly by the forms.

Forms shall be adequately braced to resist concrete design loads. If the forms are inadequately braced concrete placement shall stop until adequate bracing has been provided.

All forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall be maintained to eliminate the formation of joints due to shrinkage of the lumber. Forms shall be sufficiently tight to prevent leakage of mortar.

Forms may be constructed of wood, metal, or other approved materials, except when a particular material is specified in the contract documents. The use of fiber forms will be permitted for round columns only if the interior surface of the forms have been treated in such a manner as to prevent helical corrugation marks on the finished concrete surfaces. Forms shall be filleted 1 inch with forming material at all exposed corners to create a chamfer in the finished concrete unless otherwise shown in the contract documents.

When curved, patterned, or other special forms are required, the Contractor shall submit details of the form construction to the Engineer for approval prior to constructing the forms. Forms shall be so constructed that those surfaces on which finishing may be required may be stripped without disturbing the remaining forms. Premanufactured formliner panels, if used, shall be capable of imprinting the surface of the concrete with a uniform and aligned pattern and texture. The panels shall be composed of elastomeric urethane, polyvinyl chloride (PVC), ABS plastic, or other suitable material for their intended shape and number of reuses to achieve the desired effects. Formliners shall leave crisp, sharp definition of the architectural surface. Sufficient liners shall be used to minimize pattern repeat. Formliners shall not compress more than 1/4 inch when concrete is poured at a rate of 10 vertical feet per hour.

Any metal ties or anchorages within the forms shall be so constructed that the embedded portion of the ties can be removed to a depth of at least 2 inches from the surface of the concrete without damage to such surface. Wire ties shall not be used without written approval of the Engineer. In case wire ties are approved, all wires, upon removal of the forms, shall be cut back at least 1/4 inch from the face of the concrete with sharp chisels or nippers (nippers are necessary for green concrete). All cavities produced by the removal of metal ties shall be filled in conformance with requirements of §555-3.11, Corrective Finishing.

For walls where access to the bottom of the forms is not practicable, the lower form boards or panels shall be left loose so that the inside of the forms can be readily cleaned of all chips, dirt, sawdust, or other extraneous material, immediately prior to the placing of concrete.

Forms to be reused shall be maintained in good condition as to accuracy of shape, strength, rigidity, watertightness, and smoothness of surface. Any warped or bulged forms must be carefully resized before being re-used. Forms that are unsatisfactory in any respect shall not be used. All form surfaces that will be in contact with the concrete shall be thoroughly treated with an approved form coating in the manner, and at the rate specified by the manufacturer. Only those coatings listed on the Approved List published by the Materials Bureau are acceptable. Forms so treated shall be protected against damage or dirt prior to placing concrete.

If metal forms are used, the material shall be of such thickness that the forms will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without damage to the concrete. Metal forms, which do not present a smooth surface or line up properly, shall not be used. Special care shall be exercised to keep metal forms free from rust, grease, or other foreign matter that would tend to discolor the concrete.
B. Foundation Concrete. The footings of structures shown in the contract documents shall be considered as approximate only, and when ordered in writing by the Deputy Chief Engineer (Structures), shall be changed to such dimensions as will give a satisfactory foundation. Concrete shall not be placed in any foundation form without the Engineer’s approval.

555-3.04 Handling and Placing Concrete.

A. Placement Limitations. No concrete shall be placed when the ambient air temperature is below 45°F, unless the Engineer grants approval to a written proposal from the Contractor. No concrete shall be placed during rain.

When concrete is to be placed in contact with steel members, reinforcing steel, or previously placed concrete, the temperature of the steel and concrete shall be raised to approximately 45°F. The use of enclosures and heating equipment, including but not limited to the use of forced hot air, hot water boilers, and hoses, or other methods suitable to the Engineer, may be required before concreting begins.

When concrete is to be placed in contact with earth or rock, within piles, or for tremie placements, the temperature of the earth or rock shall be 35°F or higher. The earth or rock shall not have any snow, ice, frost, or standing water on its surface. The use of insulating materials and heating equipment may be required before concreting begins.

B. Conveyance. Concrete shall be placed so as to avoid segregation of materials and displacement of reinforcement. All equipment used for conveying the concrete mix, from the point of delivery and material acceptance to the discharge point, shall be capable of meeting the permissible variations given in Table 555-1, Concrete Conveyance Uniformity. Prior to the actual placement of concrete, the Contractor shall demonstrate the capability of the equipment to convey the concrete mixture. Tests according to Department written instructions will be performed by, and at the discretion of the Engineer. No further verification of the equipment capability will be required unless evidence of nonuniform concrete is observed during placement.

When concrete pumps are used, the lines shall have a minimum diameter of 5 inches. Concrete pumps with smaller hose diameters may be used for small placements, where mixtures using a CA1 gradation (smaller aggregates) are allowed, and where access is limited. The pumping operation shall be performed in such a manner as to discharge concrete horizontally a minimum distance of 3 feet. Where horizontal discharge is not possible, the use of double 90-degree bends at the end of the pump hose, reducer hoses, or other equipment capable of maintaining a head of concrete in the pump line may be allowed, subject to the approval of the Director, Materials Bureau.

All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each use. Water used for flushing shall be discharged clear of the concrete already in place.

Concrete shall not come in contact with any aluminum during conveying and placing operations.

<table>
<thead>
<tr>
<th>TABLE 555-1 CONCRETE CONVEYANCE UNIFORMITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test</strong></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Air Content, % by volume of Concrete</td>
</tr>
<tr>
<td>Slump</td>
</tr>
<tr>
<td>Average slump 4 inches or less</td>
</tr>
<tr>
<td>Average slump greater than 4 inches</td>
</tr>
</tbody>
</table>
C. Acceptance/Testing. The concrete mixture, prior to placement into the conveying equipment, shall meet the specified requirements for air content and slump given for the various classes and types of placement under Table 501-3, Concrete Mixtures.

D. Placement. All foreign matter of every kind shall be removed from the interior of the forms before placing concrete. Temporary studs or braces within the forms shall be removed when the concrete has reached an elevation rendering their further use unnecessary. Dropping concrete a distance of more than 5 feet or depositing a large quantity at any point and running or working it along the forms shall not be permitted. Dropchutes shall be used between vertical forms unless conveyance equipment can be inserted between forms.

Special care shall be taken to fill each part of the form by depositing concrete directly into the form as near to its final position as possible, to work the coarser aggregates back from the face of the concrete and to force the concrete under and around the reinforcement without displacing the reinforcement. After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain on the ends of the projecting reinforcement.

Concrete shall be placed in horizontal layers not more than 1 foot thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and consolidated before the preceding layer has taken its initial set to prevent damage to the green concrete and avoid cold joints between batches. Each layer shall be consolidated using appropriate vibrating practices so as to avoid the formation of a joint with a preceding layer which has not taken initial set.

When concrete placement is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a depth sufficient to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smooth and level whenever concreting is discontinued. Where a “feather edge” would be produced at a construction joint, as in the sloped top surface of a wing wall, an inset form work shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Work shall be continuous from the bottom to the top of any face.

When embedding structural shapes in concrete, the placement of concrete shall be progressed on one side of the shape only until it flushes up over the bottom flange of the shape on the opposite side, after which concrete shall be placed on both sides to completion.

E. Vibration. During and immediately after deposition, concrete shall be thoroughly consolidated by vibrating the concrete internally with mechanical vibrating equipment. The use of external vibrators will be permitted when satisfactory surfaces cannot be obtained by internal vibration alone or when it is impossible to use internal vibrators. The use of external vibrators shall be subject to the approval of the Engineer. External vibrators shall be attached to or held on the forms in such a manner as to effectively vibrate the concrete in a horizontal plane.

Internal mechanical vibrators shall be adequately powered, capable of transmitting vibration to the concrete in frequencies of not less than 5,000 vibrations per minute while inserted in concrete and shall produce a vibration of sufficient intensity to consolidate the concrete into place without separation of the ingredients. If any of the reinforcing steel has epoxy coating, an internal mechanical vibrator shall have a rubberized or elastomeric cover to prevent damage to the epoxy coating on the reinforcing bars. The vibrators and covers shall be inspected for defects prior to use.

A sufficient number of vibrators shall be employed, so that at the required rate of placement, thorough consolidation occurs throughout the entire volume of each layer of concrete. Extra vibrators shall be on hand for emergency use and when other vibrators are being serviced.

The vibrating element shall be vertically inserted in the concrete mass at a depth sufficient to vibrate the bottom of each layer effectively inserting the vibrator into the underlying lift. It shall be withdrawn completely from the concrete before being advanced to the next point of application.
Internal vibrators shall not be placed directly on the forms or the reinforcing steel. The vibratory element shall be inserted vertically into the concrete at the point of deposit and in areas of plastic concrete at evenly spaced intervals not farther apart than the radius over which the vibration is visibly effective and at a distance close enough to the forms to effectively vibrate the surface concrete. The time of vibration shall be of sufficient duration to accomplish thorough consolidation, complete embedment of the reinforcement, produce dense, smooth surfaces free from aggregate pockets, honeycombing, and air bubbles and to work the concrete into all angles and corners of the forms however, over-vibration shall be avoided. Vibration shall be continued in one place until the concrete has become uniformly plastic, but not to the extent that pools of grout are formed.

Vibration shall be supplemented by working or spading by hand in the corners and angles of forms and along form surfaces while the concrete is plastic. Vibrators shall not be used to push or distribute the concrete laterally.

555-3.05 Depositing Structural Concrete Under Water.

A. General. Use a tremie tube, pipeline, or similar method to place concrete under 32 - 90°F water in one continuous operation. Since the tremie tube and the pipeline are both tubes, the word "tube" in this specification refers to either type, except where specific reference is made to either the tremie tube or the pipeline.

Unless noted differently on the plans, use Class G concrete as described in Table 501-3, Concrete Mixtures. Substitute Class GG Concrete when clear openings between closely spaced objects such as reinforcement bars are less than 3 inches. Pozzolan replacement may be omitted for small placements in a fresh water environment when approved by the DCES.

In addition to §555-3.03 Forms, place concrete on prepared areas cleaned of all debris, mud, or other unsuitable material.

Submit a list of equipment, including back-up, and a schedule for transporting and placing concrete, to the Engineer for review at least 20 working days prior to concrete placement. The Contractor shall be responsible to design a tremie placement, with appropriate forming, that maintains a minimum vertical rise of 1 foot per hour for the overall area and a minimum placement rate of 40 cubic yards per hour, unless fluid concrete pressure requires a reduced placement rate.

Place fresh concrete before stiffening and initial set of the adjacent concrete to ensure a good bond and avoid cold joints. If a delay occurs, determine stiffening and initial set by probes or other methods approved by the Engineer. Stop the operation if the placement cannot be continued before initial set of the adjacent concrete. The Engineer will then immediately contact the DCES.

B. Methods of Placement. The tremie tube and pump and pipeline are the most common methods. Obtain approval of the DCES for any other method.

1. Tremie Tube Method (Open System). This method uses a vertical tube open at the top, where concrete is delivered to the top and falls down the tube.

   a. Tremie tube size shall be based on the delivery system used by the Contractor.

<table>
<thead>
<tr>
<th>Delivery System</th>
<th>Inside Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large volume, such as crane and bucket</td>
<td>10 inches minimum</td>
</tr>
<tr>
<td>Small volume, such as pump line or conveyor</td>
<td>5 inches minimum</td>
</tr>
</tbody>
</table>

   b. Use a sturdy hopper or funnel with a bottom opening smaller than the tremie tube diameter to transfer concrete into the tremie tube. The capacity and shape of the hopper or funnel depends on the volume and type of concrete delivery system. A device with the same size bottom opening may be used if a 1 1/2 to 2 inch diameter breather tube is installed to reach 1 foot or more down.
into the tremie tube.
c. Install a safe work platform at the top of the tremie tube.

2. **Pump and Pipeline Method (Closed System)** This method uses a vertical tube, attached to a closed tube system, where concrete is pumped to the top and falls down the tube.

   a. Use pipe with a minimum inside diameter of 5 inches.
   b. Install a minimum 2 inch diameter air vent or valve connection, or leave the pipe joint loose without a gasket, near the high point of the downgrade, 1 to 4 feet below the point where concrete starts falling down the pipe, to allow air displaced by concrete to escape, and admit air to prevent a siphoning effect.
   c. Class G concrete, the mix noted on the plans, or a “cement-water” grout may be used for pipeline lubrication and placed in the forms. Waste any other concrete mix used to lubricate pipeline.

C. **Placement Tubes for Tremie Tube or Pump and Pipeline Method.** Clearly mark each tube in at least 1 foot increments (numbered every 5 feet) to show depth to the outlet. Use watertight joints. Place tubes no more than 15 feet from the forms and no more than 30 feet on center.

   1. **Open end tubes** Install a separate tube at each placement point, as loss of seal occurs when the embedded end of this tube type is removed from fresh concrete under water. Once started, do not relocate or remove open end tubes until completion of the concrete placement at that location. If loss of seal occurs, remove and seal the tube with a watertight plate or plug for restarting. Restart tremie placement only if a seal can be reestablished using a dewatered tube where the outlet can be surrounded by fresh concrete.

   2. **End-valve sealed tubes** Install the number of tubes based on the minimum placement rate defined in A. General, as the seal is maintained when the embedded end of this type is removed from fresh concrete under water. Raise the end of the tube to about 3 feet below the fresh concrete surface. Then, close the valve with the tube 1/2 full of concrete (1/2 the water depth), and slowly remove the tube. Reverse this procedure upon relocation in fresh concrete.

D. **Dewatering.** When necessary, proceed with dewatering at least 4 days after completion of concrete placement, unless noted differently on the Contract Plans or as ordered by the Engineer. After dewatering, continue curing and excavate one or more sumps to provide for pumping of accumulated water. Excavate sumps outside of areas which will receive new concrete, or as approved by the Engineer.

E. **Concrete Evaluation.**

   1. **Nondestructive Testing.** Use as directed by the Contract, or as approved by the DCES.

   2. **Cores.** Obtain cores in the presence of the Engineer at locations and to depths shown on the contract plans. Take NX size (2 1/8 inch) cores, no earlier than 7 days after concrete placement, according to §648-3.04, Rock Core Samples, B. Sampling, the 1st sentence. Use drill bits meeting the requirements of Subsection 732-06, Coring Bits. Obtain 100% recovery from each core hole, as less is presumed to indicate defective concrete. Use a 5 foot nominal length of core drill run. Record core boring log data in accordance with §648-3.01B, Driller’s Logs.

      Label and pack all cores according to §648-3.04 C, Marking, Packaging and Transporting Samples. Deliver and store the core boxes at a site approved by the Engineer, where they become
the property of the Department. Provide assistance in moving and arranging core boxes at the site to facilitate evaluation by the Department.

**F. Defects.** Obtain additional cores for further investigation from areas which contain voids, honeycombing, seams, or other defects. The DCES will determine the number and location of additional core holes. Repair defects with grout when approved by the DCES. Placements with defects determined to be unrepairable by grouting will be rejected. Alternate repair techniques require DCES approval.

**G. Grout Repairs and Grout Placements.** This section only applies for underwater grout placements limited to quickly filled areas, such as core drill holes, small piles up to 1 foot in diameter, and other small voids. Use materials meeting §701-05, Concrete Grout Material, for the grout proportioned as specified or as approved by the DCES.

When the DCES grants approval for repairs, the proposed grouting method shall be performed by cleaning out and filling all defects and core drill holes with grout. Position a grout tube (2 inches or less in diameter) about 1 inch off the bottom of the prepared hole until the grouting operation is complete. Start pumping (closed system) or filling a tremie tube (open system) faster than the grout can fall through water. Continue placing grout until the grout coming back out the hole is the same consistency as that going in. Then withdraw the tube.

Additional cores may be required to verify acceptable repairs.

**H. Tremie Construction Joints.** Prepare the top area of the placement receiving new concrete to within 3 inches of the elevation shown on the plans. When joining fresh concrete to concrete that has already set, the concrete in place shall have its surface scoured or abraded with a suitable tool to remove all loose and foreign materials. After the surface preparation, the concrete surface, and all porous surfaces to be in contact with new concrete shall be thoroughly wet using potable water for 12 hours with soaker hoses or the use of burlap/burlene/etc. to maintain moisture. The Contractor shall remove any puddles of free-standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated, surface-dry condition until placement of the new concrete.

Fill any low areas with a leveling course of Class A concrete (or Class D for 1 1/2 to 5 inches thick placements).

Fill sumps with concrete or stone, as ordered by the Engineer.

**555-3.06 Concrete Joints.**

**A. Construction Joints.** Construction joints for the purpose of these specifications are joints used to provide for interruptions in the placement of concrete. Construction joints shall be placed only where shown in the contract documents or where approved by the Deputy Chief Engineer (Structures). Bulkheads required during placement shall be constructed at the direction of the EIC.

Unless otherwise shown in the contract documents, a shear key shall be provided at each construction joint by embedding water-saturated wooden blocks in the plastic concrete. The shear key thus provided shall be approximately 1/3 of the width of the parts joined. The key depth shall equal the thickness of standard form lumber, approximately 1/2 the key width. Shear keys need not exceed 5 1/2 inches in depth regardless of the key width.

On steel truss or open-spandrel, concrete arch spans, unless otherwise noted in the contract documents, the concrete in the floor system shall be placed about the center line of the span, beginning at the center and working simultaneously toward each end; or beginning at the ends, and working simultaneously toward the center. Care shall be taken to prevent the displacement of reinforcement during the placing of concrete. If, for any reason, it becomes necessary to introduce a construction joint, this shall be formed by means of a vertical bulkhead so constructed as to produce
a key joint, placed as shown in the contract documents or as permitted by the Deputy Chief Engineer (Structures).

When joining fresh concrete to concrete that has already set, the concrete in place shall have its surface scoured or abraded with a suitable tool to remove all loose and foreign materials. After the surface preparation, the concrete surface and all porous surfaces to be in contact with new concrete shall be thoroughly wetted, to achieve a saturated surface dry condition, using potable water for 12 hours with soaker hoses or the use of burlap/burlene/etc., to maintain moisture. If conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. The Contractor shall remove any puddles of free-standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface-dry condition until placement of the new concrete. Immediately before placing the new concrete, the forms shall be drawn tightly against the concrete already in place.

Forms for female shear keys shall be beveled on four sides to facilitate their removal and shall be securely fastened to the forms to prevent displacement before the concrete has set. Key forms shall be removed in such a manner as to avoid damage to the concrete.

B. Contraction Joints. Contraction joints shall be placed at locations shown in the contract documents and unless otherwise specified, shall be formed the same as construction joints, except that reinforcement shall not extend through the joint.

C. Expansion Joints. Expansion joints shall be placed as shown in the contract documents. Expansion joints shall provide for expansion, contraction, and the transfer of shear at the joint, unless otherwise specified. When expansion joints are formed by the insertion and subsequent removal of joint templates, this work shall be done in such a manner that joint edges are not chipped or broken down in the process.

When concrete is to be placed against a joint filler, holes or joints in the filler shall be suitably filled with mastic to prevent mortar or concrete from entering the joint and restricting its movement. The face edges of all joints shall be carefully finished or formed true to line and elevation for a minimum distance of 2 inches back from all exposed surfaces.

When caulking compound is used to seal a joint containing premolded bituminous joint filler, a layer of an approved type of pressure-sensitive release tape shall be placed between these materials due to their incompatibility.

D. Waterstops. Waterstops shall be installed in joints to provide for expansion and contraction movements at joints. Place waterstop at all joints exposed to view, as shown in the contract documents, or as ordered by the Engineer. Waterstop shall be a polyvinyl chloride or other approved flexible material, copper strip, zinc strip or lead sheet. The waterstop shall extend at least 3 inches into the concrete on each side of the joint, shall be joined to be continuous and watertight, and shall be carefully protected from damage until covered by concrete or backfill.

555-3.07 Finishing.

A. General. All exposed unformed surfaces, whether permanent or at construction joints, shall be finished by placing an excess of material in the forms and striking off the excess with a suitable float, forcing the coarse aggregate below the level of the finished surface, and troweled to a suitable finish. The use of mortar topping for surfaces shall not be permitted.

Following the discontinuance of placing concrete, all accumulation of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the plastic concrete.
B. **Bearing Surfaces.** The entire surface area of bridge seats or pedestals shall be floated and troweled to true grade or, at the option of the Contractor, left approximately 1/4 inch high and bush hammered or otherwise finished to the exact elevations indicated in the contract documents.

555-3.08 Curing.

A. **General.** All structural concrete shall be cured for a minimum of seven curing days unless otherwise stated. The curing period shall begin only after all curing procedures and practices for a given placement are established. A curing day is defined as any day during which the ambient air temperature at the concrete surface is 45°F or higher for the entire day.

Conditions may occur which prevent an entire day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur and with the Engineer's approval, the Contractor may aggregate curing hours. A curing hour is defined as any hour during which the curing temperature remains at, or above 45°F. An aggregation of 24 curing hours will be credited as one curing day. Aggregations of less than 24 curing hours will not be credited.

Curing hours will be determined with continuous recording thermometers. The number and placement of the thermometers will be determined by the Engineer. Thermometers used to monitor curing temperatures shall consist of the following types:

1. **Continuously Recording Thermometer.** The thermometer shall be capable of continuously recording temperatures within a range of 0°F to 120°F for a minimum of 24 hours.

2. **Maximum - Minimum Recording Thermometer.** For all placements, the thermometer shall be capable of recording maximum and minimum temperatures within a range of 0°F to 120°F.

   Provide all equipment, supplies, and labor necessary for calibration.

   The curing temperature of concrete is the air temperature at the concrete surface, or the air temperature between the concrete surface and its protective covering. Temperatures at these locations are critical for proper concrete curing. For the purposes of this section the temperatures at the foregoing locations shall be maintained between 45°F and 85°F inclusive.

   All structural concrete surfaces must be cured by any one, or a combination of, the following methods unless otherwise noted:
   - Polyethylene curing covers - white opaque.
   - Plastic coated fiber blankets.
   - Clear (fugitive dye) membrane curing compound.
   - Continuous burlap wetting.
   - Wet burlap and curing covers.
   - Forms left in place

   Curing shall commence on all exposed surfaces no later than 30 minutes after completion of finishing. Finishing and curing operations shall progress with concrete placement. Curing covers shall be placed as soon after concrete finishing as the Engineer determines will not cause damage to the concrete surface. However, under no circumstances shall the curing be delayed beyond 30 minutes of the completion of finishing. Care shall be taken so as not to damage the finished surface or texturing. Curing covers shall be lapped a minimum of 1 foot. All lapped edges shall be sealed with pressure sensitive tape. Covers shall be protected from displacement.

   Clear (fugitive dye) membrane curing compound shall be sprayed on the concrete surface immediately following the finishing operation, or form removal, whichever is applicable. The compound shall be applied by means of a pressure spraying system, or by distributing equipment, at a minimum rate of 150 sf per gallon of surface. The equipment for applying the compound shall be
such that the compound is applied as a fine spray with no surface damage to the concrete. The equipment shall also provide for adequate agitation of the compound during application, and shall be approved by the Engineer before work is started. Should the application method produce a nonuniform film, or should the spraying equipment fail and back-up equipment is not immediately available, the application shall cease. Curing shall then be continued by another acceptable method. The Contractor shall provide sufficient approved covers for protection of the concrete surface in the event of rain or equipment breakdown.

If forms are removed during the curing period (refer to §555-3.09), the concrete curing shall be continued using a clear (fugitive dye) membrane curing compound applied immediately after form removal.

**B. Provisions for Curing in Hot Weather.** When forms are left in place in extremely hot weather the forms shall require wetting to reduce surface heat.

If the ambient air temperature exceeds 85°F, continuous, uniform wetting for curing shall be required until the seven (7) day curing period is complete and forms are removed. Use of plastic sheeting over the established curing is not allowed in hot weather conditions.

**C. Provisions for Curing in Cold Weather.** If the ambient air temperature falls, or is expected to fall below 45°F, the requirements of Table 555-2 shall apply.

<table>
<thead>
<tr>
<th>TABLE 555-2 COLD WEATHER CURING REQUIREMENTS</th>
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<tbody>
<tr>
<td><strong>Ambient Temperature (AT) at time of concrete placement and as anticipated during curing duration</strong></td>
</tr>
<tr>
<td>$32^\circ \text{F} &lt; \text{AT} &lt; 45^\circ \text{F}$ for less than 24 consecutive hours</td>
</tr>
<tr>
<td>$32^\circ \text{F} &lt; \text{AT} &lt; 45^\circ \text{F}$ for more than 24 consecutive hours</td>
</tr>
<tr>
<td>$\text{AT} &lt; 32^\circ \text{F}$</td>
</tr>
</tbody>
</table>

Prior to use, all proposed methods must meet the approval of the Engineer. If the curing temperature falls below $32^\circ \text{F}$ at any time during the curing period, the concrete will be rejected.

To provide assurance of the curing temperatures, the Contractor shall supply thermometers meeting the requirements of §555.3.08A. Temperature measurements will be taken by the Engineer and a record will be maintained for the curing period. As a minimum, thermometers shall be placed adjacent to forms at the bottom, middle, and top of a placement. Additional thermometers may be placed in areas where extreme cold or heat, from external sources, can be expected.

If the existing method employed by the Contractor to maintain the curing temperature fails, the Contractor shall modify the existing method immediately to reestablish an acceptable curing temperature.

The length of the curing period will be extended until the required number of curing days are accumulated.

1. **General.** When approval is granted in writing by the Engineer for cold-weather concreting, the curing temperature shall be maintained between 45°F and 85°F for the curing durations stated by provision of external heat or utilization of heat of hydration retained by insulated forms. Only when temperatures are maintained between 45°F and 85°F will the time be considered acceptable curing hours.
2. **Provision of External Heat.** If the Contractor is required, or elects, to maintain curing temperatures by this method, the Contractor shall furnish sufficient canvas and framework, or other type of housing, to enclose and protect the structure. The enclosure and heat source(s) shall be established in such a way that the air surrounding the fresh concrete, on all sides, be kept at a temperature between 45°F and 85°F for the specified curing period. At the end of the curing period, the heat shall be gradually reduced at a rate not to exceed 1 degree F per hour until the temperature within the enclosure equals the temperature outside the enclosure. Materials and equipment necessary to erect the enclosure and provide external heat shall be present on the job site and approved by the Engineer before any concrete is placed.

External heat shall be provided by means of stoves, salamanders, heated hoses, steam equipment, warmed curing water, or other equipment supplied by, operated by the Contractor. Heating appliances shall not be placed in such a manner as to endanger formwork, centering, or expose any area of concrete to drying out or damage due to excessive temperatures. Sufficient equipment shall be supplied to continuously maintain the specified temperature with a reasonable degree of uniformity in all parts of the enclosure. The enclosures shall be properly vented to prevent surface disintegration of fresh concrete due to an accumulation of carbon dioxide gas. All exposed concrete surfaces within the heated area shall be protected from drying by one of the following methods:

- Use of live steam.
- Continuous wet burlap or wet burlap used with curing covers.
- Curing compounds used with curing covers.

### TABLE 555-3 INSULATION REQUIREMENTS FOR CONCRETE WALLS, PIERS AND ABUTMENTS ABOVE GROUND

<table>
<thead>
<tr>
<th>Wall Thickness (Inches)</th>
<th>Minimum ambient air temperatures (°F) allowable for concrete placed at 50°F (Thermal Resistance Values (R): hr·ft²·F/Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R = 2</td>
</tr>
<tr>
<td>Portland Cement Content: 400 lb/cy</td>
<td>47</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

| Portland Cement Content: 500 lb/cy | 47 | 43 | 38 | 33 | 42 | 31 | 20 | 9 | 36 | 19 | 2 | -15 | 24 | 30 | 7 | -16 | 39 | 36 | 18 | -15 | -46 | -79 | 48 | 10 | -25 | -60 | * | 60 | 10 | -25 | * | * |

| Portland Cement Content: 600 lb/cy | 47 | 43 | 38 | 33 | 42 | 31 | 20 | 9 | 36 | 19 | 2 | -15 | 24 | 30 | 7 | -16 | 39 | 36 | 18 | -15 | -46 | -79 | 48 | 10 | -25 | -60 | * | 60 | 10 | -25 | * | * |
3. **Heat Retention by Insulated Forms.** Insulated forms may be used to maintain acceptable curing temperatures in accordance with the provisions of Table 555-2, when ambient temperatures will not drop below 32°F. If the Contractor elects to maintain curing temperatures by this method, sufficient insulation shall be furnished to protect and maintain the temperature between the insulation and formwork within the range of 45°F to 85°F for the specified curing period.

Discontinuance of protection shall be accomplished in such a manner that the drop in temperature of any portion of the concrete shall be gradual. The surface temperature of concrete sections more than 2 feet in thickness shall not drop faster than 18°F in a 24-hour period. The surface temperature of concrete sections less than 2 feet in thickness shall not drop faster than 36°F in a 24-hour period.

Forms may be removed without restriction, providing the temperature difference between the air and the surface of the concrete is not more than 30°F. If possible, forms shall be removed about the middle of the day to take advantage of the generally higher afternoon temperatures.

Form insulating material shall be installed on the forms in such a manner so as to achieve the full benefit of its insulating properties and at the same time provide against the infiltration of wind and water. All portions of steel forms shall be covered by insulating material so that no steel is exposed to the air. Any tears or damaged areas in the insulating material shall be repaired. Special attention shall be given to ensure that all corners and angles are properly insulated and protected against wind damage.

### Table 555-2

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>Portland Cement Content: 700 lb/cy</th>
<th>Portland Cement Content: 800 lb/cy</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>46</td>
<td>39</td>
</tr>
<tr>
<td>12</td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>18</td>
<td>33</td>
<td>13</td>
</tr>
<tr>
<td>24</td>
<td>26</td>
<td>-1</td>
</tr>
<tr>
<td>36</td>
<td>12</td>
<td>-27</td>
</tr>
<tr>
<td>48</td>
<td>4</td>
<td>-40</td>
</tr>
<tr>
<td>60</td>
<td>4</td>
<td>-40</td>
</tr>
</tbody>
</table>

When using concrete containing pozzolans, do not consider the pozzolans as part of the cement content. Use values given for a Portland cement content that are equal to or less than the actual cement content of the mix, due to a lower heat of hydration when using pozzolans.
Where tie rods extend through the form insulating material, a plywood washer (¾ x 6 x 6 inches approx.) shall be placed over the tie rod and secured against the insulating material.

After placement of the concrete, the exposed concrete surfaces shall be covered with insulating blankets, except for areas where protruding reinforcing bars make the use of blankets impracticable. These areas may be covered with hay or other acceptable insulating material. Tarpaulins shall be used to protect the insulating material.

Insulating material shall be insulating blankets, solid foam, or sprayed foam meeting the requirements of §711-07, Form Insulating Materials for Cold Weather Concreting. The appropriate R value of material shall be used to insulate the concrete according to Table 555-3. Multiple layers of insulation may be used to attain the desired level of insulation (R value), to maintain the required curing temperatures. Extra care shall be taken in insulating edges and corners where additional layers or overlaps are required.

<table>
<thead>
<tr>
<th>TABLE 555-4 MINIMUM TIME FOR FORM REMOVAL/FORMING/LOADING LIMITATIONS –SUBSTRUCTURES (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUBSTRUCTURE ELEMENT</strong></td>
</tr>
<tr>
<td>All Footings</td>
</tr>
<tr>
<td>Abutment stems, backwalls</td>
</tr>
<tr>
<td>Pier Columns, Pier Plinths</td>
</tr>
<tr>
<td>Pier cap beams</td>
</tr>
<tr>
<td>All pedestals</td>
</tr>
<tr>
<td>Wingwalls or Retaining walls</td>
</tr>
<tr>
<td>Arch centers Centering under beams</td>
</tr>
</tbody>
</table>

Notes:
1. The minimum times for loading in this table are NOT applicable when using concrete that contains fly ash or ground, granulated blast furnace slag that is placed and/or cured when ambient temperatures are 60°F or less. The provisions in Note 3 are required for casting, curing, and testing of compressive strength cylinders for concrete that contains fly ash or ground, granulated blast furnace slag that is placed and/or cured when the ambient temperature is 60°F or less. The compressive strength results will be the basis of determining when loading can occur.
2. All concrete shall be cured for a minimum of seven curing days. A “Day” is a curing day as defined in Subsection 555-3.08A. Concrete surfaces being cured using forms, covers, or blankets from which the covers are removed for any
purpose prior to the full cure period shall be sprayed with an approved clear (fugitive dye) curing compound within ten minutes of cover removal.

3 When early loading is requested, the minimum time requirements for loading may be reduced (or extended) based on test cylinder compressive strength results. The DCES will establish requirements for early loading upon request. The Contractor shall notify the Engineer, in writing, at least 10 days prior to placement, that early loading is being requested, so that arrangements for test cylinders can be made. Test cylinders shall be prepared in accordance with Materials Method 9.2 – Field Inspection of Portland Cement Concrete. Two test cylinders shall be prepared for each anticipated testing period. These cylinders shall be cured in the same manner as the substructure element which they represent. After the first compression test, the Engineer shall determine subsequent testing periods based on the results of the first test. No more than three tests for each substructure element shall be allowed.

4 Minimum time for loading pedestals shall not compromise minimum loading times specified for other placements.

555-3.09 Form Removal. Forms shall be removed in such a way as to permit the concrete to take the stresses uniformly and gradually. Any method of form removal likely to cause overstressing of the concrete shall not be used.

The forms for any portion of a structure shall not be removed until the concrete is strong enough to resist damage. The earliest time of form removal shall be as specified in Table 555-4, Minimum Time for Form Removal - Substructures. If the form removal causes damage, the operation must stop immediately until such time that sufficient concrete strength is achieved. All damage shall be repaired in conformance with §555-3.13, Damaged or Defective Concrete.

555-3.10 Loading Limitations. Forms used for substructure concrete placements shall be removed in accordance with the requirements of Table 555-4, Minimum Time for Form Removal - Substructures. The minimum times for loading in this table are NOT applicable when using concrete that contains fly ash or ground, granulated blast furnace slag that is placed and/or cured when ambient temperatures are 60°F or less. The provisions in Note 3 are required for casting, curing, and testing of compressive strength cylinders for concrete that contains fly ash or ground granulated blast furnace slag that is placed and/or cured when the ambient temperature is 60°F or less. The compressive strength results will be the basis of determining when loading can occur.

555-3.11 Corrective Finishing. Immediately after forms have been removed, surfaces exposed to view shall have all projections and irregularities carefully removed and all cavities greater than 1 inch in diameter and/or 1/4 inch in depth neatly filled with mortar of the proportion used in the concrete. The same brand of cement and the same kind of aggregate shall be used for filling cavities as was used in the original concrete mix. Plastering of surfaces shall not be allowed. The surface film (drying cement paste) of all such repaired surfaces shall be carefully removed before setting occurs.

All rust and other stains shall be removed from concrete exposed to view. Removal shall be accomplished using methods and materials approved by the Engineer. Materials used for rust stain removal shall be as listed on the Approved List published by the Department’s Materials Bureau.

555-3.12 Weep Holes. The Contractor shall construct weep holes in all retaining walls and abutments as indicated in the contract documents.

555-3.13 Damaged or Defective Concrete. All defects or damage to concrete which occurs prior to the final acceptance of the work shall be repaired or replaced at no additional expense to the State. The defects shall include but are not limited to spalling and irregular cracking at joints, edge spalls, honeycombing, and damage or other imperfections caused by traffic and/or construction operations. Any concrete requiring complete replacement shall be replaced in kind as concrete originally called for in the contract documents. Any repairs shall be performed to the methods described in these specifications unless otherwise approved by the Engineer. When a repair is made, the defective or damaged concrete shall be removed by saw cutting the perimeter to a depth of 1 1/2 inches, chipping the unsuitable material to sound concrete with light, hand held, pneumatic tools at a 45 degree angle into the patch area, and cleaning all exposed reinforcing and concrete surfaces. All surfaces to be repaired shall be thoroughly

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blast cleaned. Prior to placing repair concrete, all surfaces shall be wetted to a saturated surface dry condition.

Small spalls of 0.1 cy or less, and areas of 10 sf or less where concrete removal is required may be repaired using approved Concrete repair materials. Vertical or overhead surfaces may be patched with Vertical and Overhead Patching Material. Surface preparation for small repairs shall be according to the material manufacturer’s recommendations. After repair is complete, and curing time has elapsed, the Engineer will hammer sound all repair areas to assure proper bond has been achieved.

Concrete with surfaces misshapen by bulges or deformations caused by inadequate forms, or resulting in insufficient cover of reinforcing, shall be removed or corrected.

555-4 METHOD OF MEASUREMENT

555-4.01 Concrete for Structures. The work will be measured for payment as the number of cubic yards of concrete for structures satisfactorily placed, measured to the nearest 0.1 cubic yard within the lines of the structure as shown in the contract documents. No deductions shall be made for the volume of joint material, embedded metal reinforcement, structural shapes, chamfers, tops of piles, or pipe with an end area of less than 1 sf.

555-5 BASIS OF PAYMENT

555-5.01 General. When the Contractor elects to substitute an optional concrete class as permitted by Table 501-1, Concrete Class Options, payment will be made for the originally specified class of concrete using the originally specified method of measurement.

555-5.02 Concrete for Structures. The unit price bid per cubic yard shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except reinforcement will be paid for separately under its appropriate item. Unless otherwise provided, the unit price bid shall include the cost of furnishing and placing flashing or other metal strips, flexible water stops, sheet packing, pipe drains, bituminous material, water for wetting, joint materials, felt, tar paper, joint sealing compounds, joint fillers, and concrete curing materials.

No extra compensation for falsework or falsework piling will be paid. This work is included as part of the formwork.

No extra compensation for corrective finishing or repairs to damaged or defective concrete will be paid.

Bridge bearings, expansion joints, and anchor bolts will be paid for under their appropriate items.

Progress payments will be made, after the concrete and curing applications have been properly placed, to the extent that payment will be made at 90% of the computed quantity of each concrete placement, with the balance to be paid after completion of all curing and corrective work thereon.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>555.0104</td>
<td>Footing Concrete, Class A (No Concrete Class Substitutions Permitted,</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td></td>
<td>Except Class H Where Footing is 3 feet Thick or Less)</td>
<td></td>
</tr>
<tr>
<td>555.0105</td>
<td>Concrete for Structures, Class A</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>555.05</td>
<td>Concrete for Structures, Class F</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>555.06</td>
<td>Concrete for Structures, Class G (Deposited Under Water)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>555.07</td>
<td>Concrete for Structures, Class GG (Deposited Under Water)</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>555.08</td>
<td>Footing Concrete, Class HP</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>555.09</td>
<td>Concrete for Structures, Class HP</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>555.10</td>
<td>Concrete for Structures, Class D</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>555.11</td>
<td>Concrete for Structures, Class DP</td>
<td>Cubic Yard</td>
</tr>
</tbody>
</table>
SECTION 556 - REINFORCING STEEL FOR CONCRETE STRUCTURES

556-1 DESCRIPTION. The work will consist of furnishing and placing reinforcing steel for concrete structures, or stud shear connectors, in accordance with the contract documents, and in a manner satisfactory to the Engineer.

Reinforcing steel for concrete structures may be uncoated, epoxy-coated, galvanized, or stainless steel, as indicated in the contract documents.

556-2 MATERIALS. Materials for this work shall meet the requirements of the following subsections of Section 700-Materials and Manufacturing:

- Uncoated Bar Reinforcement, Grade 60
- Wire Fabric for Concrete Reinforcement
- Epoxy-Coated Bar Reinforcement
- Stud Shear Connectors
- Epoxy-Coated Wire Fabric Reinforcement
- Mechanical Connectors for Reinforcing Bar Splices
- Galvanized Bar Reinforcement
- Stainless Steel Bar Reinforcement
- Uncoated Bar Reinforcement, Grade 75
- Grouted Reinforcing Bar Splice Sleeves

556-2.01 Devices for Supporting and Tying Reinforcement. Chairs, tie wires, and other devices used to support, position, or fasten the reinforcement shall be made of or coated with, a dielectric (electrically insulating) material. Stainless steel chairs without polyethylene tips and meeting the requirements of ASTM A493, AISI Type 430, may also be used. The specific hardware that the Contractor proposes to use shall be approved by the Engineer.

When forms are to be removed in their entirety, uncoated steel chairs equipped with snug-fitting, high-density, polyethylene tips which provide 1/4 inch clearance between the metal and any exposed surface may be used, except that uncoated steel chairs shall not be used in contact with stainless steel.

556-3 CONSTRUCTION DETAILS

556-3.01 General

A. Ordering. Prior to ordering reinforcing steel, the Contractor shall carefully check all bar lists, and assume full responsibility for their accuracy. No change in the bar list shall be made by the Contractor unless approved by the DCES. If no bar list is provided in the Plans, then §557-3.17 No Bar List Provided shall apply.

B. Handling and Storage

1. Epoxy-Coated Reinforcing Steel. All epoxy-coated reinforcement shall be stored above ground on wood or padded supports.

   Epoxy-coated reinforcement stored on-site shall be protected from sunlight and moisture using opaque waterproof covers. Covers shall be placed in a manner that will permit constant air circulation so as to minimize the formation of condensation on the epoxy-coated surface.

   All equipment for handling epoxy-coated steel shall have padded contact areas. All bundling bands shall be padded and all bundles shall be lifted with a strong back, multiple supports, or a platform bridge so as to prevent steel-to-steel abrasion from sags in the bundle.
Steel shall not be dropped or dragged. Care shall be taken at all times to prevent damage to the epoxy coating.

Steel that is partially embedded in concrete shall have the exposed sections protected with opaque waterproof covers prior to any winter shutdown of a project.

2. **Galvanized Bar Reinforcement.** All galvanized bar reinforcement shall be stored above ground on wood or padded supports and arranged so that rainwater drains off the bars.

3. **Stainless Steel Bar Reinforcement.** Stainless Steel Bar Reinforcement shall be stored separately and shall be handled using tools that are not used on carbon steel.

**C. Placing and Fastening Reinforcing Steel.** Prior to placing reinforcement, all grease, dirt, mortar, and any other foreign substances shall be removed.

- Loose rust and loose millscale on uncoated reinforcement shall be removed by wire brushing.
- Steel reinforcement shall be placed in the position indicated in the contract documents and within the allowable tolerances specified. Before concrete is placed, all reinforcement shall be securely fastened and supported with approved chairs or other approved devices.

**D. Inspection.** Concrete shall not be placed until the reinforcing steel is inspected, placement of the steel meets applicable tolerances, and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision will be rejected and removed.

**556-3.02 Steel Fabric Reinforcement.**

**A. Field Repair of Coatings.** Field repair will not be required on areas of minor damage. Minor damage is defined as any defect or break in the coating less than 1/4 x 1/4 inch. The maximum number of unrepaired minor damaged areas shall not exceed an average of six (6) per foot of wire.

- Reinforcing fabric having coating damage exceeding the above criteria shall be rejected and immediately removed from the work site.

**B. Placement.** Steel fabric reinforcement shall be placed as shown in the contract documents. Unless otherwise noted in the contract documents, steel fabric reinforcement shall be overlapped a minimum of the distance between adjacent wires in the panel. Overlapping panels of steel fabric reinforcement shall be wired together to ensure that the location and overlap of the mesh panels is maintained during concrete placement.

**556-3.03 Bar Reinforcement**

**A. Field-Bending.** The bar reinforcement shall be bent to the shapes shown in the contract documents. Unless shown otherwise in the contract documents or below, the radii of bends, measured to the inside face of the bend, shall be greater than, or equal to, three times the diameter of the bar. Bends in stirrups shall be greater than, or equal to, the diameter of the bar.

1. **Uncoated Bar Reinforcement.** When bars are heated for field-bending they shall not be heated to a temperature higher than that producing a dark cherry-red color. Only competent personnel shall be employed and proper equipment provided for cutting and bending.

2. **Epoxy-Coated Bar Reinforcement.** The alternatives of shop bending or field-bending of epoxy-coated bar reinforcement will be at the option of the Contractor. Field-bending shall be done by cold methods only.

- Field-bending operations will be allowed only when ambient and bar temperatures are 40°F.
or greater. When lower temperatures prevail, the Contractor may supply, for field-bending operations, a fully enclosed space that is heated. Direct heating of the bars shall not be permitted.

Epoxy coatings damaged by field-bending work shall be evaluated and repaired or replaced, in accordance with the requirements of §556-3.03 B.1 Epoxy-Coated Bar Reinforcement.

3. **Galvanized Bar Reinforcement.** The galvanized bar reinforcement shall be shop bent before galvanizing. Up to 5% of the mass of bars may be field bent to replace missing, damaged, or incorrectly fabricated bars. Field-bending shall be done by cold methods only. When bending galvanized bar reinforcement size 7 and greater, the minimum bend radius measured to the inside face of the bend shall be increased to 4.5 times the bar diameter. For bars numbered 14 and 18, increase the bend radius to 5.5 times the bar diameter.

   Field-bending operations will be allowed only when ambient and bar temperatures are 40°F or greater. When lower temperatures prevail the Contractor may supply, for field-bending operations, a fully enclosed space that is heated. Direct heating of the bars shall not be permitted.

   The ends of bars cut after galvanizing shall be coated with zinc repair material following the procedures of §719-01, Galvanized Coatings and Repair Methods except that repair materials containing aluminum shall not be permitted.

   Galvanizing damaged by field-bending work shall be evaluated and repaired, or replaced, in accordance with the requirements of §556-3.03 B.2 Galvanized Bar Reinforcement.

4. **Stainless Steel Bar Reinforcement.** The stainless steel bar reinforcement shall be shop bent or field bent as shown in the contract documents. When shop bending is required, up to 5% of the mass of bars may be field bent to replace missing, damaged, or incorrectly fabricated bars. Field-bending shall be done by cold methods only.

**B. Field Repair of Coatings**

1. **Epoxy-Coated Bar Reinforcement.** The Contractor will be required to field repair damaged areas of the bar coating, and to replace bars exhibiting severely damaged coatings. The material used for field repair shall be that supplied by the coating applicator.

   Field repair will be required on all areas of major damage. Major damage is defined as any defect or break in the epoxy coating 1/4 x 1/4 inch or greater. The total number of all major damaged areas which have been repaired with patching material shall not exceed five (5) in any 10 foot length of bar.

   Field repair will not be required on areas of minor damage. Minor damage is defined as any defect or break in the coating less than 1/4 x 1/4 inch. The maximum number of unrepaired minor damaged areas shall not exceed an average of six (6) per foot on any individual bar.

   A reinforcing bar having coating damage determined by the Engineer to exceed the above criteria shall be rejected and immediately removed from the work site. All such bars shall be replaced, in kind, by the Contractor at no additional cost to the State.

2. **Galvanized Bar Reinforcement.** The Contractor shall field repair damaged areas of the bar coating, and replace bars exhibiting severely damaged coatings. Severe damage is defined as more than five (5) 1/4 x 1/4 inch or larger areas in a 10 foot length. The material and procedures used for field repair shall meet the requirements of §719-01, Galvanized Coatings and Repair Methods, except that repair materials containing aluminum shall not be permitted.

**C. Splices.** Splices will be permitted only where shown in the contract documents. Should the Contractor desire to splice bars at locations other than those shown in the contract documents, written permission to do so shall first be obtained from the DCES. Such permitted splices shall be well distributed or located at points of low tensile stress. Splices shall not be permitted unless a minimum
of 2 inches can be provided between the splice and the nearest adjacent bar.

Splices for bar sizes No. 11 or smaller, shall be made by means of a mechanical connector or by placing the bars in contact and wiring them together for the full length of the splice. Splices for bars larger than No. 11 shall be made by use of a mechanical connector unless welding is specifically required by the contract documents. Mechanical connectors shall be installed in accordance with the manufacturer's written requirements. Mechanical connectors for stainless steel shall be stainless. Welding stainless steel will not be permitted unless the proposed welding technique is submitted to and approved by the DCES.

Arc-welded splices shall be made and will be inspected in accordance with the provisions of the SCM.

Prior to welding of epoxy-coated reinforcing bars, the epoxy coating shall be removed for the length to be welded plus 6 inches on each side of the weld. After welding, the spliced area shall be cleaned in accordance with SSPC - Surface Preparation Specification No. 6 (SSPC-SP6), Commercial Blast Cleaning. The surface shall be blast cleaned to SSPC-SP6 Commercial Blast Cleaning standard.

Photographs in SSPC-VIS 1, Guide And Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning, for B SP6, C SP6, D SP6, G1 SP6, G2 SP6, or G3 SP6, can be used as a guide to identify the desired cleaning, depending on the initial condition of the steel. However, the written standard for SP6 will be the primary means to determine conformance with blast-cleaning requirements. The photographs shall not be used as a substitute for the written standards. A compatible epoxy repair material supplied by the coating applicator shall be applied to the spliced area and overlap the original coating by 6 inches. The epoxy repair material shall be applied the same day as the cleaning.

Prior to welding galvanized bar reinforcement, the zinc coating shall be removed for the length of the weld plus 2 inches on each side of the weld. Cleaning shall be the same criteria as for epoxy-coated reinforcing. Coating repair shall be in accordance with the requirements of §556-3.03 B.2 Galvanized Bar Reinforcement.

**D. Placement in Structural Slabs.** Bar supports shall be spaced no farther apart than 4 feet center-to-center, nor shall any bar support be closer than 6 inches from the edge of any future concrete surface. Bridge slab bar reinforcement shall be placed in accordance with the following tolerances:

- **Vertical:** \( \pm \frac{1}{4} \) inch
- **Horizontal:** \( \pm \frac{1}{2} \) inch

The structural slab bar reinforcement mats (top and bottom) shall be securely connected together. This connection shall be accomplished by wiring or other means approved by the Engineer. Connections shall be placed no farther apart than 4 feet on center. The bar supports may be utilized for this purpose. Connecting devices shall neither deflect the bar reinforcement nor interfere with the smooth flow of concrete. Stainless steel reinforcement shall not be in direct contact with uncoated steel reinforcement, nor with galvanized reinforcement. This does not apply to stainless steel wires and ties.

Immediately prior to placement of concrete, the Engineer will verify that the reinforcing steel is positioned within the above-stated tolerances.

Subsequent to placement of concrete, the Engineer will verify, at random, that the vertical clear distance from the top of the structural slab to the top mat of main reinforcing, as shown in the contract documents, is correct within a tolerance of plus or minus 1/2 inch. If the allowable tolerance is exceeded, the Engineer will reject the work and so advise the Contractor and the DCES, in writing, stating the deficiencies upon which the rejection is based. The DCES will review the nature and extent of the deficiencies and shall designate one or more of the following alternatives:

1. The affected concrete placement shall be removed and replaced in whole or in part.
2. The Contractor shall provide special corrective measures as directed by the DCES.
3. The concrete placement shall be accepted without corrective action.
556-3.04 Stud Shear Connectors for Bridges. Stud shear connectors shall be shop or field welded to the structural steel members at the locations indicated in the contract documents. This work shall be done in accordance with the provisions of the SCM.

556-4 METHOD OF MEASUREMENT

556-4.01 Steel Fabric Reinforcement. The quantity of steel fabric reinforcement satisfactorily installed will be measured for payment as the number of square yards of overall surface area of the deck or structure shown on the contract documents, not including clear distance to the edges, measured to the nearest whole square yard. No subtractions will be made for holes smaller than one-half of a square yard, and no additional payment will be made for overlaps.

556-4.02 Bar Reinforcement. These will be measured as the number of pounds of steel bars placed. The weight of bar reinforcing will be computed by the Engineer utilizing the unit mass for each size bar as given in Table 556-1. No allowance will be made for the weight of any coating on the bars.

<table>
<thead>
<tr>
<th>TABLE 556-1 UNIT WEIGHT OF DEFORMED BARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Number</td>
</tr>
<tr>
<td>Weight (lb/ft)</td>
</tr>
</tbody>
</table>

NOTE. Bar Numbers are bar sizes in numbers of eighths of an inch.

556-4.03 Stud Shear Connectors for Bridges. Stud Shear Connectors will be measured as each connector placed.

556-5 BASIS OF PAYMENT

556-5.01 Steel Fabric Reinforcement. The unit price bid per square yard will include the cost of all labor, materials, and equipment necessary to complete the work. The removal of the concrete placement and its subsequent replacement, or other corrective work which the Contractor is directed to perform, shall be accomplished at no additional cost to the State. No additional payment will be made for the replacement of defective fabric or the replacement of fabric with defective coatings.

556-5.02 Bar Reinforcement. The unit price bid per pound shall include the cost of all labor, materials, and equipment necessary to complete the work. The unit price shall also include the cost of chairs, supports, fastenings, connections, and splices not specifically shown in the contract documents. If the Engineer permits the substitution of larger bars than those specified, or the DCES permits splices not shown in the contract documents, payment will be made only for the amount of steel which would have been required if the specified size and length had been used. No additional payment will be made for enclosures constructed for bending of bars or for replacement of defective bars or for replacement of bars with defective coatings.

556-5.03 Stud Shear Connectors for Bridges. The unit price bid per stud shall include the cost of all labor, materials, and equipment necessary to complete the work. If the use of any stud shear connector requires payment of a royalty to the manufacturer, the royalty shall be included in the unit price bid for this work.
SECTION 557 - SUPERSTRUCTURE SLABS, SIDEWALKS ON BRIDGES, AND STRUCTURAL APPROACH SLABS
(Last Revised May, 2019)

557-1 DESCRIPTION. The work shall consist of placing high performance (Class HP) concrete to construct superstructure slabs, sidewalks, safety walks, and structural approach slabs, as required by the contract documents.

557-2 MATERIALS

557-2.01 General. The materials used for superstructure slabs, sidewalks on bridges, and structural approach slabs shall meet the material requirements of the following subsections:

Structural concrete materials  555-2.01
Reinforcing steel  556-2
Prestressed concrete form units  718-05
Permanent Corrugated Metal Forms for Bridge Slabs  736-01

557-2.02 Concrete. This shall meet the material requirements for Class HP in accordance with §501. Unless otherwise directed by the Engineer, all concrete shall contain a water-reducing and retarding admixture, meeting the requirements of §711-08. The quantity of the admixture shall be sufficient to achieve the minimum retardation consistent with placing conditions to keep the entire placement plastic (either one continuous placement or all sections of a sequence placement). The dosage rate used shall be determined by the Contractor in accordance with the manufacturer’s recommendation and in concurrence with the Regional Materials Engineer. The dosage shall remain consistent for the duration of the concrete placement except for minor adjustments to meet changing environmental conditions.

557-2.03 HPIC Concrete  This shall meet the requirements of 557-2.02 HP Concrete with the following modifications:

1. The maximum w/c ratio is 0.40. Do not include absorbed moisture of the light weight fine aggregate as part of the w/c ratio calculation.

2. Substitute lightweight fine aggregate, meeting the requirements of AASHTO M 195, for 30% (by volume) of standard fine aggregate.

The Regional Materials Engineer, or his representative, will approve the batch weights prior to use. Use these values to manufacture all internally cured high performance concrete and periodically correct the batch weights to account for changes in the fine aggregate fineness modulus and aggregate moisture contents.
557-3 CONSTRUCTION DETAILS

557-3.01 Concrete Manufacturing and Transportation. The requirements of §501-3 shall apply.

A. For HPIC additional requirements follow:

1. Construct lightweight fine aggregate stockpile(s) at the production facility so as to maintain uniform moisture throughout the pile. Using a sprinkler system approved by the Materials Engineer. Continuously and uniformly sprinkle the stockpile(s) with water for a minimum of 48 hours, or until the “Absorbed Moisture content” of the aggregate in the stockpile is at least 15% by weight as determined by Test Method NY 703-19E (https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau/forms-manuals). If a steady rain of comparable intensity occurs, turn off the sprinkler system at the direction of the Materials Engineer, until the rain ceases. At the end of the wetting period, or after the rain ceases, allow stockpiles to drain for 12 to 15 hours immediately prior to use, unless otherwise directed by the Materials Engineer.

2. The moisture content of the lightweight fine aggregate must be determined immediately prior to batching, using Test Method NY 703-19E. If the supplied mix design is based on “oven dry” weight of lightweight fine aggregate, a corresponding adjusted weight must be supplied to account for the actual absorbed moisture content, so that the mix design entered in to the automated batching system is based on SSD weight. After the adjusted mix design is entered into batching system, additional adjustments must be made to the fine aggregate and water quantities to account for the “surface” moisture of the fine aggregates.

3. The lightweight fine aggregate, at the time of batching must be at least 15% absorbed moisture content. Batch the lightweight fine aggregate first, then routinely batch the fine aggregate, coarse aggregate, admixtures, cement, pozzolan, Microsilica, and remaining mixing water and mix completely.

557-3.02 Falsework. The requirements of §555-3.02 shall apply.

557-3.03 Forms. Unless otherwise noted the contractor may use any of the following forming systems to form the underside of the superstructure slabs:

A. Removable Forms. The requirements of §555-3.03A shall apply.

B. Permanent Corrugated Metal Forms for Superstructure Slabs. Where permanent metal forms are employed, the following construction procedures shall apply.

Care and protection shall be given the metal form sheets, supports, and accessory items during handling, shipping, and storage. During loading, hoisting, and unloading operations, extra precaution and care shall be taken to prevent damage to ends, corners, and edges of the form sheets, supports, and accessory items. If the form units and accessories are to be stored prior to installation, they shall not be placed in contact with the ground and the material shall be adequately covered or protected to keep it dry.

Form supports shall be placed in direct contact with the flange of a stringer or floor beam. All attachments shall be made by permissible welds, bolts, clips, or other approved means. The welding of form supports to steel not considered weldable or to portions of flanges subject to tensile stresses shall not be permitted. Welding shall be in accordance with the provisions of the New York State Steel Construction Manual (SCM) except that 1/8 inch fillet welds will be permitted. All welding shall be performed by a welder certified under the SCM.
Form sheets shall not be permitted to rest directly on the flanges. They shall be securely fastened to form supports by self-tapping screws and shall have a minimum bearing length of 1 inch at each end. Transverse construction joints shall be located at the bottom of a flute and 1/4 inch weep holes shall be field drilled at not less than 1 foot on centers along the line of the joint.

Screed rail and pouring runway supports shall not be located directly on the form sheets, form supports, or reinforcing steel. No loose sheets or miscellaneous hardware shall be left on the structural slab at the end of the work day. Metal forms shall not be used where longitudinal slab construction joints are located between stringers, nor shall they be used on the fascia overhang.

The corrugated metal sheets shall be fabricated for the placement sequence used with the joints between sections of sheet overlapped or securely fastened to eliminate differential deflections between sections. Any exposed form metal where galvanizing has been damaged, shall be cleaned and repaired as provided for in §719-01, Galvanized Coatings and Repair Methods.

C. Prestressed Concrete Form Units. The applicable requirements of §555-3.03A and the Prestressed Concrete Construction Manual shall apply.

Form supports shall be placed in direct contact with the flange of the stringer. All attachments shall be made by permissible welds, bolts, or other means approved by the Engineer. The welding of form supports to steel not considered weldable, or to portions of flanges subject to tensile stresses will not be permitted. Welds and welding shall be in accordance with those portions of the SCM concerned with fillet weld design, fillet weld details, general workmanship and technique, except that 1/8 inch fillet welds will be permitted. All welding shall be performed by a welder certified under the SCM.

D. Restrictions. The following restrictions shall apply to all forms.

1. Fascia overhangs shall be formed with removable forms to provide a flat concrete surface.
2. A bay, constructed in stages such that a longitudinal joint is required, shall only be formed with removable forms.
3. A haunch which rests upon an end diaphragm shall only be formed with removable or permanent corrugated metal forms.
4. Prestressed concrete form units shall not be used where the design span is less than 5 feet nor greater than 11 feet. The design span is equal to the beam spacing minus one-half the top flange width.
5. Prestressed concrete form units may be restricted at the ends of some skewed spans. Refer to the contract documents for details.
6. Prestressed concrete form units shall not be used on prestressed concrete box beam superstructures unless specifically allowed by the contract documents.

557-3.04 Placing and Fastening Reinforcing Steel. Immediately prior to placement of concrete, the Engineer will verify that the reinforcing steel is positioned within required tolerances. If the allowable tolerances are exceeded, the Contractor shall correct the position of the reinforcing steel before placing concrete. All reinforcing steel and chairs shall be anchored to prevent uplift.

A. Permanent Corrugated Metal Forms or Removable Forms. Except for prestressed concrete form units the requirements of §556-3.01 and §556-3.03 shall apply.

B. Prestressed Concrete Form Units. The requirements of §556-3.01 and §556-3.03 shall apply. The top reinforcing steel mat shall be securely connected to the forms and the stud shear connectors. Connections shall be placed no farther apart than 4 feet on center. Connections to the forms may be made to the form-lifting devices, reinforcing steel projecting from the forms, or devices in the form.
supplied for this purpose. Hold-down devices shot into the form will not be permitted. Connections shall neither deflect the reinforcing steel nor interfere with the smooth flow of concrete.

557-3.05 Handling and Placing Concrete. The requirements of §555-3.04 Handling and Placing Concrete shall apply. A Preplacement Meeting is required to be held at least one week prior to the start of any concrete placement for superstructure slabs. Meeting participants besides the Contractor and Engineer should include materials suppliers, subcontractors, Regional Materials Engineer, Regional Safety Officer, and others as deemed appropriate. Participants will review all aspects of the proposed placement including, but not limited to, the following:

- Equipment proposed for use and for backup.
- Planned workforce, assigned tasks of each designated position, and experience and expertise.
- Proposed construction techniques and crew experience.
- Safety considerations.
- Concrete mix design.
- Admixtures and technical data; dosage rates will be approved by the Regional Materials Engineer.
- Proposed placement rate, curing and loading schedules.
- Curing practices to be employed as well as the workforce designated to the curing process.
- Delivery/conveyance equipment, including deck finishing machine setup and operation.
- Traffic control.

For placements proposed between October 1st and April 1st, the Preplacement Meeting should additionally review cold weather concreting operations including, but not limited to, the following:

- Expected environmental conditions at time of placement and during curing
- Proposed curing methods to maintain acceptable curing temperature

No concrete shall be placed until all aspects of the proposed placement are approved by the Engineer. A written report of the preplacement meeting will be established by the Engineer. Modifications shall be submitted in writing to the Engineer for approval. Further, for placements between October 1st and April 1st, no concrete shall be placed until all aspects of the proposed placement are approved by the Regional Construction Engineer.

Before concrete slabs are placed on steel spans, all permanent field connections shall be completed unless otherwise noted on the contract plans, and all temporary supports and mechanisms used in steel erection shall be removed.

No concrete shall be placed until all the provisions of §555-3.04A. Placement Limitations are met, environmental conditions are deemed favorable, and satisfactory means to mitigate adverse environmental conditions exist. Favorable environmental conditions are defined as an expected weather forecast suitable for concrete placement during the entire placement duration, the evaporation rate not to exceed 0.25 lb/sf-hr, and acceptable curing temperatures expected for the duration of the curing period.

The Contractor shall provide any necessary means to mitigate adverse weather conditions and curing temperatures. Failure to maintain acceptable environmental conditions will result in the concrete placement being stopped and a bulkhead put in place.

The Contractor shall take the necessary measurements and calculate the theoretical evaporation rate. The measurements for air temperature, relative humidity, and wind speed shall be taken as near as possible to the final placement location of the concrete.

Concrete temperature will be taken from the same sample used for slump and air content tests. These measurements will be taken prior to commencement of concrete placement. If, in the Engineer's opinion, significant changes occur in atmospheric conditions, additional atmospheric measurements and
calculations by the Contractor will be required. The Contractor shall supply all instruments necessary to make the required calculations. All instruments shall be approved by the Engineer, as being in good working order. The Contractor’s measurements and calculations will be subject to the Engineer's approval. To determine the evaporation rate, apply the values taken for relative humidity, plastic concrete temperature, air temperature, and wind velocity to Figure 557-1 Structural Concrete Evaporation Rate.

The placing of concrete for any bridge slab shall be continuous between joints. Conveyance of concrete shall meet the requirements of §555-3.04B.

Vibrating of concrete shall be in accordance with §555-3.04E except the number of vibrators required shall be one for every 40 cy of concrete placed per hour, with a minimum of two vibrators in use at all times, and equally spaced across the placement front. One additional vibrator shall be available for use as a backup.

557-3.06 Cold Joints. “Cold Jointing,” the bonding of fresh concrete to set concrete, shall be done where indicated in the contract documents, or where approved by the DCES.

A. Horizontal Joints. Within 24 hours of the start of the placement, the hardened concrete shall have laitance and dirt removed by a high-pressure water wash. The high-pressure water wash shall be sufficiently strong to remove any laitance and dirt, but not damage the reinforcement or reinforcement coating. The pressure wash equipment shall be capable of providing pressure of 3000 to 5000 psi.

After pressure washing, the concrete shall be continuously wetted for a minimum of 12 hours immediately prior to deck placement. Before placing fresh concrete, all standing water shall be removed with oil-free compressed air. The surface shall be protected from drying to maintain a clean, saturated surface dry condition when placing the new concrete.

If the tops of precast/prestressed elements have been sealed with a penetrating sealer, pressure wash the tops a maximum of 2 hours prior to concrete placement. The requirement for prewetting is waived.

B. Construction Joints. The requirements of § 555-3.06 A. shall apply. Construction joints shall be placed only where shown in the contract documents or where permitted by the DCES.

In the event an ongoing placement is delayed excessively, the establishment of a bulkhead shall be required.

557-3.07 Finishing Integral Wearing Surfaces on Superstructure Slabs. Machine finishing shall be used throughout all superstructure concrete placement operations with the exception of areas which are inaccessible to finishing machines.

Machine finishing shall be accomplished with an approved power-driven, one-operation (strike-off and finishing) machine. The finishing machine shall have a strike-off auger set 1/4 to 1/2 inch above the finished surface, a power-driven roller or oscillating type screed, and a pan float.

Finishing machines shall be equipped with adjustable strike-off and finishing screeds, the bottom surfaces of which shall be adjusted to produce the required contour of the finished surface. Machines shall be kept in true adjustment. Machines out of adjustment shall not be used until proper adjustments have been made and the adjustments have been approved by the Engineer.

The specific method and equipment that the Contractor proposes to use for finishing will be supplied during the Preplacement Meeting and will be subject to approval by the Engineer based on the above listed requirements.

Finishing machine rail supports shall be accurately set and of substantial construction so that the finished deck surface will conform to the profile and transverse sections shown in the contract documents. Finishing machine rail supports shall be placed and adjusted to properly provide for the deflection of forms, falsework, and structural supporting members which will occur during the placement of the concrete. Finishing machine rail supports shall not be attached by welding to portions of flanges
subject to tensile stresses. The finishing machine rail supports shall be spaced at a maximum of 2 feet on center. During stage construction, the support system shall be on the stage being placed.

Where the deck surface falls outside the fascia stringer flange, the finishing machine rail supports shall be placed on the forms. The forms shall be designed to take these loads through the use of outriggers or some other approved means.

Prior to commencing concreting operations, the finishing machine shall be given a test run over the full length of the superstructure segment to be paved, with the finishing machine adjusted to its finishing position. While operating the finishing machine during this test, the finishing machine rails shall be checked for deflection and proper adjustment, the cover on slab reinforcement measured, and the controlling dimensions of slab reinforcement and forms checked. All necessary corrections shall be made and verified by the Engineer before concreting is begun.

A sufficient amount of concrete equal to the finishing machine capacity shall be supplied at all times. The finishing machine shall carry sufficient concrete in front of the screed to fill low and porous places. This operation shall be done only once and shall produce a uniformly consolidated dense smooth surface of the required contour. The passage of the strike-off auger shall provide a concrete surface slightly above grade so that after settlement, if any, and the disappearance of excess water from the surface, the passage of the finishing screed will result in a uniform surface at the required grade and contour over its entire area, and provide the required cover over reinforcing.

In areas which are inaccessible to finishing machines, use of approved manual vibratory equipped power screeds may be used, with written approval of the DCES.

Hand finishing shall be allowed only in areas inaccessible to finishing machines or manually driven vibratory-equipped power screeds. Hand finishing shall be performed in the same sequence and manner as machine finishing, unless otherwise permitted by the Engineer. Hand finishing shall be performed in such a manner as to produce a concrete surface with quality and uniformity identical to that produced by the finishing machine. Hand screeds or bullfloats shall be magnesium and 10 inches, or more, in width. Care shall be taken not to overwork the concrete surface during any finishing operation.

In the event the placement is delayed as a result of equipment breakdowns or delivery problems, all concrete in place shall be protected from evaporation by covering the surface with wet burlap, curing blankets, or plastic sheets. Excessive delays shall require the establishment of a bulkhead and the ceasing of the placement.

Prior to texturing, the finished concrete surface shall be examined by the Contractor and the Engineer using a straightedge. The straight-edge shall not be less than 10 feet long. It shall be furnished by the Contractor and maintained in good, usable condition at the placement site at all times. While the concrete is still plastic, surface depressions shall be filled with concrete of the same class as the placement in progress. Surface irregularities greater than 1/4 inch in 10 feet in either the longitudinal or the transverse direction shall be corrected in a manner acceptable to the Engineer. Thin mortar or laitance, which may have accumulated ahead of the finishing machine screed, shall be removed from the work site. They shall not be used to fill depressions.

After finishing, the surface shall be given a suitable texture with an artificial turf drag made of molded polyethylene with approximately 53,500 synthetic turf blades per square yard, each approximately 1/2 inch long. The artificial turf drag shall be of a type and brand appearing on the Department's Approved List.

The Contractor may apply texture in a transverse direction, longitudinal direction, or parallel to the finishing machine. Once begun, the direction of texturing shall not change. All texturing shall be done from a work bridge immediately following the finishing operation. Texturing shall be done prior to the beginning of curing operations. Only one pass of the turf drag over the finished area will be permitted.

If texturing is done in a transverse or skewed direction, the Contractor shall texture by hand methods immediately after finishing machine passage.
If texturing is done in the longitudinal direction the turf drag shall be a seamless strip and shall be attached to the work bridge such that the surface of the concrete is textured immediately after finishing machine passage. Small areas, otherwise inaccessible to the attached drag, may be textured by hand methods. Texture resulting from the drag shall stop within 1 foot of curbs.

The finishing movement and resulting progress of the turf drag shall be done in a manner so as to prevent ridges or gouges forming in the concrete surface. The drag shall be weighted and the contact area changed as required to produce an acceptable texture. The drag shall be cleaned periodically to remove all hardened concrete particles.

557-3.08 Finishing Integral Wearing Surfaces on Structural Approach Slabs. The requirements of §557-3.07 shall apply together with the following:

The Contractor may use an approved, manually driven, vibrator-equipped power screed in lieu of a power-driven transverse finishing machine. Only screed model types appearing on the Department’s Approved List shall be employed for this work. The Engineer may require the use of a power-driven finishing machine if satisfactory results are not being attained.

557-3.09 Finishing Surfaces to be Overlaid with Portland Cement or Asphalt Concrete.

Machine finishing shall be used throughout all superstructure concrete placement operations, with the exception of areas which are inaccessible to finishing machines. In areas which are inaccessible to finishing machines, use of approved manual vibratory equipped power screeds may be used, with written approval of the D.C. E. S.

Surfaces shall be finished to a surface tolerance of 3/8 inch in 10 feet. The surface tolerance shall be verified by the Engineer with an approved straightedge not less than 10 feet long. The straightedge shall be furnished by the Contractor who shall maintain it in good condition at the paving site at all times.

Hand finishing shall be allowed only in areas inaccessible to finishing machines or manually driven vibratory-equipped power screeds. Hand finishing shall be performed in the same sequence and manner as machine finishing, unless otherwise permitted by the Engineer. Hand finishing shall be performed in such a manner as to produce a concrete surface with quality and uniformity identical to that produced by the finishing machine. Hand screeds or bullfloats shall be magnesium and 10 inches, or more, in width. Care shall be taken not to overwork the concrete surface during any finishing operation.

Upon completion of screeding, surfaces which will be overlaid with portland cement concrete shall be textured to conform to §557-3.07.

557-3.10 Sidewalk and Safety Walk Finish on Bridges. Sidewalks and safety walks shall be constructed by placing concrete continuously to an elevation slightly higher than shown in the contract documents. The concrete shall then be screeded to the correct elevations and worked with a magnesium float to give uniform surface. Floating shall be kept to a minimum, consistent with the desired finish, in order to avoid overworking the concrete. Follow floating with a broom finish. Surface scoring will not be permitted.
FIGURE 55-7 STRUCTURAL CONCRETE EVAPORATION RATE

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

557-3.11 Curing. After finishing and plastic-concrete texturing operations are completed, the concrete surface shall be completely covered with clean, prewetted burlap. The allowable time period for wet burlap covering shall not exceed five minutes from the completion of texturing, and 30 minutes from the time of concrete placement. Care shall be taken so as not to damage the finished surface and texturing. The curing shall not be delayed beyond the specified period. Burlap shall be lapped a minimum of 1 foot. Lapped edges are not required to be sealed. Burlap shall be thoroughly saturated over its entire surface area and shall be drained of excess water prior to its application. Burlap shall be kept continuously wet, commencing 10 minutes from the time the wet burlap is placed, and protected from displacement. The Contractor may cover the wet burlap and soaker hoses only if it is necessary to maintain curing temperature.
The curing period shall begin only after all concrete for a given placement is complete. A curing day is defined as any day during which the ambient air temperature at the concrete surface is 45°F or higher for the entire day.

Conditions may occur which prevent an entire day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur and with the Engineer's approval, the Contractor may aggregate curing hours. A curing hour is defined as any hour during which the curing temperature remains at, or above 45°F.

An aggregation of 24 curing hours will be credited as one curing day. Aggregations of less than 24 curing hours will not be credited.

Curing hours will be determined with continuous recording thermometers. The number and placement of the thermometers will be determined by the Engineer. Thermometers used to monitor curing temperatures shall consist of the following types:

1. Continuously Recording Thermometer. The thermometer shall be capable of continuously recording temperatures within a range of 0°F to 120°F for a minimum of 24 hours.
2. Maximum - Minimum Recording Thermometer. For all placements the thermometer shall be capable of recording maximum and minimum temperatures in a range of 0°F to 120°F.

The curing temperature of concrete is the air temperature at the concrete surface, or the air temperature between the concrete surface and its protective covering. Temperatures at these locations are critical for proper concrete curing. For the purposes of this section the temperatures at the foregoing locations shall be maintained between 45°F and 85°F inclusive.

A. Superstructure Slabs. After the burlap placement has been fully completed, the concrete surface shall be cured for 14 curing days. The Contractor may use either option listed below. After seven curing days, the Contractor may be permitted to perform incidental work on the structure under the loading limitations of §557-3.14 Loading Limitations for Superstructure Slabs. The burlap may be displaced in limited areas, for short durations, to perform items such as sawcut grooving, placement of sidewalks, safety walks, curbing, bridge rail, and fencing. The amount of burlap displaced to perform these operations shall be limited to the immediate area affected by the Contractor’s operations. All concrete surfaces exposed during these operations shall be kept in a saturated condition. Immediately after the work is completed in the affected area, all burlap shall be replaced for the duration of the curing period. Removable forms shall remain in place until the minimum curing period is complete. HPIC Concrete curing requirement is seven days.

1. Fourteen-Day Continuous Wetting. Leave all burlap in place for 14 curing days. Provide continuous, uniform wetting for the entire curing period.

2. Wet Burlap and Curing Covers. Provide continuous uniform wetting for seven curing days. After seven curing days, either of the following methods may be used:

   a. Remove all burlap after seven curing days. Apply curing covers immediately upon burlap removal. Plastic-coated fiber blankets are not required to be laid dry. Application and maintenance of covers shall be in accordance with §555-3.08A General. Concrete cured in this manner shall not be exposed to the atmosphere for more than 10 minutes between burlap removal and curing cover placement.
   b. Apply curing covers directly over the wet burlap. Plastic-coated fiber blankets are not required to be laid dry. Application and maintenance of covers shall be in accordance with §555-3.08A General. The concrete surface shall be inspected periodically to ensure that its condition remains saturated.
The Contractor shall inform the Engineer of the intended curing procedure at the Preplacement Meeting.

**B. Structural Approach Slabs, Curbs, Sidewalks and Safety Walks on Bridges.** After the burlap placement has been fully completed, leave all burlap in place for 7 curing days. Provide continuous, uniform wetting for the entire curing period. Forms for curbs, sidewalks, and safety walks shall remain in place until the minimum curing period is complete. Forms for structural approach slabs shall remain in place until sufficient strength is achieved to avoid damage to the concrete. After removal of approach slab forms, the formed surfaces shall be cured as per the requirements of §555-3.08A.

**557-3.12 Provisions for Concreting in Cold Weather.** Cold-weather concreting provisions shall apply when the ambient air temperature below 45°F for 24 consecutive hours, or drops below 32°F at any time, during the curing or drying periods of the concrete.

When cold-weather concreting of superstructure slabs is progressed, curing shall be maintained in accordance with §555-3.08C Provisions for Curing in Cold Weather, except as modified here:

**A. Superstructure Slabs.**

The curing duration shall be 14 days (336 hours). Conditions may occur which prevent an entire 24 hour day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur the Contractor may aggregate curing hours. An aggregation of 24 curing hours will be credited as one curing day based on the Engineer’s acceptance of monitored temperature data. Any aggregations of less than 24 curing hours will not be credited as a curing day. A curing hour is defined as any hour during which the curing temperature remains at, or above 45°F. Curing temperature is defined as the temperature of the air measured at the surface of the curing concrete.

Curing temperatures shall be maintained in accordance with the requirements of Table 555-2, Cold Weather Curing Requirements. If ambient air temperatures are expected to fall below 45°F, materials and equipment necessary to maintain required curing temperatures shall be present on the site or readily available. The contractor shall provide protection in a timely manner to maintain acceptable curing.

External heat and enclosures to maintain curing temperatures may be required, as determined by the contractors proposed curing methods documented at the Preplacement Meeting. Enclosures are defined as those materials, combinations of materials, or systems that provide for uniform temperature and curing management of the concrete. If enclosures are required, they shall be constructed in such a way that all surfaces of the fresh concrete shall be maintained between 45°F and 80°F for the curing period. On structures where bottom formwork is not required, the existing superstructure materials may be considered for their insulating values provided all curing temperature requirements are maintained. If the Contractor expects to, or will, perform work when ambient temperatures are below 45°F, the enclosure shall be constructed in such a manner that work can be performed inside the enclosure without exposing any concrete to a temperature below 45°F. All concrete surfaces within heated areas shall be protected from drying by the use of live steam or use of continuously wetted burlap. All concrete surfaces within heated areas shall be protected from surface disintegration of fresh concrete due to an accumulation of carbon dioxide gas by properly venting the enclosure or use of non-combustion type heating systems.

Continuously recording thermometers shall be placed on both the top and underside of the deck to monitor areas where extreme cold or heat can be expected. Multiple thermometers may be required as directed by the Engineer. On structures where bottom formwork is not required and the existing superstructure materials are considered for their insulating value, temperatures shall be monitored at
the interface between the existing superstructure materials and new concrete using continuously recording thermocouples and thermometers.

A maximum temperature differential of 30° F between any two locations within any form of enclosure, heated or otherwise, shall be maintained at all times.

When the ambient temperature is 45°F or greater, an enclosure may be removed for access to progress additional work providing there is a temperature difference of 30 Fahrenheit degrees or less between the air and the surface of the concrete. If the temperature difference between the air and the surface of the concrete is greater than 30 Fahrenheit degrees, temperatures shall be gradually reduced at a rate not to exceed 1°F/hr until the temperature difference is equal to or less than 30 Fahrenheit degrees. If an enclosure is removed, all heating in other areas shall cease until such time that the enclosure is replaced. Upon completion of the incidental work and replacement of the enclosure, the Contractor shall reestablish acceptable curing temperature differentials, with a maximum temperature differential not more than 30 Fahrenheit degrees between any two locations within the enclosure.

After seven (7) curing days, the Contractor may perform work on the structure to complete sidewalks, safety walks, curbs, and barriers. Work shall progress only when ambient temperatures are 45°F or greater or within an enclosure as described above. Incidental work shall not cause damage to the structure.

For all incidental work, the requirements of §557-3.14, Loading Limitations for Superstructure Slabs, shall apply.

B. Structural Approach Slabs, Curbs, Sidewalks and Safety Walks on Bridges.
The provisions of 557-3.12 A Superstructure Slabs shall apply except the curing duration shall be 7 days (168 hours). After three (3) curing days, the Contractor may perform work on approach slabs to complete sidewalks, safety walks, curbs, and barriers. Work shall progress only when ambient temperatures are 45°F or greater or within an enclosure as described above. Incidental work shall not cause damage to the structure.

For structural approach slabs, the requirements of §557-3.15 Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges, shall apply.

C. Saw Cut Grooving.
When concrete is placed, cured, or dried under cold weather provisions, and a surface treatment option requiring saw cut grooving is used, saw cut grooving may be commenced after 7 curing days and shall be completed prior to commencing the drying period. Work shall progress only when ambient temperatures are 45°F or greater or within an enclosure as described in §557-3.12 A. Care shall be taken to prevent damage to the structure and no chipping or spalling of concrete shall occur at the sawcut edges.

D. Winter Surface Treatment - Superstructure Slabs and Structural Approach Slabs.
Upon completion of the curing period, the Contractor shall progress one of the following two options:

1. Option 1. The top surface and fascias of the superstructure slab shall be air dried for 10 days before being sealed with a penetrating sealer or exposed to freezing temperatures. Saw cut grooving shall be completed, as described above, prior to application of penetrating sealer. External heat and enclosures to maintain drying temperatures may be required. Drying shall be achieved by the following:

   a. Providing free air flow and maintaining temperatures between 45°F and 80°F to the top surface and fascias (vertical faces) of the superstructure slab. Fascia forms shall be removed to allow for free air flow.
b. Drying of the underside of the structure, and of the fascias when a concrete barrier is to be placed on the superstructure slab, will not be required. However, ambient temperatures shall be maintained between 45°F and 80°F in these areas for the duration of the drying period.

c. The drying period shall be continuous except that aggregate drying hours may be allowed when a contractor ceases free air flow for any reason but protects the drying concrete from exposure to any additional water. Exposure to any additional water, beyond minor leakage thru an enclosure in limited areas, will require the drying period to re-commence for 10 days. Any 3 hour period of time, or fraction thereof, when the concrete is exposed to minor leakage shall not be counted as part of the drying period. Minor leakage shall be defined as water that dries or evaporates in 3 hours or less. Limited areas are defined as areas less than 100 ft². The total area of allowable minor leakage shall not exceed 5% of the concrete area under drying conditions. The same area of concrete shall not be exposed to minor leakage more than twice. Areas that exceed 100 ft² or are exposed to additional water that does not dry or evaporate in less than 3 hours, may be dried independently to accommodate removal of the original enclosure. Any independent enclosures shall be maintained under the same temperature and air flow requirements as the original enclosure for 10 days.

d. Means of accelerating the drying process will be considered by the Director, Materials Bureau, to achieve an internal moisture content of 85% relative humidity or less, measured at a depth of 1 inch from any concrete surface.

Once the drying period is complete, temperatures shall be gradually reduced at a rate not to exceed 1°F/hr until the temperature within the enclosure equals the temperature outside the enclosure. Application of a penetrating sealer, in accordance with other items shall be completed before opening the superstructure slab to traffic.

2. Option 2. The top surface and fascias of the superstructure slab shall be air dried for 24 hours before being sealed with an interim application of penetrating sealer or being exposed to freezing temperatures. No saw cut grooving will be performed. External heat and enclosures to maintain drying temperatures may be required. Work shall be progressed by doing the following:

a. Providing free air flow and maintaining temperatures between 45°F and 80°F to the top surface and fascias of the superstructure slab. Fascia forms shall be removed to allow for free air flow.

b. Drying of the underside of the structure, and of the fascias when a concrete barrier is to be placed on the superstructure slab, will not be required. However, ambient temperatures shall be maintained between 45°F and 80°F in these areas for the duration of the 24 hour drying period. Application of interim penetrating sealer shall be completed before opening the superstructure slab to traffic.

c. After April 1st the contractor shall clean the deck of debris and provide necessary site access. The Department will inspect the superstructure slab for freeze / thaw or scaling damage. Damage shall be defined as:

1. Delaminations
2. Surface defects as follows:
   - Total combined area greater than 50 ft² with a scaling rating of 3 or greater as defined by ASTM C-672.
   - Total combined area greater than 10 ft² where the surface distress is greater than 3/16 inch deep.
(3) Pop-outs – surface imperfections greater than 3/4 inch in diameter
d. If the above described damage exists, the Contractor shall repair any damaged or
defective concrete greater than 3/16 inch deep by saw cutting the perimeter of the area to a
depth of 3/4 inch, chipping any unsuitable material to 1-1/2 inch or sound concrete
(whichever is deeper) with light, hand held, pneumatic tools, at a 45 degree angle into the
repair area. Clean all repair area surfaces thoroughly by blast cleaning. Repair small areas 3
ft² or less using approved concrete repair material that provides a permeability less than 1200
coulombs, Item 701-04, preparing the surface according to the material manufacturer’s
recommendations. Repair larger areas using Class DP concrete, preparing the surface
according to §584-3.02 and 584-3.03. Cure Class DP concrete for 7 days.

e. After all necessary repairs are completed, the Contractor shall perform diamond grinding
to the entire superstructure slab and approach slabs, to within 1 foot of any curb or barrier.
Diamond grinding shall be performed as follows:
(1) The depth of the grinding shall be approximately 3/16 inch to obtain a smooth texture.
(2) In all travel lanes, use equipment having gang-mounted diamond saw blades on a
multi-blade arbor specifically designed for PCC pavement or superstructure production
grinding. Using equipment capable of producing a 3 ft wide (minimum) grinding pass that
is equipped with a vacuum system capable of removing slurry from the bridge deck
surface, such as the Target 3800, Boart-Longyear (Kushion Kut) PC5000 or PC600, or
equal as approved by the Director, Materials Bureau. Smaller diamond grinding equip
shall be used as necessary to complete grinding adjacent to curbs or barriers. The
Contractor shall submit requests to use other equipment at least 7 days prior to the start of
grinding operations.
(3) Begin and end diamond grinding lines normal to the bridge deck centerline. Grind the
bridge deck longitudinally such that at least 95% of the bridge deck surface is ground and
the bridge deck is in the same plane across a joint or crack when measured with a 3 ft
(minimum) straithtedge. When steel joints are specified, joints shall be placed to allow
for the required grinding of 3/16 inch. Feathering of the grinding operation at steel joints
shall be kept to a minimum. Provide surface drainage by maintaining the proper cross-
slope on the finished surface and by blending adjacent passes. Regrind the bridge deck if
an acceptable surface is not being obtained.
(4) Continuously remove slurry from the bridge deck using the vacuum system on the
grinding equipment. If required, provide equipment capable of transporting the slurry
from the job site to an acceptable waste area or facility, without spilling.
(5) Traffic may be allowed on ground areas after slurry removal is complete or on decks
where only partial diamond grinding is complete.
(6) After diamond grinding is complete, concrete shall be saw cut grooved according to
contract documents and specifications for saw cut grooving, followed by penetrating
sealer application placed in accordance with contract documents and specifications for
penetrating sealers.

E. Winter Surface Treatment –Curbs, Sidewalks and Safety Walks on Bridges.
Upon completion of the curing period, concrete shall be air dried for 24 hours by providing free air
flow and maintaining temperatures between 45°F and 80°F to all concrete surfaces. The drying
period shall be continuous. Upon completion of drying, curbs, sidewalks and safety walks shall be
sealed with a penetrating sealer in accordance with contract documents.

557-3.13 Removal of Forms. Removal of forms for superstructure slabs shall meet the requirements of
§555-3.09 Form Removal and as modified herein. The minimum curing period prior to form removal is
10 curing days, except that for cold weather concreting a minimum of 14 curing days is required unless
minimum compressive strengths are achieved as determined by the D.C. E. S. A curing day is defined in §555-3.08A. Permanent field connections, if required, shall be made on the same day prior to removal of forms and falsework.

The following inspection procedures will be used as a check to insure the soundness of the concrete structural slab adjacent to the steel forms. Not less than two days after completion of a concrete structural slab pour, but prior to the next slab pour, the Contractor shall remove a section of the steel form from the most recently completed pour of each span, at a location selected by the Engineer, in order to provide visual evidence that the concrete mix or the construction procedures are obtaining the desired results. If either the concrete mix or the construction procedures are varied significantly within a pour, such as a change in the extent of vibration or change in the workability of the mix, the Contractor shall remove another section of form to verify that the new procedures yielded desirable results.

After the concrete has been placed in a span for a minimum of ten days but prior to any further work performed on the superstructure in that span, the Engineer will spot-check the underside areas of the steel forms by sounding with a suitable-weight hammer at least 50% of the area of at least 25% of the individual form panels on a random basis to determine whether any honeycomb or void areas exist. If such areas are detected, the Contractor shall remove the forms from these areas for a visual inspection of the slab.

The amount of sounding and form removal may be reduced after a substantial amount of slab has been constructed and inspected, if the Contractor's methods of construction and the results of the inspections as outlined above indicate that sound concrete is present throughout the slabs.

If, after removing a section of form, the concrete is found to be defective, additional panels shall be removed. All defective concrete shall be repaired to match the adjacent concrete in section and color.

The form sections shall be removed by a metal saw or air-carbon-arc gouging with minimum damage to the concrete. Cuts shall only be sufficiently deep to sever the form. Any other method of removal shall be submitted to the Deputy Chief Engineer (Structures) for approval. Cuts that are parallel to the corrugations in the forms shall be located on the sloping surface midway between a crest and a valley. Cuts parallel to the supporting beams shall be made through the supporting angles taking care not to damage the structural steel beams. The Contractor will not be required to replace the removed forms.

The Contractor shall provide all the facilities required for safe, suitable and convenient means of access to the forms for the Engineer’s inspection.

557-3.14 Loading Limitations for Superstructure Slabs. Superstructure slabs, during the curing period, may be subjected to a vehicle load not to exceed 10 tons, or a wheel load not to exceed 3 tons no sooner than seven curing days after placement. Full legal loading may commence using either of the following options:

A. Superstructure slabs may be subjected to full legal loads no sooner than 14 calendar days after completion of the curing period.
B. The Contractor may subject a superstructure slab to its full legal load upon completion of the curing period, or any day thereafter provided that the procedure below is followed:

1. The Contractor shall notify the Engineer at the Preplacement Meeting of the intention to subject the slab to full legal load prior to the 14th day after completion of curing.
2. During the slab concrete placement, the Engineer will cast two sets (pairs) of test cylinders in addition to each set cast for record and cure the cylinders on site in the same manner as the superstructure slab.
3. The Engineer will forward cylinders to the Materials Bureau or Regional Testing Facility. One set will be tested fourteen calendar days after placement and, if necessary, the second set will be tested twenty-one calendar days after concrete placement. Under no circumstances will cylinders be tested sooner than fourteen calendar days after the concrete placement they represent.
4. Concrete cylinder sets (pairs) designated for advance testing shall achieve an average compressive strength of 3000 psi, or greater, with individual cylinders having a compressive strength of 2800 psi, or greater.

5. Results of compression tests will be transmitted to the Engineer as soon as possible. The Engineer will inform the Contractor of the cylinder testing results and allow early loading if appropriate. If the required compressive strengths are not achieved, the requirements of §557-3.14A shall apply.

557-3.15 Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges. During the curing period, approach slabs may be subjected to a vehicle load not to exceed 10 tons, or a wheel load not to exceed 3 tons. The Contractor may subject structural approach slabs, sidewalks, and safety walks to their full legal load upon completion of the 7-day curing period.

557-3.16 Damaged or Defective Concrete. Damaged or defective concrete shall be defined by, and repaired in accordance with, the requirements of §555-3.13, Defective or Damaged Concrete.

Subsequent to placement of concrete, either before or after setting, the Engineer will verify at random that the vertical clear distance from the top of the structural slab to the top mat of main reinforcing, as shown on the contract plans, is correct within a tolerance of plus or minus 1/2 inch. If the allowable tolerance is exceeded, the Engineer shall reject the work so advise the Contractor and the Deputy Chief Engineer (Structures), in writing, stating the deficiencies upon which the rejection is based.

The Deputy Chief Engineer (Structures) shall review the nature and extent of the deficiencies and shall designate one or more of the following alternatives:
- The affected placement shall be removed and replaced in whole or in part.
- The Contractor shall provide special corrective measures as directed by the Deputy Chief Engineer (Structures).
- The concrete placement shall be accepted without corrective action.

After the concrete has hardened, the Engineer will examine it using the Contractor’s straightedge. Surface irregularities greater than 1/4 inch in 10 feet shall be corrected. Unless otherwise directed by the Regional Materials Engineer, the concrete used for repairs shall be of the same materials as that used for the original placement.

557-3.17 No Bar list provided. When no bar lists are provided in the contract documents the following shall apply:

1. At least thirty (30) days prior to fabrication of the reinforcement the Contractor shall submit a minimum of two copies of the bar lists and placement drawings showing the bar locations to the Engineer. The details of the bar list and placement drawings shall meet the requirements of the current edition of the Concrete Reinforcing Steel Institute’s publication Reinforcing Bar Detailing. Placement drawings shall be size “B”. Drawings and bar lists shall be clear and legible.
2. Requests for information or changes along with reasons shall be documented in a separate list.
3. The Engineer will transmit the documents to the designer for review for conformance with the design requirements in accordance with the Shop Drawing Approval process. The designer will not be checking lengths, number of bars, weights or bar marks. Corrections will be returned to the Contractor. When the documents are satisfactory they will be returned to the Contractor stamped “Approved In Conformance With Design Requirements”.
4. Partial submissions that require coordination with other drawings will not be accepted.

557-4 METHOD OF MEASUREMENT. The work will be measured for payment in square yards of superstructure slab, approach slab, or sidewalk and safety walks installed, measured to the nearest 0.1 square yards.
Winter surface treatment of superstructure and approach slabs will be measured for payment in square yards of superstructure and approach slab, measured to the nearest 0.1 square yard.

557-5 BASIS OF PAYMENT. The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work. Unless otherwise provided, the unit price bid shall include the cost of furnishing and placing bar reinforcement, wire fabric for concrete reinforcement, copper flashing, flexible water stops, mechanical connectors where specified, sheet packing, water for wetting, joint sealing compounds, joint fillers, concrete curing materials, including any materials for temperature management during the curing period and the cost of screed rail supports and other brackets or braces necessary to support finishing machines.

If permanent metal forms are used, the cost of furnishing all facilities required for access, removing the permanent forms for inspection or repair purposes, painting the cut edges of the forms and repairing the concrete as required herein shall be included in the price bid for this work.

No extra compensation for corrective finishing or repairs to damaged or defective concrete will be paid.

Progress payments will be made on a per-span basis as follows:
Forty (40) percent of the area will be paid for after all reinforcing is properly placed. Forty (40) percent of the area will be paid for after the concrete has been properly placed and proper curing applications have been instituted. The remainder will be paid for after completion of all curing, and necessary corrective work.

The unit price bid for Surface Treatment of Superstructure and Approach Slabs shall include all labor, materials and equipment necessary to satisfactorily complete the work including work zone traffic control for work associated with deck cleaning, evaluation, and diamond grinding. The cost for interim penetrating sealer applied under §557-3.12C.2., prior to the concrete being exposed to freezing conditions, shall be included in this item. The cost for saw cut grooving and final application of penetrating sealer will be paid for under separate items and paid for only once.

Winter Surface treatment – Superstructure Slabs and Structural Approach Slabs shall only be paid when environmental conditions related to temperature and moisture protection during the drying period require use of enclosures.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<td>557.0101</td>
<td>Superstructure Slab with Integral Wearing Surface – Bottom Formwork Required – Type 1 Friction</td>
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<td>557.0109</td>
<td>Superstructure Slab with Integral Wearing Surface – Bottom Formwork Required – Type 9 Friction</td>
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<td>Section</td>
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SECTIO N 558 - LONGITUDINAL SAWCUT GROOVING OF STRUCTURAL SLAB SURFACE
(Last Revised September, 2019)

558-1 DESCRIPTION. Sawcut grooves into the surface of a portland cement concrete structural slab at the locations indicated in the contract documents.

The Contractor is hereby notified that concrete curing requirements, combined with structural slab loading restrictions, may have a significant effect upon the specific time, relative to concrete placement, at which sawcut grooving may be performed. The Contractor shall be familiar with the limits imposed by these factors and conduct operations accordingly.

558-2 MATERIALS. Use multibladed wet saw cutting equipment using circular saw blades. The Engineer may allow the use of single blade, circular saw equipment, where it is determined such equipment is necessary to complete the work as required. The equipment the Contractor proposes to use will be subject to the approval of the Engineer, prior to use.

Use water which meets the requirements of §712-01.

558-3 CONSTRUCTION DETAILS. Sawcutting concrete produces silica dust. Include sawcutting of concrete in the Health and Safety Plan in accordance with the silica safety requirements of §107-05 L.4.

Start sawcutting only after the specified curing period has elapsed, unless otherwise allowed by the applicable specification.
Cut longitudinal grooves parallel to the centerline of roadway using a single pass. Space the center-to-center of grooves at 0.75 inch +/- 10%. Cut all grooves rectangular in shape conforming to the following dimensions:

Width 0.1 inch (+ 20%, - 0)       Depth 0.15 inch +/- 50%

During the grooving operations, the Engineer will verify, at random, that the minimum groove depth is being achieved. Should the Engineer determine that minimum groove depth is not being achieved, the Contractor shall stop grooving operations and make all adjustments necessary to achieve the minimum depth.

Supply the Engineer with two (2) accurate, easily readable gauges with which to verify groove depth. Deliver the gauges and applicable manufacturer’s instructions for use, if necessary, no later than one week prior to the anticipated beginning of grooving operations.

Terminate grooves within the following limits unless otherwise indicated on the contract documents:

<table>
<thead>
<tr>
<th>Location</th>
<th>Closest Allowable Distance</th>
<th>Farthest Allowable Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage structure</td>
<td>4 inches</td>
<td>15 inches</td>
</tr>
<tr>
<td>Vertical face (curb or parapet), or face of railing (no curb)</td>
<td>4 inches</td>
<td>15 inches</td>
</tr>
<tr>
<td>Joint System (Dimension measured perpendicular from the edge of the joint system)</td>
<td>4 inches</td>
<td>15 inches</td>
</tr>
</tbody>
</table>

Using a self-contained system, continuously collect any slurry or debris created by the grooving operation such that it does not accumulate on the surface.

558-4 METHOD OF MEASUREMENT. The quantity will be measured as the number of square yards of structural slab satisfactorily grooved, measured between the faces of barrier, curb, or rail, and between the ends of the slabs, computed to the nearest whole square yard. No deduction will be made for areas left ungrooved near curbs, barriers, rails, joints, drainage structures, or other objects embedded in the slab.

558-5 BASIS OF PAYMENT. The unit price bid per square yard shall include the cost of all labor, materials, and equipment necessary to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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</thead>
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<tr>
<td>558.02</td>
<td>Longitudinal Sawcut Grooving of Structural Slab Surface</td>
<td>Square Yard</td>
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</tbody>
</table>

SECTION 559 - PROTECTIVE COATINGS AND GRAFFITI REMOVAL

559-1 DESCRIPTION. The work in this section shall include work required for protective coatings and graffiti removal.

559-2 MATERIALS. Materials shall meet the requirements specified in the special specifications.

559-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

559-4 METHOD OF MEASUREMENT. As specified in the special specifications.
559-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 560 - MASONRY

560-1 DESCRIPTION. Under this work the Contractor shall furnish and place masonry, with or without coping, of the type, shape, size, color and location indicated in the plans, proposal or as directed by the Engineer.

560-2 MATERIALS. Materials shall meet the requirements specified in the following subsections of 700 - Materials:

Split Faced Concrete Brick 704-10
Precast Concrete Coping 704-11
Caulking Compound for Structures 705-06
Premolded Resilient Joint Filler 705-07
Masonry Mortar 705-21
Bar Reinforcement - Grade 60 709-01
Wire Fabric for Concrete Reinforcement 709-02
Admixtures 711-08

560-2.01 Dimension Stone Masonry. All stone shall be sound, durable, free from reeds, rifts, seams, laminations and minerals which would cause discoloration or deterioration from weathering. The stone shall be of size, quality and color acceptable to the Regional Director. Duplicate samples of stone showing the complete color range shall be submitted to the Regional Director for approval. Stone shall be quarried so the stratification will be radial or parallel to the bed when set in place except where split face or seam face finish is called for on the plans. All beds and joints shall have a "Fine Point or Sawn Finish" for at least 2 inches from the arris lines. The balance shall not fall off from a straight line for more than 1/6 of the stone's minimum dimension. When stones project beyond adjoining faces, the fine pointing shall be carried at least 2 inches in from the adjoining surfaces (arris lines of stone or face of concrete).

Soffits of ring stones shall be cut to the curve of the arch and shall have a “Fine Point or Sawn Finish” unless otherwise shown on the plans. All other showing surfaces shall be finished as indicated on the plans.

On square bridges and on bridges where the skew is 30 degrees or less, the ring stones shall be cut so the joint sides are parallel to the faces of the abutments. On bridges with a skew greater than 30 degrees the ring stones shall be cut so the joint sides of each stone will be at right angles with the face. Soffit joints shall lie in a horizontal plane.

“Fine Point or Sawn Finish” shall be as described in §560-2.07, Definition of Finishes.

560-2.02 Split Faced Concrete Masonry. Split faced concrete masonry units shall be new, sound, durable, true to size, free from laminations and cracks, and uniform quality which complies with the requirements of §704-10. All split face concrete masonry units delivered to the site shall be of the sizes necessary to produce the wall pattern as indicated on the plans.

An approved mechanical self-leveling splitting machine with two steel knives, one directly above the other will be used for all field splitting. Four samples of each thickness of each split faced concrete masonry unit shall be submitted to the Engineer for tentative approval. They shall be labeled with the contract title and number, the Contractor's name, and manufacturer's name. The split faced concrete masonry units used in the work shall be equal in all respects, color, quality, texture and surface to the approved samples.

Anchors shall be a metal slot formed from sheet zinc not less than 0.025 inches in thickness, bent to form a dovetail channel 5/8 inch wide at the front, 1 inch wide at the rear, 1 inch deep and with wings 1/8
to 1/4 inch wide. The slots shall be provided with a felt insert to prevent the entrance of fresh concrete. These inserts shall be removed just prior to the insertion of the ties. Ties shall be formed of zinc not less than 0.078 inches thick, 1 inch wide with one end designed to fit snugly into the anchor slots and shall be crimped with corrugations 1/8 inch deep, but no less than 1/16 inch deep.

The ties shall be at least 4 inches long. The Contractor shall submit to the Engineer for tentative approval four samples of the material used to fabricate the ties, i.e. anchors, felt and ties.

560-2.03 Stone Masonry. All stone shall be sound, durable, properly quarried, free from reeds, rifts, seams, laminations and minerals which would cause discoloration from weathering. Samples of stone shall be submitted to and be approved by the Regional Director prior to the beginning of any work on this masonry. The size, color and quality of the stone delivered to the site shall be substantially in accordance with the approved samples.

The stones may have an average variation of 1/6 of the thickness shown on the plans, however, they shall have a minimum thickness of at least 2/3 that shown on the plans and a maximum thickness of 1/6 over the maximum thickness shown on the plans.

560-2.04 Rubble Stone Masonry. All stones shall be clean, free from structural defects and acceptable to the Engineer. Selected stones, roughly squared and pitched to line, shall be used at all angles and ends of walls.

560-2.05 Precast Concrete Coping. Precast concrete coping units shall be new, sound, durable, true to size, free from laminations and cracks and of uniform quality which complies with the requirements of §704-11.

560-2.06 Mortar. Use 705-21 Masonry Mortar.

560-2.07 Definition of Finishes. Finishes of stone or manufactured masonry units shall be defined as shown in Table 560-1.

560-3 CONSTRUCTION DETAILS

560-3.01 General. Masonry or precast concrete coping shall not be constructed when the ambient temperature is 40°F or below, or when the stone or masonry units contain frost, except by written permission of the Engineer and subject to any conditions the Engineer may require.

Stone, masonry units or coping units shall not be dropped upon or slid over existing masonry, nor shall hammering or turning of stones, masonry units or coping on the masonry be allowed. Stones, masonry unit or coping units shall be carefully set without jarring masonry already laid, and they shall be handled in a manner so as not to cause disfigurement.

<table>
<thead>
<tr>
<th>TABLE 560-1 MASONRY UNITS, SURFACE FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Finish Name</strong></td>
</tr>
<tr>
<td>Smooth Finish</td>
</tr>
<tr>
<td>Fine Point or Sawn Finish</td>
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<tr>
<td>Rough Finish</td>
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<tr>
<td>Scabbed Finish</td>
</tr>
<tr>
<td>Seam and Split Face</td>
</tr>
<tr>
<td>Rock Face</td>
</tr>
<tr>
<td>Thermal Finish</td>
</tr>
</tbody>
</table>

**NOTE:** All faces of Dimension Masonry shall extend to the pitch lines shown on the plans.
560-3.02 Dimension Stone Masonry. The provisions of §560-3.01 shall apply with the following additional requirements:

A. Preparation of Stone and Bed. Each stone shall be cleaned and thoroughly saturated with water before being set. The bed which is to receive the masonry shall also be cleaned and moistened.

B. Bedding of Stone. All stone shall be well bedded in mortar and settled in place with a suitable wooden maul before the setting of the mortar.

C. Spalls not Permitted in Mortar Beds. No pinning up of stones with spalls will be permitted, and no spalls will be permitted in beds.

D. Expansion Joints. All surfaces of stone in contact with expansion joint material shall be made smooth, unless otherwise shown on the plans. The joints shall be filled with premolded resilient joint filler and sealed with an approved joint sealer as shown on the plans, or as ordered by the Engineer.

   All joints in concrete backing shall be protected against intrusion of water into or through the joint by the installation of an approved water stop. The water stop shall be embedded into the concrete at least 3 inches on each side of the joint and shall be installed as near to the inside face of the concrete backing as practicable. The water stop may be of ASTM B370, 20 ounce preformed copper strip, 0.025 inch minimum thickness, soldered to be water tight and continuous, or may be approved flexible water stop as shown on the plans. Water stops shall be manufactured and installed so as to provide for the expansion and contraction movements present at the joint.

   In case any stone is moved or the joint broken, the stone shall be taken up, the mortar thoroughly cleaned from beds and joints, and the stone reset in fresh mortar.

   Joints shall not be filled by pouring in a thin or liquid mortar.

E. Pointing (new construction) and Tuck Pointing (raking out and repointing).

   1. Pointing. Tool the face joints with a pointing tool before the mortar sets, as approved by the Engineer. Avoid smearing the masonry surfaces with excess mortar forced out of the joints. For joints not pointed when the masonry is laid, prepare the joints for pointing by following the tuck pointing procedures. There will be no separate payment for this work.

   2. Tuck Pointing (Repointing). Repoint the joints in masonry where indicated on the Contract plans or directed by the Engineer. Use an Item 705-21 Type M, S or N masonry or mortar cement, tuck pointing mortar (or a specially designed one) with the same or weaker strength than the original mortar, as approved by the Engineer.

      Remove soft, loose, cracked and deteriorated mortar to a minimum depth (measured from the wall face) of twice the average joint width, and remove all deteriorated mortar beyond the minimum depth, as ordered by the Engineer. Do not damage the masonry during the removal process. Clean all contamination from the prepared joints.

      Prior to repointing, flush with water and leave all surfaces to be re-mortared in a dampened, surface dry state. Pack the prepared joints in layers with mortar that closely matches the original color and texture, allowing each layer to become thumb-print hard before the next. Use at least two layers when the joint depth is twice the joint width. Apply a final layer thickness that does not exceed the joint width. When the final layer is thumb-print hard, finish with a pointing tool that recreates the original joint shape, or as approved by the Engineer.

      Perform pointing when the ambient temperature is 40°F or above, and the masonry is frost free. Avoid recessed joints that hold water.
After the mortar sets, clean all mortar and cement stains from other surfaces. In direct sunlight, keep the newly pointed masonry moist for at least 3 days. In shade, moisten 2 to 3 times a day for at least 3 days.

**F. Drawings.** The contract plans show the general character of the masonry. Prior to the beginning of any work, the Contractor shall prepare and submit for the approval of the Regional Director, three sets of detail plans for all dimension masonry shown on the plans. The Contractor shall carefully check and assume full responsibility for the accuracy of this work. These detail plans will be examined and either approved or returned without approval to the Contractor, who shall check the indicated corrections and resubmit two sets of prints of revised details. When the detail plans have been approved, the Contractor shall furnish the Regional Director with three sets, one of which shall be reproducible. The drawings shall conform to the size and type of requirements for Shop Drawings set forth in the New York State Steel Construction Manual.

**560-3.03 Split Faced Concrete Masonry.** The provisions of §560-3.01 shall apply with the following additional requirements:

**A. Sample Wall.** The Contractor shall construct a split faced concrete masonry wall 6 feet long and 4 feet high of approved units and matching mortar at a location designated. This procedure shall be repeated until a sample wall is approved by the Engineer. The approved sample wall shall be maintained intact until the Engineer directs its removal.

In lieu of the field sample wall, the Contractor may show, for approval, a building constructed with units of the same type, color, texture and surface finish required. The field sample wall shall be required if the building masonry is not approved.

Upon approval of the sample wall or building, the Contractor shall furnish and lay split masonry to conform with the approved sample wall.

**B. Protection and Handling.** Split faced concrete masonry units shall be protected by a wrapping of 4 mil polyethylene, and shall be handled on pallets by mechanical means, or by hand or tongs. Dumping of the masonry units from trucks, wheel barrows or other conveyances is prohibited. Particular care shall be taken to protect all edges and the face of the masonry units. Distorted, laminated, checked or cracked masonry units will be rejected and removed from the site of construction.

On delivery to the site, the masonry units shall be neatly piled off the ground, on pallets or other approved implements, and protected from moisture by wrapping them with 4 mil polyethylene.

Masonry units which become wet, shall not be laid in the wall until their conformance with the specifications for §704-10 is shown by tests. The cost of these tests shall be borne by the Contractor.

**C. Laying.** The split faced concrete masonry shall be laid up, in the pattern shown on the plans, by skilled masons and in a first-class manner. The masonry shall be laid true to line and grade in level horizontal beds and be properly anchored. Each masonry unit shall be laid in a full mortar bed and in a manner to form a full end joint in one operation. The space between the split face masonry and the supporting concrete shall be filled with mortar and rodded until the mortar rises to the top of the masonry unit as each unit is placed.

**D. Bonding.** The split faced concrete masonry shall be bonded to the supporting concrete. Dovetail anchors shall be continuous, set vertically and spaced on centers not exceeding 1 foot on the concrete walls. Ties shall be installed in the anchor slots at a maximum vertical height of 1 foot on centers.
E. **Joints.** Joints in the exposed face shall be struck with a concave jointing unless otherwise specified. The joints shall be 3/8 inch wide and the concave jointing shall be 1/8 inch deep at the center.

F. **Protection Against Weather.** The split faced concrete masonry shall be protected against the action of the weather. The tops and at least 2 feet down the sides of all walls not completed shall be constantly protected with suitable waterproof covering properly secured in place during periods of suspended work. The facing shall be so protected until it has been bonded to the concrete wall and completely sealed against moisture. During hot dry weather, the masonry shall be protected from the sun and kept moist for at least three days after completion.

G. **Protection Against Damage.** Projections and angles exposed to damage shall be boxed or otherwise protected to prevent damage. Any units damaged during the progress of the work shall be replaced with new units at the Contractor's expense.

H. **Cleaning of Exposed Faces of Mortar and Drippings.** Exposed faces of split faced concrete masonry units shall be cleaned free of excess mortar and mortar drippings, as the work progresses, to prevent excessive rubbing during final cleaning operations.

I. **Expansion and Contraction Joints.** Expansion and contraction joints shall be constructed as shown on the plans. The surfaces of the joints shall be plumb, true to line and smooth to the caulking compound.

J. **Final Cleaning.** After the completion of adjacent work likely to soil the masonry, the split faced concrete masonry shall be thoroughly cleaned, removing all dirt, dust, mortar, stains, etc. The concrete masonry shall be brushed, while dry, with stiff fiber brushes. If this brushing does not clean the masonry to the satisfaction of the Engineer, then the Contractor shall clean the facing with soap powder in clean water applied with stiff fiber scrub brushes. After scrubbing with soap and water the Contractor shall rinse the masonry with clean water. The Contractor may, with the Engineer's approval, substitute a cleaning solution that will not harm the concrete or mortar joints. The cleaning operation shall in all cases start at the top and proceed downward.

K. **Caulking.** When the split faced concrete masonry has received the final cleaning, all expansion and contraction joints shall be filled at least 1 inch deep with caulking compound. All surfaces to receive the caulking compound shall be clean, free of loose materials, dirt, dust, frost, moisture, oils, laitance or curing compounds and shall be primed with clear lacquer, shellac or the manufacturer's recommended primer after the surfaces have been cleaned. A bond breaker shall be used as a release material back of the caulking compound. The bond breaker may be polyethylene, specially treated bond inhibiting pressure sensitive tape or any approved equal. The caulking compound shall be tooled with a concave joint finishing tool to provide a neat smoothly finished joint of uniform width. Where solvents are required on the jointing tool, they shall be as recommended by the manufacturer of the caulking compound.

560-3.04 **Stone Masonry.** The construction provisions of §560-3.02 shall apply. The individual stones shall be trimmed, recut and dressed, as may be necessary at the site, to obtain a pattern in the finished wall which will be in character with the requirements of drawings, specifications and the approved sample wall. The following general requirements will apply to the placing of stone masonry:

A. **Cross-Joints, Steps or Ladders.** There shall be no cross-joints, steps or ladders.
B. Subdivision of Rectangles. There shall be no subdivision of rectangles.

C. Stone Shapes. There shall be no unusually shaped stone.

D. Clusters. There shall be no clusters of stone of the same length and height.

E. Horizontal Joint Length. There shall be no continuous horizontal joint greater in length than 10 feet.

F. Vertical Joints. There shall be no more than five stones abutting any one vertical joint.

G. Stone Proportions. There shall be no stone longer than six times its height nor shorter than one and one half times its height. The length of the average stone shall be three to five times its height.

H. Horizontal Joints. Horizontal joints shall not have a slope varying from the horizontal by more than one percent.

I. Color. Where stone masonry and dimension masonry are specified, for the same structure or in close proximity to each other, there shall be no great contrast in size or color between the Stone Masonry and the Dimension Masonry.

Prior to beginning the work the Contractor shall lay up a sample wall conforming to the requirements of §560-3.03A except that the material details for the work shall conform to those for Stone Masonry.

560-3.05 Rubble Stone Masonry. The provision of §560-3.01 shall apply with the following additional requirements:

The stone shall be laid to form substantial masonry presenting a neat, finished appearance. The minimum size of stone to be used shall be 4 inches in depth or rise, 9 inches in width, and 12 inches long. Spalls and pinners will not be allowed to show on the face of the work and shall be used otherwise only where necessary. All stones shall be soundly and completely bedded in the mortar. The length of stretchers shall not exceed three times their rise, and the width of stretchers shall in no case be less than one and one-half times their rise. At least one-fourth of the stones in the face shall be headers and shall be evenly distributed. The length of headers shall be not less than 32 inches nor more than the thickness of the wall, where the work is 4 feet or less in thickness. Where the work is more than 4 feet thick, the length of headers shall be not less than 32 inches. The width of headers shall be not less than their rise. All stones shall be laid to break joints 6 inches or more and to thoroughly bond the work. No joint in the face shall be over 1 inch in width. Backing shall be good-sized, well-shaped stones so laid as to break joints. Spaces between stones shall be filled with spalls set in mortar. The degree of roughness of exposed faces shall be measured with a 6 foot straight edge supported between adjacent projections on the stone face. Variations in the stone face, in excess of 4 inches, measured from the straight edge to the extreme depression in stone or mortar will not be permitted. Rear faces shall present approximately plane surfaces.

Pointing shall conform to the requirements of §560-3.02E.

560-3.06 Rubble Stone Masonry Laid Dry. The specifications of §560-3.05, Rubble Stone Masonry, shall apply except that no mortar shall be used and the requirements of §560-3.01 Construction Details (General), pertaining to frost shall not apply unless otherwise directed by the Engineer.

560-3.07 Precast Concrete Coping. The provisions of §560-3.02, Dimension Stone Masonry and §560-3.03, Split Faced Concrete Masonry, shall apply with exception of §560-3.02D, §560-3.03A, and §560-3.03D.
560-3.08 **Tuck Pointing.** Apply the provisions of §560-3.02E2 Tuck Pointing. For re-caulking work, rake out any old caulking to a minimum 1 inch depth and follow the provisions of §560-3.03K, Caulking. Do not damage masonry during the removal and cleaning process.

560-4 **METHOD OF MEASUREMENT**

560-4.01 **Dimension Masonry.** Dimension masonry will be measured as the number of square feet (including joints within the dimension masonry) measured on the plane of all the exposed surfaces of the dimension masonry incorporated in the work.

560-4.02 **Split Faced Concrete Masonry.** Split faced concrete masonry will be measured as the number of square feet (including joints within the masonry and between the split faced concrete masonry and the concrete wall, and the mortar bed for precast concrete coping), on the plane of all exposed surfaces of the masonry incorporated in the work. Split faced masonry below the finished surface of the ground or paving shall be considered as exposed in computing the area for payment. The approved, constructed, split faced concrete masonry sample wall will be paid for as split face concrete masonry.

560-4.03 **Rubble Stone Masonry.** Payment for rubble stone masonry will be made for the number of cubic feet within the payment lines shown on the plans and placed in accordance with the specifications. Concrete, mortar or any joint material within these payment lines will, for the purpose of payment, be classified as stone masonry and will not be paid for under any other item.

560-4.04 **Stone Masonry.** Payment for stone masonry will be made for the number of square feet (including joints within the stone masonry) measured on the plane of all the exposed surfaces of the stone masonry incorporated in the work. Mortar joints between concrete and stone masonry will be paid for as stone masonry.

Stone masonry shown on the plans below the finished grade or sidewalk (to prevent the possible exposure of unfaced concrete) shall be considered as exposed in computing the payment area for this item. Thirty square feet will be used in payment for the complete accepted sample wall required in this specification.

560-4.05 (Vacant)

560-4.06 **Precast Concrete Coping.** The quantity to be paid for will be the number of feet of precast concrete coping (including the joints between the coping units) placed in accordance with the plans, specification and orders of the Engineer.

560-4.07 **Tuck Pointing.** The Engineer will measure this work in the field as the number of square or linear feet of masonry pointed and cleaned, as bid. Linear measurements will be made along the joint centerline.

560-5 **BASIS OF PAYMENT**

560-5.01 **Dimension Stone Masonry.** The unit price bid per square feet shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

Concrete, dimension masonry, mortar or any joint material within the nominal thickness of the dimension masonry will, for the purpose of payment, be classified as dimension masonry and will not be paid for under any other item. Projections, if any, into the concrete beyond the nominal thickness of dimension masonry will be paid for as the class of concrete displaced by the stone. No deduction will be made for railing post holes.

Mortar Joints between Dimension Masonry and Concrete will be paid for as Dimension Masonry.
Mortar Joints between Dimension Masonry and Stone Masonry will be paid for as Stone Masonry.

560-5.02 Split Faced Concrete Masonry. The unit price bid per square feet shall include the cost of furnishing all labor, materials (including anchors, ties, premolded bituminous joint material, and caulking compound) and equipment necessary to complete the work. The payment shall also include the labor, materials and equipment necessary to remove and dispose of all constructed sample masonry panels when directed by the Engineer.

No payment shall be made to the Contractor for the submitted alternate sample walls or for any unapproved sample walls.

The cost of furnishing and placing anchoring devices shall be included in the unit price bid for this work.

The cost of erecting and disposing the sample wall shall be included in the unit price bid for this item.

560-5.03 Stone Masonry. The unit price bid per square feet shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

Concrete, stone masonry, mortar or any joint material within the nominal thickness of the stone masonry will, for the purpose of payment, be classified as stone masonry and will not be paid for under any other item. Projections, if any, into the concrete beyond the nominal thickness of stone masonry will be paid for as the class of concrete displaced by the stone. No deduction will be made for railing post holes.

The cost of furnishing and placing anchoring devices shall be included in the unit price for this item.

560-5.05 Rubble Stone Masonry. The unit price bid per cubic feet for Rubble Stone Masonry with joints or laid dry, shall include the cost of furnishing all labor, materials and equipment necessary to complete the work except excavation will be paid for under the appropriate excavation item.

560-5.06 Precast Concrete Coping. The unit price bid per feet shall include the cost of furnishing all labor, materials (including anchors, reinforcement, premolded resilient joint materials, and caulking compound) and equipment necessary to complete the work.

560-5.07 Tuck Pointing. Include all labor, material (including any re-caulking material), and equipment to complete the work in the unit bid price.

560-5.08 Progress Payments. Progress payments will be made, at the unit price bid, for 75% of the quantity properly placed. The balance of the quantity will be paid for upon proper cleaning and caulking of the joints.

Payment will be made under:

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<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tbody>
<tr>
<td>560.01</td>
<td>Dimension Stone Masonry</td>
<td>Square Foot</td>
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<tr>
<td>560.02</td>
<td>Split Faced Concrete Masonry</td>
<td>Square Foot</td>
</tr>
<tr>
<td>560.0401</td>
<td>Stone Masonry</td>
<td>Square Foot</td>
</tr>
<tr>
<td>560.05</td>
<td>Rubble Stone Masonry</td>
<td>Cubic Foot</td>
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<td>560.06</td>
<td>Rubble Stone Masonry Laid Dry</td>
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<td>560.07</td>
<td>Precast Concrete Coping</td>
<td>Foot</td>
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<td>560.08</td>
<td>Tuck Pointing</td>
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<tr>
<td>560.09</td>
<td>Tuck Pointing</td>
<td>Square Foot</td>
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SECTION 561 (VACANT)

SECTION 562 - REINFORCED CONCRETE THREE-SIDED STRUCTURES
562-1 DESCRIPTION. The work consists of designing and constructing reinforced concrete three-sided structure(s) at the location(s) indicated on the Plans.

A reinforced concrete three-sided structure is composed of some of the following discrete elements:

1. Span Unit
2. Span Unit Footing
3. Wing Wall with Footing
4. Headwall
5. Invert Slab with Cut-off Wall
6. Apron with Cut-off Wall

NOTE: Any of the above elements may be cast in place at no additional cost to the State.

562-2 MATERIALS. Materials for all precast concrete components shall meet the requirements of the PCCM. Materials for cast-in-place concrete shall be Class HP concrete meeting the requirements of Section 555 and modified to include corrosion inhibitor meeting the requirements of 711-13. The penetrating type protective sealer shall meet the requirements of 717-03. Reinforcement shall meet the requirements of Section 556.

562-3 CONSTRUCTION

562-3.01 Design. An appropriate structure design and all details necessary for construction meeting the Design parameters given in these specifications shall be developed and submitted to the DCES for approval. All design work, detail development, and proposed handling and installation procedure development, shall be done by a Professional Engineer. The design submittal shall conform to the requirements stated in the PCCM. The DCES reserves the right to reject a proposed design(s) if the structure type is determined to be unsuitable for the proposed application based on safety, durability, serviceability, or maintainability.

The Load Rating shall be determined in accordance with the current AASHTO "Manual for Bridge Evaluation" with all interim provisions in effect. The contractor shall show which method (allowable stress or load factor) was used in load rating computations. Load ratings shall also be computed by the Load and Resistance Factor Rating (LRFR) method. The load ratings shall be shown on the Production Note Sheet of the shop drawings. The contractor shall include all load rating computations in the design calculation submittal.

562-3.02 Design Parameters. The design of the structure(s) described above shall meet the following:

2. Live Load: HL-93 and the NYSDOT Design Permit Vehicle.
3. Highway Profile Section: As shown in the contract documents.
4. Soil Parameters: As shown in the contract documents.
5. Layout, Span, Rise, and Length of the Bridge Structure: As shown in the contract documents.
6. Staged Construction: Construction staging shall be as shown in the contract documents.
7. Wing Walls: As shown in the contract documents.
8. Railing or Barrier: The railing anchorages or barrier anchorages on the structure shall be designed to develop adequate global and local capacities required to resist the loads in Section 13 of the NYSDOT LRFD Bridge Design Specifications.
9. **Hydraulics**: The proposed structure shall provide hydraulic area (effective flow area) below the design high water elevation shown in the contract documents.

10. **Allowable Concrete Stress**: As per the provisions of the NYSDOT LRFD Bridge Design Specifications, except that maximum tensile stress in concrete for handling and erection loads when analyzed according to the proposed handling and installation procedures, shall not exceed \(0.15 \sqrt{f'ci}\), where \(f'ci\) is the concrete compressive strength at the time being considered.

11. **Joints**: All joints between Span Units shall be designed to be leak proof. The determination of the acceptability of the proposed joint system by the DCES shall be final.

12. **Cover to Reinforcing**: NYSDOT Bridge Manual, Chapter 15

**NOTE**: The shape(s) of the Span Unit shown in the contract documents is for illustration purposes only. Other shapes meeting the design parameters are acceptable, unless otherwise noted in the contract documents.

### 562-3.03 Changes to Design Parameters

If the Contractor wants to propose a structure not in full compliance with the design parameters in the contract, a preliminary proposal, fully explaining the changed design parameters shall be submitted to the DCES for review and approval. The Contractor is not expected to develop a detailed design until the proposed design parameters have been approved by the DCES.

### 562-3.04 Design Computations, Shop Drawings/Detail Drawings

The preparation and submission for review and approval shall be according to the PCCM. Shop drawings shall show detailed handling procedure to be used during fabrication, storage, and transportation of the precast elements. All necessary supporting calculations shall be included in the design computation package.

Fabrication of all steel components shall meet the requirements of the SCM.

Shop drawings shall show the required tolerances for the geometry of all precast components, placement of reinforcement, location of all inserts, etc. Design shall consider the effects of these tolerances.

### 562-3.05 Fabrication

Fabrication of all precast elements shall be according to the PCCM.

### 562-3.06 Installation Drawings

Installation drawings shall meet the requirements of the PCCM and the following:

- **A.** Details of all joints including all materials and a step-by-step procedure for installing them shall be shown on the installation drawings.

- **B.** All welding operations during installation shall be shown on the installation drawings and shall meet the requirements of the SCM.

- **C.** Details for all cast-in-place concrete not detailed in the contract documents.

### 562-3.07 Installation

Installation of all precast elements shall be according to the approved installation drawings. All elements after installation and prior to backfilling will be inspected for cracks or other visible defects. All defective elements shall either be replaced or be repaired using procedures approved by the DCES and at no additional cost to the state.

Cast-in-place elements shall have laitance removed by blasting and shall be coated with penetrating type protective sealer.
562-3.08 **Erection Drawings.** A separate set of erection drawings shall be prepared and submitted for review and approval of the Department as per the provisions of Section 2.6 ERECTION DRAWINGS of the PCCM.

562-3.09 **Tolerances (After Erection)**

A. Joint Width: ± 3/8 inch

B. Vertical Difference Between Top of Adjacent Units: ± 1/2 inch

C. Span - Variation From Post-Pour Measurement Recorded on the Shipping Paperwork: ± 3/8 inch

562-3.10 **Backfilling**

A. Backfilling operations shall not begin until:

1. Span units to span unit footing key joints are grouted as shown on the approved installation drawings and have cured a minimum of 24 hours.
2. Transverse connections between unit segments are placed and secured (if required).
3. Joint seals are properly placed and approved by the Engineer.

B. Backfilling operations shall be conducted in accordance with Section 203 - Excavating and Embankment, with the following modifications:

1. Fills shall be placed and compacted in layers not exceeding 12 inches in depth.
2. Dumping for filling operations shall not be nearer than 3 feet to a plane passing vertically through the back face of any footing.
3. Backfill shall be placed as symmetrically as possible around the structure with differential depths of backfill on opposite sides of the structure span units not exceeding 18 inches.
4. Fill within 1 foot of any surface of the structure shall be compacted with hand compaction equipment.
5. Vibratory rollers shall not be used within 10 feet of any surface of the structure.
6. Construction equipment shall not travel or rest on an uncompleted structure unless the designer of the structure span unit has evaluated the loading conditions, submitted calculations to the DCES, and has received written approval of the proposed loading. Actual conditions at the time of loading, including both the weight of the fill and the equipment, shall be part of the analysis. The Contractor shall repair any damage resulting from equipment passage at no additional cost to the State.

562-4 **METHOD OF MEASUREMENT.** Measurement for payment for the Reinforced Concrete Span Units, Wing Walls, Apron, and Invert Slabs will be computed from the payment lines shown on the plans. No field measurements will be made. The quantity to be paid under this work for the Reinforced Concrete Span Units, Invert Slab with Cut-Off Wall and Concrete Apron with Cut-Off Wall shall be the number of square yards of plan area. The quantity to be paid under this work for the Wing Wall with Footing shall be the number of square yards of face area.

562-5 **BASIS OF PAYMENT.** The Contractor shall include the cost of all engineering, labor, materials, and equipment necessary to complete the work in the unit price bid. The Contractor shall include the costs of the footings, headwalls, and cut-off walls in the unit price bid of the element to which it is attached.

*Payment will be made under:*

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<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
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Sections 200 - 599  STANDARD SPECIFICATIONS (USC) May 1, 2020  Volume 2
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<th>Sections</th>
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<tr>
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<td>Reinforced Concrete Span Units</td>
<td>Square Yard</td>
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<tr>
<td>562.02</td>
<td>Invert Slab With Cut-Off Wall</td>
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<td>562.03</td>
<td>Wing Wall with Footing</td>
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<tr>
<td>562.04</td>
<td>Concrete Apron With Cut-off Wall</td>
<td>Square Yard</td>
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</tbody>
</table>

**NOTE:** Serialization for the Span Units: nn represents the specific structure identifier.

### SECTION 563 - PRESTRESSED CONCRETE UNITS (STRUCTURAL)

**563-1 DESCRIPTION.** This work shall consist of furnishing and placing prestressed concrete units for structures, as specified in the contract documents.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all prestressed concrete units (structural) and the fabricator of any steel diaphragms for the prestressed concrete units in accordance with §106-01 Sources of Supply.

### 563-2 MATERIALS

**563-2.01 Prestressed Units.** Prestressed concrete units shall meet the requirements of the P.C.C.M.

**563-2.02 Transverse Tie Rods or Strands.** Refer to P.C.C.M., Section 4.

**563-2.03 Shear Key Material.** Refer to P.C.C.M., Section 4.

**563-2.04 Anchorage Block-Out Grout.** Refer to P.C.C.M., Section 4.

**563-2.05 Concrete.** The concrete shall meet the requirements of §718-06, High Performance Concrete For Precast and Prestressed Bridge Beams.

**563-2.06 Diaphragms.** The requirements of §718-07 shall apply.

**563-2.07 Grouted Reinforcing Bar Splice Sleeves shall meet the requirements of §709-15 Grouted Reinforcing Bar Splice Sleeves.**

### 563-3 CONSTRUCTION DETAILS.

The requirements of the P.C.C.M. shall apply.

### 563-4 METHOD OF MEASUREMENT

**563-4.01 Prestressed Concrete I-Beam Units.** The quantity to be paid for under this work shall be the number of feet (horizontal length center-to-center of bearings or anchor dowels, as shown on the plans) of each unit furnished and placed in accordance with the plans and specifications.

**563-4.02 Prestressed Concrete Box-Beam Units and Hollow and Solid Slab Units.** The quantity to be paid for under this work shall be the number of square feet of plan area of each prestressed unit installed. Plan area is defined as the area bounded by the centerline of bearings and the outer edges of each prestressed unit. No deductions will be made for chamfers, shear keys, or notch cuts. Space between the units shall not be included in any measurement.

### 563-5 BASIS OF PAYMENT.

The unit price bid for these units shall include all labor, materials, diaphragms, and equipment necessary to complete the work except that bearings shall be paid for under their respective items. Damaged units which cannot be satisfactorily repaired or which do not meet dimensional and camber tolerances shall be replaced by the Contractor at no cost to the State.
Progress payments will be made when each unit is furnished and placed in accordance with the plans and specifications exclusive of preparing and filling joints. Payment will be made at the unit price bid for 90% of the quantity properly placed. The balance of the quantity will be paid for upon completion of the work. The completion of work will include the correct preparation and filling of the joints as well as the tightening of transverse ties.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tr>
<td>563.010X</td>
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<td>563.02</td>
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<tr>
<td>563.03</td>
<td>Prestressed Concrete Hollow Slab Units</td>
<td>Square Foot</td>
</tr>
<tr>
<td>563.04</td>
<td>Prestressed Concrete Solid Slab Units</td>
<td>Square Foot</td>
</tr>
<tr>
<td>563.05</td>
<td>Prestressed Concrete New England Bulb Tee Units</td>
<td>Foot</td>
</tr>
</tbody>
</table>

X = Type Designation (1 through 6)

SECTION 564 - STRUCTURAL STEEL
(Last Revised May, 2019)

564-1 DESCRIPTION. This work shall consist of fabricating, furnishing and erecting structural steel and other metal parts in accordance with the contract documents and as directed by the Engineer.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all structural steel in accordance with §106-01 Sources of Supply.

564-2 MATERIALS. Materials for this work shall meet the requirements of the New York State Steel Construction Manual (SCM) and the following subsections of Section 700 Materials and Manufacturing:

- Structural Steel 715-01
- High Strength Bolts, Nuts and Washers 715-14
- Pins and Rollers 715-15

Certified copies of the results of tests conducted by the manufacturer shall be furnished to the Engineer in accordance with the requirements of §715-01 Structural Steel.

564-2.01 Structural Steel Replacement - Stock Steel Option. Stock steel may be furnished for components that are not fracture-critical members (FCMs). For FCMs, stock material shall be supplied only with the approval of the DCES. If furnished, the stock steel shall comply with the provisions of §715-01 Structural Steel. Positive heat identification will be required for all stock steel. Certified copies of the results of chemical analysis and physical tests shall be furnished to the Department.

564-3 CONSTRUCTION DETAILS. All structural steel work, including, but not limited to fabrication inspection, transportation, and erection shall be performed in accordance with the provisions of the SCM. Shop inspection will be provided unless otherwise noted on the contract plans, or waived by the DCES.

Shop drawings prepared for Structural Steel Replacement shall be prepared, approved and distributed in accordance with the provisions of the SCM, except that the term DCES shall be interpreted as the Engineer.

A. Shop Drawings. The Contractor shall provide all shop drawings and/or prints required by the contract documents or the Steel Construction Manual. Any prints required beyond the number specified shall be furnished by the Contractor at cost.
B. **Laminar Defects at the Boundary of Tension Groove Welds.** The Contractor shall provide all work and materials required for the correction or elimination of laminar defects at the boundary of tension groove welds.

The cost of all ultrasonic testing and repairs and the cost of replacement of defective portions of plates where partial replacement is approved shall be borne by the Contractor and included in the price bid for structural steel.

C. **Inspection of Bolted Connections.** The Contractor shall provide all labor and equipment necessary for the performance of inspection of bolt tightness during structural steel fabrication and erection. The State will witness the bolt testing, but will not provide equipment or labor.

D. **Qualification Test for Welders, Welding Procedures and Electrode and Flux Combinations.** The Contractor shall provide tests required to qualify welders, welding procedures and electrode and flux combinations. All tests shall be witnessed by the Department.

E. **Radiographic Inspection.** The Contractor shall provide radiographic inspection and preparation for radiography, together with the cost of providing access and of furnishing adequate facilities for the review of radiographs in the shop or field.

F. **Ultrasonic Inspection.** Ultrasonic inspection (UT) that is to be performed in the shop as per the requirements of the SCM shall be performed by a NYSDOT certified UT technician employed by or under contract to the fabricator. Any UT inspection work to be done on the job site will be performed by the State or its designated representative. The Contractor shall perform any required preparation and furnish access to the weld joints to be inspected.

G. **Magnetic Particle Inspection.** The Contractor shall provide magnetic particle inspection when specified or required by the inspector to verify limits of defects discovered during visual inspection.

H. **Repair of Defects in Welds and Base Metal.** The Contractor shall repair defects found by visual inspection or nondestructive tests at no additional cost to the State.

I. **Field Inspection of Rejected Material or Material Not Offered for Shop Inspection even though Required to be Shop Inspected by the Contract Documents.** When the Department, at its discretion, permits inspection of the materials to be performed at the contract site, all costs of this inspection shall be borne by the Contractor as a condition of the Department's approval of inspection of this material, at no additional cost to the State.

J. **Straightening Bent Material and Correcting Camber Deficiencies.** The Contractor shall perform all corrective work required to straighten bent material and correct camber deficiencies, when permitted, at no additional cost to the State.

K. **Field Repair, Reaming and Drifting of Holes.** The Contractor shall provide all work permitted for the correction of unacceptable holes at no additional cost to the State.

L. **Metal Scuppers.** The Contractor shall provide Metal scuppers as structural steel unless otherwise noted in the contract documents.

M. **Adjustment and Alignment of Bearings.** The Contractor shall provide all labor, materials and equipment required for adjustment and alignment of bearings.
**N. Field Splices.** Field splice locations and details are shown in the contract documents. If the Contractor wishes to change the location of the splice(s), the Contractor shall submit a request to the Engineer for approval by the DCES in accordance with Section 203.5 of the SCM.

**O. Photographs.** The Contractor shall provide photographs requested by the DCES in accordance with the provisions of the SCM.

**P. Testing of Stock Steel.** The Contractor shall provide all labor, materials and equipment necessary to perform chemical and physical tests on stock steel when such tests are required.

**Q. Heat-Curving and Cambering.** The Contractor shall provide nondestructive testing, repairs or replacement of material damaged due to over stressing or destructive heating during heat-curving or cambering.

**564-4 METHOD OF MEASUREMENT.** Castings, forgings, fasteners, anchor bolts for other than bridge bearing installation, cables and other metal parts used in the permanent construction, will be measured as structural steel, even if made of other materials.

**564-4.01 Pound.** The quantity to be measured for payment will be in pounds to the nearest whole pound. The weight of each shipping unit shall be clearly shown on the approved shop drawings.

**A. Payment Weight.** The weight of metal as shown on the approved shop drawings, shall include permanent bolts and welds in the structure as erected. The weight of all required bolts, nuts, washers, and all required welds will be estimated by adding 3% to the steel weight estimate, making no allowance for waste, and included in the weight for which payment will be made.

The weight of all erection materials including but not limited to bolts, pilot and driving nuts, temporary protective coatings, and all boxes, crates or other containers used for packing, together with sills, struts, and rods used for supporting members during transportation, will be excluded from the measurement for payment.

**B. Computed Weight.** The density of steel used in computing weights for payment will be assumed to be 490 pcf. The density of cast iron will be assumed to be 450 pcf.

The weights of rolled shapes and of plates of all dimensions will be computed based on their nominal weights as required by the dimensions shown on the approved shop drawings. If the Contractor elects to use steel members with weights that are greater than the nominal weights specified on the approved drawings for its convenience, the computations will be based on the nominal weight values shown on the approved shop drawings. Deductions will be made for copes, cuts and all holes except those holes required for high-strength bolts.

The weights of castings will be computed from the dimensions shown on the approved shop drawings, with an addition of 10% for fillets and overrun.

**564-4.02 Each.** The quantity to be measured for payment will be made on an ‘Each’ basis.

**564.03 Lump Sum.** The work will be measured for payment on a lump sum basis.

**564-5 BASIS OF PAYMENT**

The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work, not including bridge bearings and associated anchor bolts.

**Payment will be made under:**

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<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
</table>

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

Sections 200 - 599  STANDARD SPECIFICATIONS (USC) May 1, 2020  Volume 2
SECTION 565 - BRIDGE BEARINGS

565-1  DESCRIPTION. The work shall consist of furnishing, placing and setting bridge bearings at the locations indicated on the plans.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all bridge bearings in accordance with §106-01 Sources of Supply.

565-1.01  Bearing Types. There are various types of bearings. The specific type required will be indicated on the plans. Bearing types are:

A. Type S.R. - Steel Rocker Bearings. These accommodate rotation by pivoting around a pinned joint. They are fabricated in fixed and expansion versions. The expansion version accommodates longitudinal movement by means of a curved rocker rotating on the bearing surface. Steel rocker bearings do not allow for transverse movement. This type of bearing shall only be used in rehabilitation situations where only one or two bearings are to be replaced on a bridge.

B. Type S.S. - Steel Sliding Bearings. These accommodate rotation by means of a rocker. They are fabricated in fixed and expansion versions. The expansion version accommodates movement with a sliding element. Steel sliding bearings do not allow for transverse movement. This type of bearing shall only be used in rehabilitation situations where only one or two bearings are to be replaced on a bridge.

C. Type M.R. - Multi-Rotational Bearings. These accommodate rotation by the deformation of a confined elastomeric element, or an unconfined urethane disc. Multi-rotational bearings are fabricated in fixed and expansion versions. The expansion version accommodates movement by means of sliding elements. Expansion versions may be guided, allowing movement in only one direction, or non-guided, allowing multi-directional movement.

D. Type E.P. - Plain Elastomeric Bearings. These accommodate rotation by the deformation of a plain elastomeric pad. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

E. Type E.L. - Steel Laminated Elastomeric Bearings. These accommodate rotation by the deformation of a laminated elastomeric and steel pad. They may be used for both fixed and expansion applications without changes in details. The bearings will accommodate longitudinal, transverse, and rotational movements.

F. Type E.B. - Elastomeric Bearings with External Load Plates. These accommodate rotation by the deformation of a plain or steel laminated elastomeric pad. Elastomeric bearings with external load plates are fabricated in fixed and expansion versions. The fixed version will accommodate rotational movements. The expansion bearings will accommodate longitudinal, transverse, and rotational movements.

565-2 MATERIALS
565-2.01 General. Materials shall meet the following requirements:

Concrete Grouting Material 701-05
Steel Anchor Dowel 709-01a
Disc-Design Structural Bridge Bearings 716-06
Pot-Design Structural Bridge Bearings 716-07
Plain Elastomeric Bridge Bearings 716-10
Steel-Laminated Elastomeric Bridge Bearings 716-11
Elastomeric Bridge Bearings with External Load Plates 716-12
Rubber-Impregnated Woven Cotton Fabric 728-01
Rubber-Impregnated Random Fiber Pad 728-02
Plain Rubber Pad 728-03
Nuts ASTM A563
Washers ASTM F436
Anchor Studs ASTM A325 or A449 Type 1
Cap Screws ASTM F835M or A574M
Structural Steel Paint Class 1 708-01

NOTE a. Steel anchor dowels shall meet the requirements of §709-01 - Bar Reinforcement.

565-2.02 Fabrication. Steel components of bridge bearings shall be fabricated in accordance with the applicable requirements of the NYS Steel Construction Manual (SCM). In addition, component parts of individual bearings shall meet fabrication details as shown in the contract documents.

A. Type S.R. Bearings. These shall conform to the plans and other contract documents.

B. Type S.S. Bearings. These shall conform to the plans and other contract documents.

C. Type M.R. Bearings. These shall conform to the requirements of either §716-06.01 or §716-07.01 as applicable, and other contract documents. When type M.R. bearings are specified, the Contractor may supply either disc design or pot design bearings. Only one bearing design, disc or pot, shall be supplied for any one bridge.

D. Type E.P. Bearings. These shall conform to the requirements of §716-10 and other contract documents.

E. Type E.L. Bearings. These shall conform to the requirements of §716-11 and other contract documents.

F. Type E.B. Bearings. These shall conform to the requirements of §716-12 and other contract documents.

565-2.03 Drawings. Shop drawings shall meet the requirements specified in the following:

Type S.R. and S.S. Bearings SCM
Type M.R. Bearings 716-06.01 or 716-07.01
Type E.L. Bearings 716-11
Type E.B. Bearings 716-12

565-2.04 Protective Coatings
A. Machine finished surfaces in contact, including pins, pin holes, surfaces in sockets at the top of rocker bearings, and bronze or copper plates in sliding contact shall receive one coat of automotive grease as soon as machining is complete. None of these surfaces shall be painted.

B. Stainless steel and polytetrafluoroethylene surfaces shall not be painted or otherwise coated.

C. Metal to metal surfaces to be field welded shall be given a coat of clear lacquer or other protective coating approved by the Engineer, or Inspector, if exposure is to exceed three months prior to welding. The coating shall be removed at the time of welding. Painting, if required, will be done only after the completion of welding. Surfaces to be painted shall be primed and painted in accordance with §565-2.04D.

D. All other metal surfaces shall be cleaned to meet SSPC-SP10, “Near-White Metal Blast Cleaning” and painted in accordance with section 572, Structural Paint System: Shop Applied. The paint shall be selected from the Department’s Approved List, Structural Steel Paints – Class 1. For bearings used in conjunction with unpainted steel, the color of the finish coat shall Weathered Brown as defined by §708-05.

565-2.05 Shipping. Each bearing shall be shipped as an assembled unit, except for elastomeric bearings. Elastomeric bearings may be shipped in packages containing more than one bearing, provided the package can be handled with normal construction equipment. Bearings shall be packaged in such a manner to protect all rotating and sliding surfaces from the intrusion of outside material. Bearings shall be packaged securely to prevent separation of the elements during shipping.

565-3 CONSTRUCTION DETAILS

565-3.01 Concrete Bearing Surface Elevations

A. General. The elevation of the concrete bearing surface for all types of bearings, except Type M.R. bearings, shall be as given on the plans.

B. Type M.R. Bearings. The elevation of the concrete bearing surface may vary from that given on the plans depending on the vertical dimension of the actual bearing supplied. The Contractor shall notify the Engineer of all required elevation changes. Changes to the roadway profile will not be allowed. All elevation adjustments necessary to maintain the profile shall be made to the concrete bearing surfaces. Any adjustments, including changes to the reinforcement, will be made at no additional cost to the State.

565-3.02 Concrete Bearing Surface Preparation. No bearing shall be placed upon a concrete bearing surface which is deformed, irregular, or poorly finished. The entire bearing surface area shall be floated and troweled.

565-3.03 Setting Anchor Studs. Anchor studs shall be set as shown on the plans unless changes are permitted by the DCES. If anchor studs are cast in substructure concrete, templates, or other suitable means, shall be used to keep the studs vertical at the required embedment and in the correct horizontal position during concrete placement. If the Contractor elects to drill the finished, cured concrete in order to set the anchor studs, the reinforcing steel shall be positioned prior to casting the concrete so that it will not be damaged during drilling. If anchor studs are drilled and grouted, material and construction details shall be in conformance with §586-2 and §586-3.

565-3.04 Bearing Pad Installation. Bearing pads placed between concrete, or other masonry, and steel masonry plates shall be located to correct alignment and elevation, and placed at the time of masonry plate installation. Bearing pads shall conform to §728-01, §728-02, or §728-03 at the Contractor's option. Each bearing pad shall be the same size in plan as the masonry plate it supports. Holes to accommodate anchor studs shall be cleanly and accurately cut prior to bearing pad placement.
565-3.05 Bearing Installation and Alignment

A. Type S.R. and Type S.S. Bearings

1. General

a. The centerline of sole plates or fixed portions of bearing assemblies attached to the structural steel shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.
b. The bearing shall be cleaned and regreased with automotive grease at the time of installation.

2. Fixed. No additional requirements apply.

3. Expansion. These may vary from perfect alignment. Therefore, expansion bearings shall be set in accordance with the following.

a. Type S. R. Bearings

(1) The bearing shall be set vertical under full dead load at an ambient temperature of 68°F.
(2) The maximum variation from perfect alignment is a function of the bearing height. The bearing height is the distance between the upper and lower contact surfaces of the movable portion of the bearing. For bearings with a height of 20 inches or less, the maximum variation from perfect alignment, taking into account the effect of temperature and load at the time of measurement, shall be calculated by the following formula:

$$M = \pm \left( \frac{1}{2} \text{ inch} + \frac{L}{14,000} \right)$$

where “M” = maximum variation from perfect alignment measured as the horizontal distance between the centerline of the cap plate and the centerline of the masonry plate in inches and “L” = total expansion length in inches between the centerline of the movable bearing being considered and the centerline of the fixed bearing, from which motion must progress. Such variations shall not exceed 1 inch offset, or a five degree rotation of the movable portion of the bearings from the required alignment, whichever is less.

The maximum variation of all bearings having a height exceeding 20 inches shall be approved on an individual basis by the DCES.
(3) No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

b. Type S. S. Bearings

(1) The sliding plate shall be centered on the masonry plate under full dead load at an ambient temperature of 68°F.
(2) The maximum variation from perfect alignment between the centerlines of the fixed and movable portions of the bearing device, taking into account the effect of temperature and load at the time of measurement, shall not exceed plus or minus 1/2 inch longitudinally. This variation shall be measured as the horizontal distance between the centerline of the sliding
plate and the centerline of the masonry plate. The movable portion of the bearing device shall be fully supported by the fixed portion under all temperature and loading conditions. (3) No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

B. Type M.R. Bearings

1. General. The centerline of sole plates or other fixed portions of bearing assemblies attached to the structural steel shall not be offset from the centerline of bearing stiffeners or diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.

2. Fixed. No additional requirements apply.

3. Expansion. These may vary from perfect alignment. Therefore expansion bearings shall be set in accordance with the following:

a. The sliding plate shall be centered on the masonry plate under full dead load at an ambient temperature of 68°F.

b. The maximum variation from perfect alignment between the centerline of the fixed and movable portions of the bearing device, taking into account the effects of temperature and load at the time of measurement, shall not exceed plus or minus 1 inch longitudinally unless otherwise indicated on the plans. This variation shall be measured as the horizontal distance between the centerline of the sliding plate and the centerline of the masonry plate.

c. No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

C. Type E.P. and Type E.L. Bearings

1. General

a. These bearings are designed to function properly provided that minimum distortion occurs along the beam axis under full dead load at an ambient temperature of 68°F. Elastomeric bearings shall be installed when the ambient temperature is between 40°F and 80°F inclusive. The Contractor may elect to install the bearings when the ambient temperature is outside of the allowable range, provided the Contractor submits, and receives DCES approval, of an installation procedure that either resets the bearings when the temperature is in the allowable range or deforms the bearings so that they perform as if they were installed at 68°F.

b. For prestressed concrete superstructures, the bearing shall be anchored to establish the fixed end of the bridge as soon as possible after stringer erection. For adjacent prestressed box beams, or prestressed slab superstructures, the anchorage shall be completed prior to filling the shear keys. The method of anchorage shall be in accordance with the details shown on the plans. Anchor dowel holes shall be core drilled to the nominal size and depth and at the locations required by the plans. In lieu of core drilling, the Contractor may submit an installation procedure that incorporates the use of either preset anchor bolts or pipe sleeves to the DCES for
approval. Prior to placing the anchor dowel, the hole shall be inspected and approved for filling by the Engineer. Fill material shall be in accordance with the details on the plans.

2. Fixed. No additional requirements apply.

3. Expansion

a. These may vary from perfect alignment. The maximum variation from perfect alignment under full dead load shall not exceed the value shown on the plans. This variation shall be measured as the horizontal distance between the centerline of the highest elastomer surface and the centerline of the lowest elastomer surface.
b. No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

D. Type E.B. Bearings

1. General

a. The centerline of sole plate or other fixed portions of bearing assemblies, attached to steel stringers, shall not be offset from the centerline of bearing stiffeners of diaphragm connection plates by more than one-half the thickness of the flange at that location, or the thickness of the bearing stiffener or connection plate, whichever is the lesser distance.
b. These bearings are designed to function properly provided that minimal distortion occurs along the beam axis under full dead load at an ambient temperature of 68°F. Elastomeric bearings shall be installed when the ambient temperature is between 40°F and 80°F inclusive. The Contractor may elect to install the bearings when the ambient temperature is outside of the allowable range, provided the Contractor submits, and receives DCES approval, of an installation procedure that either resets the bearings when the temperature is in the allowable range or deforms the bearings so that they perform as if they were installed at 68°F.

2. Fixed. No additional requirements shall apply.

3. Expansion

a. These may vary from perfect alignment. The maximum variation from perfect alignment under full dead load shall not exceed the value shown on the plans. This variation shall be measured as the horizontal distance between the centerline of the highest elastomer surface and the centerline of the lowest elastomer surface.
b. No bearing adjustments shall be made until the completed structural slab has been in place for at least seven curing days. Any adjustments needed to meet the above requirements may require jacking the superstructure. All adjustments shall be accomplished according to a written procedure submitted by the Contractor for DCES approval. All adjustments shall be made at no additional cost to the State.

565-3.06 WELDING

A. Type S.R. Bearings. Bearings shall be welded permanently to the structural steel only after all necessary adjustments have been made. All welding shall be done in accordance with the requirements of the SCM. The Contractor shall submit a Welding Procedure Specification to the
DCES. No welding shall be performed until the manufacturer receives an approved Welding Procedure Specification.

**B. Type S.S. Bearings.** The requirements of §565-3.06A shall apply.

**C. Type M.R. Bearings.** The requirements of §565-3.06A shall apply except that during field welding operations the temperature of the steel adjacent to the rotational element shall not exceed 200°F. Temperature shall be controlled by welding procedures and monitored using temperature indicating crayons, or other devices. Procedures, crayons, and other devices shall be acceptable to the Engineer. If the temperature limit is exceeded, the DCES and the Director, Materials Bureau shall be immediately notified. The DCES will provide the proper repair procedure, which may include complete replacement of the bearing. All repair work shall be done at no additional cost to the State.

**D. Type E.B. Bearings.** The requirements of §565-3.06A and §565-3.06C shall apply.

565-3.07 **Grouting Anchor Bolt Holes.** All slotted anchor bolt holes in masonry plates shall be filled with concrete grouting material to the top edge of the hole. All excess grout material shall be cleaned from the bearing surfaces in a manner satisfactory to the Engineer. Slotted anchor bolt holes in fixed bearings may be filled any time subsequent to stringer placement. Slotted holes in expansion bearings shall be filled only after all necessary bearing adjustments have been made.

565-3.08 **Final Verification.** Prior to final acceptance of the bridge, the Engineer will verify that all necessary adjustments have been made; that all steel bearings, or external load plates, are permanently welded or attached with cap screws to the superstructure steel as shown on the contract plans; that all slotted holes are completely filled with grout; that all anchor studs are firmly tightened; and that all other work required to make the bearings completely functional has been completed.

565-4 **METHOD OF MEASUREMENT.** Measurement will be taken as the number of bearings installed in accordance with the Contract Documents.

565-5 **BASIS OF PAYMENT.** The unit price bid for each bearing shall include the cost of all labor, materials, equipment and adjustment necessary to complete the work. All material between the bottom of the superstructure, and the top of the substructure, including anchor studs and sole plates, shall be included in the price bid for this item.

565-5.01 **Progress Payments.** Eighty percent of the quantity will be paid for after the bearing is installed. The remainder of the quantity will be paid for after the bearing is aligned.

**Payment will be made under:**

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<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<td>565.1121</td>
<td>Type S.R. Expansion Bearing (All Load Ranges)</td>
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565.1724 Type M.R. Fixed Bearing (676 to 900 k) Each
565.1725 Type M.R. Fixed Bearing (Over 900 k) Each
565.1821 Type E.P. Bearing (All Load Ranges) Each
565.1921 Type E.L. Bearing (0 to 55 k) Each
565.1922 Type E.L. Bearing (56 to 111 k) Each
565.1923 Type E.L. Bearing (112 to 168 k) Each
565.1924 Type E.L. Bearing (169 to 225 k) Each
565.1925 Type E.L. Bearing (Over 225 k) Each
565.2021 Type E.B. Fixed Bearing (0 to 55 k) Each
565.2022 Type E.B. Fixed Bearing (56 to 111 k) Each
565.2023 Type E.B. Fixed Bearing (112 to 168 k) Each
565.2024 Type E.B. Fixed Bearing (169 to 225 k) Each
565.2025 Type E.B. Fixed Bearing (Over 225 k) Each
565.2031 Type E.B. Expansion Bearing (0 to 55 k) Each
565.2032 Type E.B. Expansion Bearing (56 to 111 k) Each
565.2033 Type E.B. Expansion Bearing (112 to 168 k) Each
565.2034 Type E.B. Expansion Bearing (169 to 225 k) Each
565.2035 Type E.B. Expansion Bearing (Over 225 k) Each
565.30 Rubber Impregnated Woven Cotton-Polyester Fabric Each

SECTION 566 - MODULAR EXPANSION JOINT SYSTEMS

566-1 DESCRIPTION. The work shall consist of fabricating, furnishing, and installing a modular expansion joint system at the locations indicated on the Contract Plans.

566-1.01 Modular Joint Systems. Modular expansion joint systems are manufactured in various sizes, defined by their total movement capability. The correct movement capability required at any one location is indicated on the Contract Plans.

566-1.02 Sealing Elements. On each individual structure, all the box seals used in the modular joints shall be of the same configuration and shall be from the same manufacturer.

566-1.03 Modular Joint System Suppliers

A. Multicell Modular Joint Systems. Only firms which appear on the Department’s Approved List will be acceptable suppliers. No supplier other than those listed will be considered.

B. One Cell Modular Joint Systems. Firms that do not appear on the Department’s Approved List may supply one cell Modular Joint Systems. Firms which appear on the Department’s Approved List will also be acceptable suppliers.

566-1.04 Terminology. The following terminology will be used throughout this section:

A. Joint System. This term is used to describe the installation with all of its component parts as installed in the structure slab, and if applicable in sidewalks, barriers and other bridge components.

B. Segment. A modular joint system manufactured at less than full roadway width. No segment shall be less than a single lane width long.
**C. Joint.** The separation between two elements of a bridge to allow for movement.

**566-2 MATERIALS.** Materials shall conform to the following requirements.

**566-2.01 Modular Joint System.** The modular joint system and all its component parts, including stiffening plates and anchorages, shall be supplied by the Manufacturer. The Manufacturer shall certify that the following components meet the listed requirements:

- Hollow Beams, Steel Extrusions and Milled Steel Shapes: ASTM A588
- Box Seals: 705-09a
- Strip Seal: ASTM D2628b
- Adhesive: 567-2.02A6
- Stud Shear Connectors and Threaded Studs: 709-05
- Connecting and Sliding Plates - 3/8 inch Thickness: ASTM A588
- Parapet Cover Plates - 1/2 inch Thickness: ASTM A36c

**NOTES:**

a. Shape approval by the Director of Materials is not required. Hardness, Type A Durometer shall be 60 ± 5; ASTM Method D2240. A 3 foot sample of the seal shall be submitted for testing to the Materials Bureau. No splices shall be permitted in permanent seals for any reason whatsoever.
b. Recovery test not required.
c. Parapet Cover Plates shall be Galvanized in accordance with §719-01, Type I.

**566-2.02 Shop Drawings**

A. Shop Drawings shall be required for any joint system supplied as part of this work. Shop Drawings shall be prepared and reviewed in accordance with the applicable provisions of the SCM and this Specification and submitted to the DCES for approval. All Shop Drawings shall note the name and address of the Joint System Fabricator, including the actual location (address) where the fabrication will take place.

B. The Modular Joint System Manufacturer's instructions for the proper installation of the joint system shall be entered on the Shop Drawings. Manufacturer's instructions shall include the proper width settings for various ambient temperatures. Shop Drawings which lack Manufacturer's installation instructions shall be returned without examination.

C. Filler metal shall be qualified in accordance with Section 7 of the SCM. Welding Procedure Specifications (WPS) shall be submitted for approval to the DCES with the Shop Drawings for each combination of joint type and welding process shown on the Shop Drawings. Shop Drawing Approval shall be withheld until this requirement has been met.

**566-2.03 Fabrication**

A. All steel fabrication (shop and field) shall be done in accordance with the requirements of the SCM. Mill inspection of the steel will not be required.

B. All metal surfaces to come in contact with the neoprene sealer shall be blast cleaned in accordance with the requirements of Steel Structures Painting Council Surface Preparation No. 6 (SSPC-SP6) - Commercial Blast Cleaning. After cleaning, all cleaned surfaces shall exhibit a clean quality of CSP6, or better, as defined by Steel Structures Painting Council Standard SSPC Vis 1.

C. The cleaned metal surfaces shall be protected from rusting until such a time as the sealer, and lubricant adhesive are placed against the metal surface. Any cleaned metal surface upon which rusting appears shall be reclad in accordance with the foregoing, at no additional expense to the State.

D. The curb and parapet sliding plates, if required, shall be shop assembled to fit the modular joint system. The plates may be disassembled from the joint system for shipment to the project site.
E. Unless otherwise noted, each modular expansion joint system shall be fabricated as a single entity. It shall fit the full width of the structure as indicated on the Contract Plans. The system shall be preset by the Manufacturer prior to shipment. Presetting shall be done in accordance with the joint opening at 68°F. The joint opening will be indicated on the Contract Plans. Should the plans indicate that segmental fabrication is permissible, or required, each segment shall be fabricated to exactly fit that portion of the superstructure under construction, including sidewalks. Segments shall be fitted with temporary seals. Temporary seals will not require lubricant adhesive.

F. Shop inspection shall be conducted at the discretion of the Department.

566-2.04 Acceptance. The fabricated joint system will be accepted at the work site by the Engineer after a visual inspection and upon receipt of the Manufacturer's Certification Report (MCR) that the materials and the fabricating procedures were in accordance with the Approved Shop Drawings and this Specification. The Manufacturer shall submit, with the MCR, a Certified Copy of the Mill Test Report (MTR) for all steel used to fabricate the joint system.

566-3 CONSTRUCTION DETAILS

566-3.01 Manufacturer's Representative. During the initial stages of the joint system installation the Contractor shall have present at the installation site a Representative of the Joint System Manufacturer. This person shall be competent in all respects regarding the proper installation procedures to be used. The Representative shall advise the Contractor of, and certify to the Engineer that, the proper procedures are being followed. All certifications to the Engineer shall be in writing. A Manufacturer’s Representative is not required for One Cell Modular joint Systems.

566-3.02 Field Inspection. Immediately prior to installation, the joint system shall be inspected by the Engineer, for proper alignment, and complete bond between the neoprene sealer and the steel, and proper stud placement and effectiveness. No bends or kinks in the joint system steel shall be allowed (except as necessary to follow the roadway grades). Nor shall the straightening of such bend or kinks be allowed. Any joint system exhibiting bends or kinks shall be removed from the work site, and replaced by a new joint system, at no additional cost. Neoprene sealer not fully bonded to the steel shall be fully bonded at the expense of the Contractor. Studs shall be inspected visually, and shall be given a light blow with a hammer. Any stud which does not have a complete end weld, or does not emit a ringing sound when struck a light blow with a hammer, shall be replaced. Studs located more than 1 inch, in any direction, from the location shown on the Shop Drawings, shall be carefully removed and a new stud placed in the proper location. All stud replacements shall be at no additional cost.

566-3.03 Installation

A. Manufacturer’s Instructions. The modular expansion joint system shall be installed in strict accordance with the Manufacturer’s instructions, and the advice of their Official Representative. Two weeks prior to the intended installation, the Engineer shall be supplied with two copies of the written instructions. The permanently installed joint system shall match exactly the finished roadway profile and grades. The words “permanently installed”, shall be interpreted to mean that any work necessary to be done to any other part of the structure, in order to achieve a truly complete permanent installation, has been done. This will apply even if the other work is to be paid for under other items of the Contract.

B. Joint System Width, Splices, and Installation Equipment. The modular expansion joint system shall be set to the proper width for the ambient temperature at the time of setting, as indicated on the Shop Drawings. If the joint system has been fabricated in segments, they shall be field spliced to create a single unbroken system.
All mechanical devices, supplied by the Joint System manufacturer, used to set the joint system to the proper width, will remain the property of the Manufacturer. When no longer required, the devices shall be returned to the Manufacturer.

C. Sliding Plate. In order to perform the work of installing the joint systems in a proper manner, some portions of the curb and parapet cannot be constructed until after the sliding plates of the joint system are installed. This surface shall be scrubbed with wire brooms. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface, and all porous surfaces to be in contact with new concrete, for 12 hours. If, in the opinion of the Engineer, conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. Construction joints must be wetted by continuous spraying with hoses using potable water. The Contractor shall remove any puddles of free standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete.

D. Permanent Seals. After the joint system has been completely installed over the full width of the structure, including sidewalks, the temporary seals shall be removed and replaced with permanent seals. After the temporary seals are removed, all metal surfaces which will be in contact with the permanent seals shall be commercially blast cleaned (SSPC-SP6) to visual standard CSP6 as defined by SSPC Vis 1-89.

E. Final Placement. After the modular joint system has been set to its final line and grade, the recess opening shall be filled with Class E Concrete. This surface shall be scrubbed with wire brooms. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface, and all porous surfaces to be in contact with new concrete, for 12 hours. If, in the opinion of the Engineer, conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. Construction joints must be wetted by continuous spraying with hoses using potable water. The Contractor shall remove any puddles of free standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete. The uppermost surface of the concrete placement shall be finished in accordance with the requirements of Section 557 except that machine finishing will not be required. The cost of this work shall be included in the unit price bid for the slab item(s).

F. Watertight Integrity Test. After the joint system is permanently installed, including plates and all concrete placements, a watertight integrity test shall be performed. The test shall be done in accordance with the requirements of §567-3.01H.

566-4 METHOD OF MEASUREMENT. The work will be measured as the number of feet of joint system completely installed. Measurement will be taken horizontally and vertically along the centerline of the joint system between the outer limits indicated on the Contract Plans. The words “completely installed” shall be interpreted to mean the joint system in-place with the following operations completed, where applicable:
- Nuts tightened, or retightened, as required.
- Concrete placed and finished.
- Watertight integrity tests performed.

566-5 BASIS OF PAYMENT

566-5.01. The unit price bid per foot shall include the cost of all labor, materials and equipment necessary to complete the work.
566-5.02. No payment will be made for any work noted to be done at the expense of the Contractor, or any work noted to be paid for under other items of the Contract.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>566.01</td>
<td>Modular Expansion Joint System - One Cell</td>
<td>Foot</td>
</tr>
<tr>
<td>566.02</td>
<td>Modular Expansion Joint System - Two Cell</td>
<td>Foot</td>
</tr>
<tr>
<td>566.03</td>
<td>Modular Expansion Joint System - Three Cell</td>
<td>Foot</td>
</tr>
<tr>
<td>566.04</td>
<td>Modular Expansion Joint System - Four Cell</td>
<td>Foot</td>
</tr>
<tr>
<td>566.05</td>
<td>Modular Expansion Joint System - Five Cell</td>
<td>Foot</td>
</tr>
<tr>
<td>566.06</td>
<td>Modular Expansion Joint System - Six Cell</td>
<td>Foot</td>
</tr>
</tbody>
</table>

SECTION 567 - BRIDGE JOINT SYSTEMS

567-1 DESCRIPTION. The work shall consist of furnishing and installing bridge joint systems. The particular bridge joint system required will be indicated on the contract plans.

The Contractor shall notify the Deputy Chief Engineer, Structures (DCES) of the name and address of the fabricator of all bridge joint systems in accordance with §106-01 Sources of Supply.

567-1.01 Bridge Joint Systems. There are various kinds of bridge joint systems. Those included as part of the work required by this section are:

A. Armored Joint System with Elastomeric Sealer. The system shall consist of armored joint segments, angles, anchor studs, threaded studs, bolts, nuts, lock washers, expansion bolt anchors, and sealant, all combined as noted in the contract documents so that a fully operational and waterproof system shall seal the joint in which it is installed.

B. Armored Joint System with Compression Seal. This system shall consist of angles, preformed compression seal, anchor studs, threaded studs, bolts, nuts, lock washers all combined as noted in the contract documents so that a fully operational and waterproof system shall seal the joint in which it is installed. The system shall provide for the full expansion and contraction movements of the joint.

This system is fabricated as a single entity designed to be installed across the full width of the bridge as measured along the centerline of joint. If the bridge in question has a raised median, one field splice of the joint system will be allowed at the raised median.

Type. Preformed compression seals are manufactured in various type sizes, defined by a literal-numerical type designation (e.g. Type A1, etc.). The type of seal to be installed in any one armored joint system will be indicated on the contract plans.

C. Armored Joint System with Preformed Elastic Strip Seal. This system shall consist of structural steel components, angles, anchor studs, threaded studs, bolts, nuts, washers, lock washers, anchor bolts, preformed elastic strip seal and adhesive, all combined in the manner required by the Contract Documents so that a fully operational, waterproof system will seal the joint over which it is installed. Armored joint systems of this nature are installed by various methods. The required method for a particular installation will be indicated on the Contract Plans.

Type. Preformed elastic strip seals are manufactured in various sizes, defined by a type number. The type of strip seal to be installed in any one joint system will be indicated on the Contract Plans.
**D. Armorless Bridge Joint System.** The system shall consist of components shown on an Approved Materials Detail Sheet for a Manufacturer and System whose name appears on the Materials Bureau Approved List. The required method of installation will be shown on the Approved Materials Detail Sheet.

567-1.02 Terminology. The following terminology will be used throughout this section:

**A. Armored Joint System.** This term is used to describe the installation with all of its component parts as installed in the structure slab. Terminology used to differentiate one kind of joint system from another will be found in the title of the various subsections (e.g. 567-2.01 Armored Joint System with Elastomeric Sealer, etc.)

**B. Segment.** A joint system manufactured at less than full roadway width. No segment shall be less than a single lane width long.

**C. Joint.** The separation between two elements of a bridge structure to allow for movement.

**D. Materials Detail Sheet (MDS).** A sheet approved by the DCES and containing all material requirements and installation information for Armorless Bridge Joints which are included on the Materials Bureau Approved List.

**567-2 MATERIALS.** Material and Fabrication requirements shall be as described for the various bridge joint systems.

**567-2.01 Armored Joint System with Elastomeric Sealer**

- Elastomer (Polychloroprene or Natural Rubber)
- Structural Steel Segment Angles
- Headed Concrete Anchor Studs and Threaded Studs (Dimensions as shown on the contract plans)
- Bolts, Nuts and Washers Steel
- Expansion Bolt Anchor Steel
- Bonding Tape (to bond end surfaces of the preformed elastomeric joint sealer to each other)

**A. Physical Composition.** Armored segments shall be comprised of elastomer or natural rubber, and structural steel components in the manner indicated on the contract plans.

**B. Length.** Armored segments shall be furnished in lengths not less than a single lane width, excluding length of tongues. Shorter lengths may be used at locations requiring special treatment or to provide the closing sections.

**C. Steel Fabrication.** All steel fabrication work shall be done in accordance with the requirements of the SCM. Mill inspection will not be required. Shop inspection will be conducted at the discretion of the Department.

**D. Cleaning.** The surface of the armored joint segment, to which the preformed elastomer is to be heat bonded, shall be thoroughly cleaned of all dirt, oil, grease, scale and oxides by grinding or sandblasting immediately prior to the heat bonding process. The metal surface after cleaning, shall be
defined by SSPC Vis 1-89 Pictorial Standard, and shall meet the requirements of SSPC-SPC-6, Commercial Blast Cleaning, but shall not be of a quality less than CSP6.

### TABLE 567-1 ELASTOMER MATERIAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test</th>
<th>Polychloroprene</th>
<th>Natural Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>D412</td>
<td>1800 psi</td>
<td>2250 psi</td>
</tr>
<tr>
<td>Tensile Elongation at break</td>
<td>D412</td>
<td>400 percent minimum</td>
<td>400 percent minimum</td>
</tr>
<tr>
<td>Hardness, Shore A Durometer</td>
<td>D2240</td>
<td>45 (5)</td>
<td>50 (5)</td>
</tr>
<tr>
<td>Compression Set (22 hrs at 158°F)</td>
<td>D395 Method B</td>
<td>20 percent maximum</td>
<td>20 percent maximum</td>
</tr>
<tr>
<td>Low Temperature</td>
<td>D746 Procedure B</td>
<td>Not brittle at -40°F</td>
<td>Not brittle at -65°F</td>
</tr>
<tr>
<td>Oil Deterioration (Volume increase after immersion in ASTM Oil No. 3 for 70 hrs @ 212°F)</td>
<td>D471</td>
<td>120 percent maximum</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

**E. Basis of Acceptance.** All materials used for this item, regardless of whether they are employed for fabrication or installation, shall be accepted at the work site upon certification, by the proper manufacturer, that all of the requirements of the contract documents have been met.

#### 567-2.02 Armored Joint System with Compression Seal

- **Compression Seal**: 705-09
- **Angles, Plates and Bars (Structural Steel)**: ASTM A242, A588, 715-01 and SCM
- **Headed Concrete Anchor Studs and Threaded Studs (Dimensions as shown on the contract plans)**: 709-05
- **Bolts, Nuts and Washers**: ASTM A307 Grade A or ASTM A325
- **Support Bar for the compression seal**: ASTM A242, AISI 1018 or AISI 1020
- **Expansion Bolt Anchors**: U.S. Government GSA FF-S-325
  - Group III, Type 1 or Group VIII, Type 1

**NOTES:**
1. The sealer shall be applied in one piece for the full length of each joint. Splices will not be permitted if the full length of joint is less than 50 feet. If the full length of joint is more than 50 feet, but less than 100 feet long, one shop splice in the sealer will be permitted. If the full length of joint is greater than 100 feet, shop splices in the sealer will be permitted at approximately 50 foot intervals.
2. Support angles may be ASTM A36
3. If AISI 1018 or AISI 1020 steel is used it shall be painted in accordance with the requirements of the contract documents.

### TABLE 567-2 MOISTURE CURING URETHANE ADHESIVE

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average weight per gallon</td>
<td>8 lbs 10%</td>
</tr>
<tr>
<td>Solids Content</td>
<td>72% - 74% by Weight</td>
</tr>
<tr>
<td>Adhesive to remain fluid, from</td>
<td>5°F to 120°F</td>
</tr>
<tr>
<td>Film Strength (ASTM D412)</td>
<td>1200 psi</td>
</tr>
<tr>
<td>Elongation</td>
<td>350%</td>
</tr>
</tbody>
</table>

**A. Assembly.** The joint system shall be shop assembled and delivered to the work site ready for installation.
If the Contractor desires to assemble the joint system at the work site, prior permission to do so must be obtained from the DCES.

Joint systems assembled at the work site shall have all materials certified by the respective manufacturers that the respective materials meet the requirements of §567-2.02A. Field methods of fabrication shall be in accordance with the requirements of this subsection.

**B. Procedures.** Steel fabrication shall be done in conformance with the requirements of the SCM. Mill inspection will not be required. Shop inspection will be conducted at the discretion of the Department.

**C. Cleaning.** Metal surfaces which are to be coated with adhesive shall be cleaned in accordance with Steel Structures Painting Council, Surface Preparation No. 6, Commercial Blast Cleaning (SSPC SP6) with the following modifications and additions:
1. The cleaned surfaces shall have adhesive applied before detrimental rusting occurs.
2. A commercial blast cleaned surface shall be as defined by SSPC SP6 and SSPC Vis 1-89 pictorial references BSP6 and CSP6 only.

**D. Basis of Acceptance.** The armored joint system with preformed compression seal will be accepted at the work site upon certification to the Engineer by the Contractor, that the materials used and the fabricating procedures were in accordance with this specification.

The certification shall include the name of the sealer manufacturer, the lot numbers of all sealers used in the fabrication of the armored joint system and the statement that all sealer used in the fabrication of the armored joint system was appropriately identified as accepted materials by the presence of Department security seals when received by the fabricator.

**567-2.03 Armored Joint System with Preformed Elastic Strip Seal.** Since there are various methods of installing the joint system, all of the materials listed in this Subsection may not be applicable for a particular installation. It is the Contractor's responsibility to ensure that only those materials necessary are actually installed, where required, or as specified on the Approved Shop Drawings.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angles, Plates, Extrusions and Milled Shapes</td>
<td>ASTM A588 and 715-01</td>
</tr>
<tr>
<td>Headed Concrete Anchor Studs and Threaded Studs (Dimensions indicated on the Contract Plans)</td>
<td>709-05</td>
</tr>
<tr>
<td>Bolts and Nuts</td>
<td>ASTM A307 or A325.</td>
</tr>
<tr>
<td>Anchor Bolts</td>
<td>ASTM A307 Grade A</td>
</tr>
<tr>
<td>Anchor bolt grout</td>
<td>701-07</td>
</tr>
<tr>
<td>Preformed Elastic Strip Seal</td>
<td>ASTM D2628 modified¹</td>
</tr>
<tr>
<td>Adhesive(to bond the strip seal to the steel surfaces)</td>
<td>Table 567-2, Moisture Curing Urethane with Hydrocarbon Solvent</td>
</tr>
<tr>
<td>Concrete²</td>
<td>501, Class E</td>
</tr>
<tr>
<td>Elastomeric Concrete²</td>
<td>Contract Documents</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Recovery Test is not required. The sealer shall be supplied in one piece for the full length of each joint.
2. Concrete and Elastomeric Concrete, if used, shall be placed and paid under a separate item.

**A. Steel Fabrication.** Steel fabrication shall be done in conformance with the requirements of the SCM. Mill inspection will not be required. Shop inspection will be conducted at the discretion of the Department.
B. Cleaning. Metal surfaces which are to be coated with adhesive shall be thoroughly cleaned of all dirt, oil, grease, scale and oxides by grinding or sandblasting. Metal surfaces after cleaning shall exhibit a clean quality of CSa2, or better, as defined by the Steel Structures Painting Council Standard SSPC Vis1.

C. Adhesive Coating. The recess of the steel extrusions shall be thoroughly coated with adhesive. The strip seal shall be installed within the recess in such a manner that it will be completely and firmly bonded to the recess surface over the total length of the joint system.

D. Basis of Acceptance. The fabricated joint system will be accepted at the work site by the Engineer after a visual inspection and upon receipt of the Manufacturer's Certification Report (MCR) that the materials and the fabricating procedures were in accordance with the Approved Shop Drawings and this Specification. The Manufacturer shall submit, with the MCR, a Certified Copy of the Mill Test Report (MTR) for all steel used to fabricate the joint system.

567.2.04 Armorless Bridge Joint. The material requirements shall be as shown on the Approved Materials Detail Sheet corresponding to a Manufacturer and System listed on the Materials Bureau Approved List.

567.2.05 Shop Drawings. Shop drawings will be required for any joint system supplied as part of this work. Shop drawings shall meet the various applicable requirements of this subsection. All shop drawings shall note the name and address of the joint system (or segment) fabricator as well as the location where the joint system (or segments) are to be fabricated.

A. General. The applicable provisions of Section 2-Drawings, of the New York State Steel Construction Manual shall apply with the following modifications

1. Shop Drawings. Shop drawings shall be submitted for review, approval and distribution in accordance with the requirements of the SCM, Section 2. The shop drawings shall indicate the type, location and details of the mechanical devices required to compress the joint to its required width based on the ambient temperature at the time of installation. All references, within Section 2 to the DCES, shall be interpreted as the Regional Director, with the following exceptions:
   - 202.7 - Distribution of Approved Shop Drawings.
   - 202.8 - Disposal of Original Reproducibles.

   No shop drawing approval will be issued for shop drawings unaccompanied by current WPS(s). No shop work shall begin prior to the Contractor's receipt of approved shop drawings.

2. Welding Procedure Specifications. The Contractor shall submit with the shop drawings a Welding Procedure Specification (WPS), approved by the DCES for each combination of joint system type and welding process shown on the shop drawings.

   The WPS approval date shall be within 36 months of the joint system fabrication date. A submitted WPS showing an approval date earlier than 36 months prior to joint system fabrication will be rejected and the Contractor shall be required to submit shop drawings accompanied by a currently approved WPS(s). No extension of time, nor additional payment will be forthcoming for delays caused by the Contractor's failure to submit current WPS(s).

567.3 CONSTRUCTION DETAILS. The construction details shall be as required for the various joint systems and the approved shop drawings.

567.3.01 Armored Joint System with Elastomeric Sealer
A. Manufacturer's Representative.  The joint system shall be installed in strict accordance with the manufacturer's instructions and this subsection. In the event of a conflict, the terms of this subsection shall rule. A representative of the manufacturer shall be present at the beginning of the installation. The representative shall be fully conversant in all respects with the correct installation methods. The representative shall be responsible to advise both the Engineer and the Contractor, that the proper installation method is being followed.

B. Preparation.  The preformed recess which is to receive the joint system shall be air blown or vacuum-cleaned in order that all loose or foreign matter is removed prior to installation of the system.

C. Storage Inspection and Handling.  The joint system shall be stored, inspected and handled in accordance with the following:

1. Handling and Storing.  All material shall be handled and stored in a manner approved by the Engineer, and consistent with the requirements of the SCM. No material shall be dropped, thrown, or dragged upon the ground. Material shall be kept clean, properly drained and stored on proper supports above the ground. All material shall be adequately shored, braced, or clamped to resist lateral forces which might occur. Permanent distortion will be cause for rejection of material.

   If the shop applied protective coating deteriorates to the point that the Engineer considers it unacceptable, the contractor shall restore the shop applied coating to a condition acceptable to the Engineer. This work shall be done before other coatings are applied. The work shall be done in accordance with the requirements of the contract documents.

2. Field Inspection.  All installation work shall be subject to the Engineer's inspection. The Engineer shall be given all facilities required for a thorough inspection. Materials and workmanship subject to shop inspection shall be identified by the acceptance stamp of the Shop Inspector. Materials and workmanship not required to be shop inspected will be inspected by the Engineer. Certified copies of the results of tests conducted by the manufacturer shall be furnished to the Engineer in accordance with the requirements of 715-01.

D. Installation Inspection.  Immediately prior to installation, the armored segments shall be inspected by the Engineer for proper alignment and complete bond between the polychloroprene and the steel, and proper stud placement and effectiveness. No bends or kinks in the armoring steel shall be allowed, nor shall straightening of such bends or kinks be allowed. Armored segments exhibiting bends or kinks shall be removed from the work site, and replaced with new armored segments at the Contractor's expense. Armored segments which exhibit any separation of the polychloroprene and the armoring steel shall be removed from the work site and replaced with new armored segments at the Contractor's expense. Studs shall be inspected visually and shall be given a light blow with a hammer. Any threaded stud which does not have a complete end weld or does not emit a ringing sound when struck a light blow with a hammer shall be replaced. Studs located more than 1 inch from the location shown on the shop drawings shall be carefully removed and a new stud placed in the proper location.

E. Mechanical Devices.  In order for the armored segments to be installed properly, they must be set at a width which is directly dependent upon the ambient temperature at the start of installation, as shown on the shop drawings. The width setting shall be accomplished through the use of mechanical devices supplied by the armored segment fabricator. After the armored segment has been set to its proper line and grade and securely attached to its supports, the mechanical devices shall be removed and returned to the armored segment manufacturer.
F. Sealing Segment Surfaces. The mating surfaces of the armored segments shall be scrubbed with wire brushes, or other means satisfactory to the Engineer, to remove any rust from the steel and roughen the polychloroprene. This operation shall immediately precede the application of tape to the mating surfaces.

G. Concrete Placement and Finishing. After the joint system has been fully installed, concrete shall be placed in accordance with the contract plans. The concrete shall be finished in accordance with 557-3.07 - Finishing Integral Wearing Surfaces on Superstructure Slabs.

H. Watertight Integrity Test At least five work days after the joint system has been fully installed the Contractor shall test the entire (full length) joint system for watertight integrity employing a method satisfactory to the Engineer. The entire joint system shall be covered with water, either ponded or flowing, for a minimum duration of 15 minutes. The concrete surfaces under the joint shall be inspected, during this 15 minute period and also for a minimum of 45 minutes after the supply of water has stopped, for any evidence of dripping water or moisture. Water tightness shall be interpreted to be no free dripping water on any surface on the underside of the joint. Patches of moisture shall not be cause for non-acceptance.

Should the joint system exhibit evidence of water leakage at any place whatsoever, the Contractor shall locate the place(s) of leakage and take all measures necessary to stop the leakage. This work shall be done at the Contractor's expense. A subsequent water integrity test shall be performed subject to the same conditions and consequences as the original test.

567-3.02 Armored Joint System with Compression Seal

A. Delivery. The joint system shall be delivered to the work site ready for installation in accordance with the requirements of 567-2.02B1.

B. Preparation. The requirements of 567-3.01B, shall apply.

C. Storage Inspection and Handling. The requirements of 567-3.01C shall apply.

D. Installation Inspection. The armored joint system with compression seal shall be inspected in the same manner as required for armored segments under 567-3.01D. All of the requirements of 567-3.01D shall apply, except that compression seal not fully bonded to the armoring angles will not mandate replacement of the joint system. However, any compression seal which is not fully bonded, shall be fully bonded to both armoring faces, by the Contractor, at no expense to the State.

E. Mechanical Devices. The requirements of 567-3.01E shall apply.

F. Concrete Placement and Finishing. The requirements of 567-3.01G shall apply.

G. Watertight Integrity Test. Not required.

567-3.03 Armored Joint System with Preformed Elastic Strip Seal

A. Site Delivery. The joint system shall be shop assembled and delivered to the work site ready for installation, unless prior permission to field assemble has been granted by the Engineer.

B. Field Assembly.
1. If the Contractor desires to assemble the joint system at the work site, prior permission to do so shall be obtained from the Engineer, in writing.

2. Joint systems assembled at the work site shall have all materials certified by the respective Manufacturers. The certifications shall state that the Materials requirements of this Specification have been met.

C. Storage Inspection and Handling. The requirements of 567-3.02C shall apply.

D. Installation Inspection. The requirements of 567-3.02D shall apply. The term “compression Seal” shall be interpreted as “preformed elastic strip seal.”

E. Mechanical Devices. The requirements of 567-3.01E shall apply.

F. Recess Finishing. If the joint system is installed within a preformed concrete or asphalt recess, the recess will be filled and finished to grade with either structural concrete or elastomeric concrete. The exact materials will be indicated on the Contract Plans. The respective materials will be installed in the following manner:

   1. Concrete. Placement shall be in accordance with 555. Finishing shall be done in accordance with 557-3.07. Machine finishing will not be required.

   2. Elastomeric Concrete. Placement shall be in accordance with the requirements of the elastomeric concrete specification.

G. Watertight Integrity Test. The requirements of 567-3.01H shall apply.

567-3.04 Armorless Bridge Joint System

A. Manufacturer's Representative. The joint system shall be installed in strict accordance with the manufacturer's instructions and the Approved Materials Detail Sheet. In the event of a conflict, the terms of the Approved Materials Detail Sheet shall rule. A representative of the bridge joint system manufacturer shall be present prior to placement to inspect the prepared surfaces and remain at the job during all phases of the installation. The representative shall be fully conversant in all respects with the correct installation methods. The representative shall be responsible to advise both the Engineer and the Contractor on properly installing the joint system. The representative may be excused from the project site at the discretion of the EIC.

B. Preparation. All surfaces shall be prepared as per the Approved MDS. At a minimum, the preformed recess which is to receive the joint system shall be air blown using air free of water and oil or vacuum-cleaned so that all loose or foreign matter is removed prior to installation of the system. The substrate shall be dry for a minimum of 24 hours prior to installation for the joint system.

C. Storage Inspection and Handling. The joint system shall be stored, inspected and handled in accordance with the Approved Materials Detail Sheet.

D. Installation Inspection. All installation work shall be subject to the Engineer's inspection.

E. Watertight Integrity Test. At least five work days after the joint system has been fully installed the Contractor shall test the entire (full length) joint system for watertight integrity. The entire joint system shall be covered with water, either ponded or flowing, for a minimum duration of 15 minutes.
The concrete surfaces under the joint shall be inspected during this 15 minute period, and also for a minimum of 45 minutes after the supply of water has stopped, for any evidence of dripping water or moisture. Water tightness shall be interpreted to be no free dripping water on any surface on the underside of the joint. Patches of moisture shall not be cause for non-acceptance.

Should the joint system exhibit evidence of water leakage at any place whatsoever, the Contractor shall locate the place(s) of leakage and take all measures necessary to seal the leak. A subsequent water integrity test shall be performed subject to the same conditions and consequences as the original test.

567-4 METHOD OF MEASUREMENT. Measurement will be made as the number of feet of joint system completely installed, measured horizontally and vertically along the centerline of joint system between the outer limits as indicated on the contract plans.

The words “completely installed” shall be interpreted to mean the joint system in place with the following operations completed where applicable:
- All sealant in its proper position.
- All nuts tightened or retightened as required.
- Concrete placed and finished.
- Elastomeric concrete placed and finished.
- Water-tight integrity tests.

567-5 BASIS OF PAYMENT. The unit price bid per foot shall include all labor, materials and equipment necessary to complete the work. No additional payment will be made for corrective actions.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tbody>
<tr>
<td>567.31</td>
<td>Armored Joint System with Compression Seal-Type A1</td>
<td>Foot</td>
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<tr>
<td>567.32</td>
<td>Armored Joint System with Compression Seal-Type A2</td>
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<td>567.33</td>
<td>Armored Joint System with Compression Seal-Type A3</td>
<td>Foot</td>
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<td>567.34</td>
<td>Armored Joint System with Compression Seal-Type A4</td>
<td>Foot</td>
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<td>567.35</td>
<td>Armored Joint System with Compression Seal-Type A5</td>
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<td>567.36</td>
<td>Armored Joint System with Compression Seal-Type A6</td>
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<td>Armored Joint System with Compression Seal-Type A7</td>
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<td>567.50</td>
<td>Armored Joint System with Preformed Elastic Strip Seal - Type as Noted</td>
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<tr>
<td>567.60</td>
<td>Armorless Bridge Joint System</td>
<td>Foot</td>
</tr>
</tbody>
</table>

SECTION 568 - BRIDGE RAILING

568-1 DESCRIPTION. This work shall consist of furnishing and erecting bridge railing as shown on the contract plans and in accordance with the specifications.

As soon as the Contract is awarded, the Contractor shall notify the DCES of the name and address of the Fabricator of all bridge railing in accordance with §106-01 Sources of Supply. This notification shall list the specific shop or shops in which the railing will be fabricated.

568-2 MATERIALS. Materials shall meet the requirements of the following subsections:

Concrete Grouting Material  701-05
Steel Bridge Railing        710-23
Stainless Steel Connecting Products  715-16
Rubber Impregnated Random Fiber Pad  728-02
568-3 CONSTRUCTION DETAILS

568-3.01 Erection of Railing

A. Inspection of Railing. Immediately prior to erection, the railing shall be inspected for damage. Significant bends or kinks in the railing not specifically called for in the contract documents shall constitute sufficient cause for rejection. Straightening of such bends or kinks shall not be allowed.

Bending or curving rails in the field in order to fit alignment requirements, shall not be permitted. The Engineer may order some bending or curving to allow for necessary minor adjustments.

B. Inspection of Galvanizing. Damage to galvanizing of steel bridge railing shall constitute sufficient cause for rejection except for the following conditions:

1. If the damaged area is not required to be repaired under the provisions of 710-23, Steel Bridge Railing.
2. If the total damaged area of a single piece (i.e. post or rail) is 6 square inches or less. Total damaged area is exclusive of the damaged area as described under §568-3.01B1.

C. Field Galvanizing for Repair. Field galvanizing repair shall be allowed to be performed upon damaged areas meeting the requirements of §568-3.01B2.

Field galvanizing repair shall be made by painting zinc repair material onto the damaged area in accordance with the requirements of §719-01, Galvanized Coatings and Repair Methods.

All finished surfaces of welds and adjacent surfaces of rails and posts upon which galvanizing has been removed, due to any field welding operation, shall be field galvanized.

D. Field Welding. Field welding shall not be permitted unless noted in the contract documents or ordered by the Engineer.

E. Erection. All railing shall be erected in accordance with the contract documents or, when required, the approved shop drawings prepared and submitted as specified in the New York State Steel Construction Manual.

F. Positioning Railing. Railing shall be erected so that the rails are parallel to each other and to the top of parapet, sidewalk or structural slab.

G. Positioning Posts. Posts shall be set vertical.

H. Base Plates. Post base plates shall be perpendicular to the post, unless otherwise noted. When the railing is to be placed on a preformed surface, the base plate may be placed parallel to the grade or may be perpendicular to the post and made level by the use of beveled shims conforming to the applicable requirements of §710-23, Steel Bridge Railing.

I. Non-Metallic Pads. Posts which are to be placed on a preformed surface shall be mounted on a non-metallic pad conforming to the requirements of §728-02. Beveled Shims, if required, shall be inserted between the non-metallic pad and the post base plate.

J. Jacking Nuts. For railings set on jacking nuts, the railing posts shall be erected to proper line and grade before concrete under the post and in back of the granite curb is placed or before the mortar pad is placed.
K. Rail Span. The rails of railings shall span the following minimum number of posts:

<table>
<thead>
<tr>
<th>Railing Type</th>
<th>Number of Posts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-Rail, Steel</td>
<td>3*</td>
</tr>
<tr>
<td>Four-Rail, Steel</td>
<td>3</td>
</tr>
<tr>
<td>Five-Rail Steel</td>
<td>3</td>
</tr>
</tbody>
</table>

NOTE: * If this is not possible, the absolute minimum shall be 2 posts if approved by the DCES.

L. Anchor Studs. After the anchor stud nuts have been tightened in a manner satisfactory to the Engineer, the studs shall be flame cut 1 inch above the nut. The first thread of the stud above the nut shall be damaged. The cut end of the anchor stud shall be coated in conformance with the requirements of §719-01, Galvanized coating and Repair Methods.

M. Touch-Up Painting. Any damage to the paint on a railing system shall be repaired in accordance with §657 Painting Galvanized Surfaces.

N. Inspection. All erection shall be subject to the inspection of the Engineer who shall be given all facilities required for a visual inspection of workmanship and materials.

Any single piece of the railing system with a total damaged area in excess of the amount specified in §568-3.01B2 shall be rejected and replaced.

568-3.02 Cement Mortar Pads

A. Proportioning. Cement mortar pads shall consist of a concrete grouting material.

The concrete grouting material shall meet the requirements of §701-05, Concrete Grouting Material. The grouting material shall be mixed with water, in the ratio recommended by the manufacturer, to produce a trowelable mix.

B. Mixing. Mixing shall be carried out in strict accordance with the manufacturers recommendations or the following as determined by the Engineer.

- All necessary mixing equipment shall be present and in good working order prior to the start of mixing.
- Mixing time shall not exceed three minutes unless otherwise permitted. No mixing shall be started until all preparations have been made to place the mortar.
- All mortar in any individual batch shall be used within 25 minutes after the start of mixing.
- Retempering will not be allowed.

C. Surface Preparation. All concrete surfaces to receive the mortar shall be free from laitance, oil, grease, paint, dust, loose particles or other foreign material.

The concrete surface shall be cleaned by sandblasting to the satisfaction of the Engineer, followed by a thorough vacuum cleaning.

The bottom surfaces of the base plates shall be free of oil, dirt and other foreign matter.

The concrete surface shall be lightly moistened with water.

D. Form Preparation. The forms shall be positioned about the base plate as shown in the plans or as directed by the Engineer. If the forms are to be coated with a release agent, it shall not be deleterious to the physical properties of the mortar system being used as determined by the Engineer.

E. Application. After the concrete surfaces and the base plates surfaces have been properly prepared the mortar shall be placed within the limits of the forms and tamped into place to assure that there are no voids in the completed pad. Exposed surfaces of the mortar shall be screeded and troweled to the
level of the bottom of the base plate. The mortar pads shall be protected from rain for at least 24 hours.

**F. General.** In all cases, the installation of the mortar pads shall be made when the concrete and ambient air temperatures are above 50°F.

### 568-4 METHOD OF MEASUREMENT

#### 568-4.01 Bridge Railing

The quantity to be paid for bridge railing shall be the number of feet measured along the centerline of railing anchorage between the extreme outer limits indicated on the contract plans.

#### 568-4.02 Transition Bridge Railing

The quantity to be paid for transition railing shall be the number of feet measured along the axis of the top rail between the limits shown on the plans.

### 568-5 BASIS OF PAYMENT

#### 568-5.01 Bridge Railing

The unit price bid shall include the cost of furnishing all labor, materials and equipment necessary to complete the work. All pads (including Mortar Pads), shims, splices with their hardware, railing anchor studs with nuts, washers and anchor plates, and hand rails when specified shall also be included in the price bid.

No payment shall be made for those railing pieces which are replacements for those railing pieces that have been rejected.

Progress payments will be made when the railing is erected in accordance with the contract documents as specified in the New York State Steel Construction Manual exclusive of the cutting, peening and galvanizing of studs. Payment will be made at the unit bid price for 90% of the quantity erected. The balance of the quantity will be paid for upon proper completion of the work.

*Payment will be made under:*

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<td>Steel Bridge Railing (Five-Rail)</td>
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<td>Steel Bridge Railing (Two-Rail) with Handrail</td>
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<td>Steel Bridge Railing (Three-Rail)</td>
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<td>Pedestrian and Bicycle Railing (Four-Rail)</td>
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</table>
568.89  Pedestrian and Bicycle Railing - Brown (Five-Rail)  Foot
568.90  Bicycle Railing (Two-Rail)  Foot
568.91  Bicycle Railing - Brown (Two-Rail)  Foot
568.92  Bicycle Railing (Four-Rail)  Foot
568.93  Bicycle Railing - Brown (Four-Rail)  Foot

SECTION 569 - PERMANENT CONCRETE TRAFFIC BARRIER FOR STRUCTURES

569-1 DESCRIPTION

569-1.01 Work. The work shall consist of constructing concrete traffic barrier, of the configuration and at the locations indicated on the Contract Plans.

569-1.02 Methods. Construction of the barrier shall be accomplished by cast-in-place or precast methods. Slip forming will be allowed as an acceptable cast-in-place method, unless the plans show anchor bolts projecting beyond concrete limits; in this instance slipforming procedures will require the approval of the DCES.

569-1.03 Shape Modification. The barrier shape indicated on the plans shall not be altered. Minor modifications, to allow slip-forming, will be submitted to the Regional Construction Engineer for approval.

569-1.04 Approvals. For approval requirements and procedures refer to the Construction Details.

569-2 MATERIALS

569-2.01 Fabrication. Materials used for traffic barrier fabrication shall meet the following requirements:

- Precast Concrete Barrier 704-03 and 704-05
- Cast-In-Place Concrete (Constructed Forms) 501, Class A Concrete
- Cast-In-Place Concrete (Slip Formed) 501, Class J
- Epoxy Coated Reinforcing Bars 709-04
- Steel Tubes ASTM A500, Grade B
- Steel Plates, or Bars ASTM A36 or A588 (A709 Grade 36 or 50W)
- Anchor Bolts (Fully Threaded) ASTM A325 or A449 Type 1
- Nuts ASTM A563, Class 10S HH
- Washers ASTM F436, Type 1 or 3
- Concrete Grouting Material 701-05
- Concrete Repair Material 701-04
- Concrete Repair Material - High Early Strength 701-12
- Joint Filler ASTM D1056, Grade 2B1 or 2B2.
- Curing Compound 711-05
- Locking and anchoring devices for precast units 715-01 and 709-04, as applicable
- Galvanizing 719-01

All steel, except reinforcing steel, shall be galvanized.

569-2.02 Fabrication Tolerances. All cast-in-place concrete barrier, regardless of the method of construction, shall conform to the following finished tolerances:
Bar Reinforcement Cover -0, + 1/2 inch
Width (Top) -0, + 1/4 inch
Width (Bottom) -0, + 1/2 inch
Surface Straightness 1/2 inch in 20 feet
  (Deviation from theoretical centerline)
Vertical Alignment 1/2 inch in 20 feet
  (Deviation from a line parallel to the theoretical grade line)
Horizontal and Vertical Misalignment 3/16 inch
  (between adjacent precast units)

All precast concrete barrier shall conform to the tolerances contained in §704-03, §704-05 and to the foregoing misalignment tolerance. Reinforcement cover shall be verified while the concrete is still plastic, except in the case of cured precast units. In that case, cover will be verified in accordance with established Department procedures. These procedures may include coring.

569-3 CONSTRUCTION DETAILS

569-3.01 Approvals

A. Cast-In-Place Concrete - Modifications to Contract Plans. The DCES shall be supplied with three copies of pertinent details and necessary design computations. Every effort will be made to render a decision, in a timely manner, after all pertinent information has been received. However, the time required to render a determination will not be taken into account should the Contractor request an extension of time.

B. Precast Concrete. Precast barrier systems shall be approved by the DCES prior to the contract award in order to be used in the contract.

569-3.02 General: Cast In Place Concrete

A. Cleaning. Surfaces against which barrier is to be placed shall be thoroughly cleaned and vacuumed to remove any dirt or other foreign substances, laitance or partially loose chips of concrete.

B. Defects. Defects are divided into two categories: minor defects and major defects. Minor defects in the barrier shall be repaired. Major defects shall be cause for rejection of the section. Such rejected sections shall be removed and replaced or, upon approval of the Engineer, the section shall be repaired to the satisfaction of the Engineer.

1. Minor Defects. Minor defects are defined as holes, honeycombing or spalls which are 6 inches or less, in diameter, and which do not expose the outermost surface of the steel reinforcement. Surface voids 5/8 inch, or less, in diameter, and 1/4 inch, or less in depth are not considered defects. They do not require repair.

2. Major Defects. Major defects are defined as:

a. Any defect, except as noted in §569-3.02 B.1. above which does not meet the definition of a minor defect.
b. Minor defects which, in aggregate, comprise more than five percent (5%) of the surface of the barrier section.
C. Repair. Repair shall be made with a material acceptable under §701-04 or §701-12. Methods of repair shall be acceptable to the Engineer. The color of the repaired portion shall match, as nearly as practicable, the color of the surrounding concrete. Repaired portions shall exactly match shape requirements. The repaired portion shall withstand a moderate blow from a 16 ounce hammer. Repair shall be done at no cost to the State.

569-3.03 General: Precast Concrete. The definition of defects and the repair requirements contained in 704-03 shall apply.

569-3.04 Cast-In-Place Concrete - Constructed Forms. The requirements of Section 555 and Section 556 shall apply with the following modification:

Thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing water with oil-free compressed air, and protect the surfaces from drying, so the concrete remains in a saturated surface dry condition until placement of the new concrete. If the forms are removed before seven curing days have passed, the concrete shall be cured by means of a clear curing compound. No curing blankets will be required.

Curing compound shall be sprayed on the concrete surface immediately following the slipforming and hand finishing operations. The compound shall be applied by means of pressure spraying or distributing equipment at the rate directed by the Engineer, but not less than 1 gallon per 150 square feet of surface. The equipment for applying the compound shall be such that the compound is applied as a fine spray with no surface damage to the concrete. The equipment shall also provide adequate agitation of the compound during application, and shall be approved by the Engineer before work is started. Should the method of applying the compound produce a non-uniform film, or should the spraying equipment fail and duplicate equipment not be immediately available, the application of curing compound shall be discontinued immediately and the curing shall be accomplished by another method acceptable to the Engineer. The Contractor shall stockpile sufficient approved coverings for protection of the concrete in the event of rain, non-uniform film application, or breakdown of spray equipment.

569-3.05 Cast-In-Place Concrete - Slipformed. The requirements of Section 555, Section 556 and the following, shall apply:

A. The forming of the barrier shall be accomplished by self-propelled equipment approved by the Engineer. The requirements of 555-3.03 shall not apply. Thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing water with oil-free compressed air, and protect the surfaces from drying, so the concrete remains in a saturated surface dry condition until placement of the new concrete.

B. After all reinforcing bars have been placed, all bridge joints installed, and all other hardware placed in the area of the barrier, the Contractor shall perform a "dry run" over the entire length of the barrier installation location. It is necessary only to "dry run" a single day's placement during any given day; however, the entire barrier length shall be traversed.

The "dry run" may be made with either the actual slip forming equipment, or with an exact "mock-up" of the equipment. The "mock-up"; if utilized, shall be the exact size, shape and dimensions of the slip forming equipment. It shall be a minimum of 4 feet long. Its movement shall be able to be correlated with a string, or survey, line indicating the correct offset location of the barrier.

C. After the "dry run" portion of the work has been completed and all obstructions have been cleared, the slip-forming equipment shall be demonstrated for capability. The demonstration shall be done in
the presence of the Engineer. The Contractor shall make all adjustments, or alterations, to ensure that
the equipment has the capability to produce an acceptable product. No work shall be done without
the Engineer's approval. The capability demonstration will be required only once for each piece of
forming equipment used on the project.

D. The Engineer's approval is for equipment capability only. The Contractor shall be entirely
responsible for meeting the tolerances given under MATERIALS, 569-2.03. Fabrication Tolerances.
Sections which do not meet tolerance requirements are subject to removal and replacement at no cost
to the State, at the discretion of the Engineer.

E. Central and Transit Mixed Concrete. The provisions of 501-3.03 C and D shall apply for Central
Mixed and Transit Mixed Concrete respectively, except that water may be added to the mixture one
additional time at the point of deposition to maintain the desired slump. The water addition may be
made anytime after the beginning of discharge until approximately two-thirds of the load, as
determined by the Engineer, has been discharged. After the water addition, the concrete shall be
mixed at least 30 revolutions in the mixing range. When the water addition is made after discharge
the total number of revolutions shall not be more than 190.

Truck Mixed Concrete. The provisions of §501-3.03 E shall apply except that after initial slump
has been achieved, water may be added to the mixture one additional time to maintain the desired
slump. The water addition may be made anytime after the beginning of discharge until approximately
two-thirds of the load, as determined by the Engineer, has been discharged. After the water addition,
the concrete shall be mixed at least 30 revolutions in the mixing range.

F. Concrete supply shall be sufficient to produce a continuous, completely shaped barrier. If concrete
placement is interrupted, for any reason, the placement shall be protected from drying by several
layers of wet burlap. A construction dam, or bulkhead, shall be installed if the interruption exceeds
30 minutes. If the interruption exceeds 90 minutes, further placement shall be discontinued.
Concrete placement at this location may then resume only after 12 hours, measured from the time of
delay, has elapsed.

G. Concrete placement may begin at the joint beyond the bulkhead without time constraints. If the
length of placement between the bulkhead and the next joint is such that, in the opinion of the
Engineer, it may not be slipformed, the Contractor shall form the section by methods other than
slipforming.

H. Cold joints in the barrier, that is, joints formed due to the attachment of fresh concrete to set
concrete, shall be made in the following manner. The set concrete shall have its surface cut to
remove all loose, and otherwise unsatisfactory materials. Tools used for this purpose shall be
approved by the Engineer, prior to use. The surface shall be scrubbed with wire brooms and shall be
kept wet until new concrete is placed.

I. The Contractor shall make provisions to allow hand finishing, should it be necessary, on all
surfaces. Hand finishing, if done, shall be done immediately after the passage of the slipforming
equipment. Curing compound shall be applied only after hand finishing has been completed at any
particular location.

J. Concrete shall be cured by means of a clear curing compound in accordance with the requirements
of 569-3.04.

K. Joints and construction grooves shall be introduced at the locations indicated on the Contract
Plans. If sawcutting methods are employed the following requirements shall apply:
1. The equipment shall be demonstrated, for capability, to the Engineer.
2. No sawcuts, for any purpose, shall be made in the structural slab.
3. In order to avoid sawcuts in the structural slab, the portion of the joint 3 inches directly above the structural slab shall be hand tooled immediately after finishing.
4. All sawcuts shall be made normal to the structural slab surface. The joints shall be sawcut as soon as no damage to the concrete will result with a maximum time of 8 hours. The clear curing compound shall be reapplied at the sawcut.

569-3.06 Precast Concrete

A. Immediately prior to installation, the barrier units shall be inspected for defects. Defects which conform to the definition of minor defects as given in §704-03 shall be repaired in accordance with the requirements of that subsection.

After the inspection for defects has been completed, the contact surface of all precast barrier shall be sandblast cleaned in accordance with the requirements of §584-3.02A, and §584-3.02C. After sandblasting operations are completed the surfaces shall be thoroughly vacuum cleaned.

B. After the cleaned surface has been accepted, thoroughly wet the surface over which the precast barrier will be placed for at least 12 hours immediately prior to placing the grout bed. Remove all standing water with oil-free compressed air, and protect the surface from drying, so the surface remains in a saturated surface dry condition when placing the grout bed. All precast barrier shall be installed on grout beds conforming to the requirements of §701-05 as modified herein. The exact bedding placement requirements shall be established by the barrier system manufacturer. However, no grout bed shall be greater than 1/2 inch in thickness after the barrier has been installed in its permanent position. All grout bedding material shall be tooled flush with the barrier edge.

Care shall be taken to prevent grout from setting prior to barrier unit installation. If, in the opinion of the Engineer, the grout has set, or has begun to set, it shall be removed. No retempering will be permitted. The affected installation area shall be thoroughly cleaned of grout, by methods acceptable to the Engineer, and new grout shall be placed, all at no additional cost. All vertical adjustments shall be made by the addition, or removal, of grout. No wedges will be permitted.

Lifting of the barrier which, in the Engineer's opinion, will result in permanent voids occurring between the barrier unit and the grout bed, will not be permitted.

C. Unless otherwise noted joints between units shall utilize materials required by ASTM D1056, Grade 2B1 or 2B2 and shall be installed in the manner indicated on the approved precast barrier system drawings.

D. Units which are damaged during installation, due to the Contractor's operations, shall be repaired, or replaced, as determined by the Engineer. Repair or replacement shall be done at no cost to the State.

E. Precast barrier anchored to the underlying support by means of drilled-in-bolts, may be anchored by one of two methods:

1. **Bolts chemically anchored to the underlying support.** Holes drilled for this method will not go completely through the underlying support. Bolt installations will be subjected to load testing acceptance requirements.

2. **Bolts mechanically anchored to the bottom of the underlying support.** Holes drilled for this method will go completely through the underlying support. Bolt installations will not be load tested.

569-3.07 Requirements for Method permitted under §569-3.06E1
A. Drilling shall be done by means of a rotary impact drill. Hole diameter shall be in strict accordance with the grout manufacturer's instructions. If reinforcing steel is encountered, the reinforcing shall be cut and removed by means of a core drill. If approved by the Engineer, hole locations may be moved to avoid encountering reinforcing steel. The remainder of the drilling shall be done by rotary impact drill.

Drilling with a lubricant will not be permitted. Water use is permissible. Concrete spalled, or otherwise damaged by the contractor's operations shall be repaired, in a manner approved by and, to the satisfaction of the Engineer, at no additional cost.

B. Unless otherwise specified in the Contract Documents, the minimum depth of embedment of the anchor bolt shall be in accordance with Table 569-1.

The Contractor may increase the embedment length beyond that shown on the Plans or specified in the above table provided 1) the increase is done at no additional cost to the State and 2) the hole stops at least 2 inches from the bottom of the structural slab.

<table>
<thead>
<tr>
<th>TABLE 569-1 MINIMUM EMBEDMENT AND REQUIRED TEST LOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal Anchor Bolt Diameter (inches)</strong></td>
</tr>
<tr>
<td><strong>Embedment Length (inches)</strong></td>
</tr>
<tr>
<td><strong>Test Load (kips)</strong></td>
</tr>
</tbody>
</table>

C. Grouting material shall be a non-metallic, non-shrink grout, or polymer resin. It shall contain no products which promote the corrosion of steel. When cured, the material shall exhibit a maximum loss of four percent (4%) when tested for freeze-thaw resistance. Freeze-thaw testing will be done in accordance with Materials Test Method 502-3P, except that the material will be subjected to 50 cycles of testing. Cured material shall not be reactive with salt water, portland cement, or petroleum products.

The contractor shall supply the Engineer with two copies of the grout manufacturer's certification that the material meets the foregoing requirements.

D. All anchor bolts shall be inserted at least the specified depth into the hole. After insertion of the bolt, all excess grout shall be struck-off flush with the concrete face. Should the grout fail to fill the hole, additional grout shall be added to the hole to allow a flush strike-off.

E. A portion of each lot of grouted-in anchor bolts shall be designated by the Engineer for load testing. The first lot shall consist of the first 10 grouted in anchor bolts. The remaining lots shall be defined by the Contractor subject to the following:

- The lot size shall not exceed 600 anchor bolts.
- A lot shall only include anchor bolts installed during a single construction season.
- A lot shall only include anchor bolts grouted with the same grout or resin.

Unless otherwise specified in the Contract Documents, the minimum load applied during the load testing shall be in accordance with Table 569-1.

Table 569-2 shows the lot size (column L), the initial number of anchor bolts selected for testing (column N1) and the number of anchor bolts selected for additional testing (column N2).

<table>
<thead>
<tr>
<th>TABLE 569-2 SAMPLING PLAN FOR ANCHOR BOLT PROOF LOAD TESTING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lot Size L</strong></td>
</tr>
<tr>
<td>1-30</td>
</tr>
<tr>
<td>31-50</td>
</tr>
<tr>
<td>51-75</td>
</tr>
</tbody>
</table>
NOTES:
1. If all of the N1 anchor bolts selected for testing pass the load test, then the lot shall be accepted.
2. If the lot size is 75 or less and one or more of the N1 anchor bolts fail the load test, then all the anchor bolts in the lot shall be tested.
3. If the lot size is 76 or greater and only 1 of the N1 anchor bolts fails the load test, the Engineer shall designate an additional N2 anchor bolts for testing. If none of the N2 anchor bolts fail the load test, the lot shall be accepted. If any of the N2 anchor bolts fails the load tests all of the anchor bolts in the lot shall be tested.
4. If the lot size is 76 or greater, and more than one of the N1 anchor bolts fail the load testing then all the anchor bolts in the lot shall be tested.

Anchor bolts shall be deemed to pass if the specified test load is attained without permanently displacing the anchor bolts. **THIS LOAD TESTING SHOULD BE NON-DESTRUCTIVE. LOADING SHOULD BE STOPPED AS SOON AS THE MINIMUM ACCEPTABLE PULL-OUT RESISTANCE IS ATTAINED.**

F. The testing equipment shall consist of a calibrated jack system, a frame to distribute the jack load, couplers to connect the jack to the anchor bolts, and safety devices. Prior to starting the testing, the Contractor shall supply the Engineer with a certificate of calibration for the jack less than 6 months old.

Supports for the frame used to distribute the jack load shall be located outside a circle centered at the anchor bolt and of a diameter equal to 2 inches plus twice the anchor bolt embedment length but need not exceed 2 feet. The frame and jack shall be positioned so that the load is applied along the centerline of the anchor bolt. Chains or cables shall be used to connect the various pieces of the tensioning system so that free projectiles will not be created by a failure of an anchor bolt anchorage, coupling or other portion of the tensioning system.

G. All anchor bolts which fail load testing shall be replaced and load tested in accordance with the foregoing requirements at no additional cost.

**569-3.08 Requirements for Method permitted under §569-3.06E2**

A. The requirements of §569-3.07A shall apply.
B. Grouting material shall meet the requirements of §701-05. It shall be mixed and placed in strict accordance with the grout manufacturer's instructions unless otherwise modified by the contract documents.
C. Both hole and bolt shall be clean and dry at the time of bolt insertion. The bolt shall be held in place such that it will remain vertical during subsequent grout placement. The method of bolt retention shall be such that the grout will be held within the hole until setting is complete.

Barrier units mechanically anchored to the underlying support by means of bolting shall be grouted into place in accordance with the following:
- Grout shall be prepared in accordance with the grout manufacturer's written instructions. Two copies of the manufacturer's instructions shall be delivered to the Engineer a minimum of two weeks prior to the beginning of barrier installation work.
- Grout shall be placed only if the ambient air temperature is at least 50°F and is predicted to rise. No grout shall be placed if the ambient air temperature falls below 45°F, unless external heat has been provided in the manner required by §555-3.08. The underlying support may be used as the floor of the enclosure if the Engineer approves.
- External heat shall be maintained for a minimum of seven curing days. A curing day is defined by §555-3.08A. After seven curing days have passed, or the grout has reached a minimum compressive
strength of 3000 psi, whichever occurs last, the enclosure may be removed. All work of providing external heat shall be done at no additional cost.

569-4 METHOD OF MEASUREMENT. The work will be measured as the number of feet of concrete traffic barrier installed. Measurement will be taken along the centerline of the top of the barrier. No deduction will be made for joints.

569-5 BASIS OF PAYMENT

A. The unit price bid per foot shall include the cost of all labor, materials and equipment necessary to complete the work. This price shall also include the cost of bar reinforcement, drilling, and testing.
B. In the case of barrier constructed by cast-in-place methods, 40% of the quantity will be paid for after all of the bar reinforcement has been placed and approved by the Engineer. This payment shall include the cost of chairs, supports, fastenings, connections and any splices not specifically indicated on the plans. If the Engineer permits the substitution of larger bars than those specified, or the DCES permits splices not indicated on the plans, the payment will not be increased nor will any extra compensation be considered.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
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<tbody>
<tr>
<td>569.01</td>
<td>Permanent Concrete Traffic Barrier for Structures (Full Section)</td>
<td>Foot</td>
</tr>
<tr>
<td>569.02</td>
<td>Permanent Concrete Traffic Barrier for Structures (Half Section)</td>
<td>Foot</td>
</tr>
<tr>
<td>569.03</td>
<td>Vertical Faced Concrete Parapet</td>
<td>Foot</td>
</tr>
<tr>
<td>569.04</td>
<td>Single Slope (Half-Section) Concrete Bridge Barrier</td>
<td>Foot</td>
</tr>
<tr>
<td>569.05</td>
<td>Single Slope (Full-Section) Concrete Bridge Barrier</td>
<td>Foot</td>
</tr>
<tr>
<td>569.06</td>
<td>F-Shaped (Half-Section) Concrete Bridge Barrier</td>
<td>Foot</td>
</tr>
<tr>
<td>569.07</td>
<td>F-Shaped (Full-Section) Concrete Bridge Barrier</td>
<td>Foot</td>
</tr>
<tr>
<td>569.08</td>
<td>Texas Aesthetic Concrete Bridge Barrier</td>
<td>Foot</td>
</tr>
</tbody>
</table>

SECTION 570 - PAINT REMOVAL OPERATIONS

570-1 DESCRIPTION. This work shall consist of providing environmental protection and developing and implementing a worker Lead Health Safety program during paint removal operations.

Whenever a structure spans over a railroad, covers shall be placed and maintained in accordance with §105-09 Work Affecting Railroads. Structures that span a navigable waterway may be subject to regulation by various agencies.

570-1.01 Lead-Exposure Control Plan (LECP). This work shall consist of the development and implementation of a Lead Exposure Control Plan to protect workers from the harmful effects of lead exposure in accordance with 29 CFR Subpart D. Work activities which may expose workers to health hazards include, but are not limited to abrasive blasting, paint removal, torch-cutting, welding, grinding, and rivet busting.

570-1.02 Medical Testing. This work shall consist of medical testing to monitor the safety of workers with lead exposures.

570-1.03 Personal-Exposure-Monitoring Sample Analysis. This work shall consist of monitoring the exposure levels of workers to define the hazard and/or to verify the effectiveness of control measures.
570-1.04 **Decontamination Facilities.** This work shall consist of installation, operation, maintenance, and cleaning of decontamination facilities for personnel with lead exposures.

570-1.05 **Environmental Ground Protection.** This work shall consist of the collection and removal of waste materials, including old paint chips, corrosion residues, spent abrasives, and newly applied paint that result from cleaning and painting operations as specified in the contract documents or as directed by the Engineer.

570-1.06 **Environmental Water Protection.** This work shall consist of the collection and removal of waste materials, including paint chips, corrosion residues, spent abrasives and newly applied paint that result from cleaning and painting operations as specified in the contract documents or as directed by the Engineer.

570-1.07 **Class B Containment.** This work shall consist of furnishing, installing, and removing a containment enclosure around the work area used to contain and collect debris generated during paint removal and surface preparation using vacuum shrouded power tools, vacuum blasters, and hand tools. Open abrasive blasting shall not be conducted in a Class B containment.

570-1.08 **Class A Containment.** This work shall consist of furnishing, installing, and removing a total containment enclosure around the immediate work area to contain and collect debris generated during paint removal and surface preparation operations as specified in the contract documents or as directed by the Engineer.

570-2 **MATERIALS.** A high-efficiency particulate air (HEPA) filter shall be defined as a filter that is at least 99.97% efficient against particles that are 0.3µm in diameter.

570-3 **CONSTRUCTION DETAILS**

570-3.01 **Lead-Exposure Control Plan (LECP).** At least 20 calendar days prior to starting any work which could entail employee exposure to lead, the Contractor shall submit two copies of a written Lead-Exposure Control Plan (LECP) to the Engineer for review and acceptance. This LECP shall address all of the elements required by 29 CFR Subpart D and shall be coordinated with, and need not be repeated in, the site-specific Health and Safety Plan. The Contractor shall not begin any work which could entail lead exposure until the LECP has been accepted by the Engineer.

Submission of the LECP and its acceptance by the Engineer shall not be construed to imply approval of any particular method for addressing lead health and safety concerns, or to relieve the Contractor of the responsibility for adequately protecting the health and safety of all workers.

A competent person shall have current training as SSPC C-3, Competent Person Training for Deleading of Industrial Structures, or the SSPC C-5 refresher training class.

**A. Industrial Hygienist.** Where required, the Contractor shall engage an Industrial Hygienist (IH) meeting one or more of the following qualifications:

- Current certification by the American Board of Industrial Hygiene.
- A Bachelor's Degree in engineering, chemistry, physics, biological sciences, industrial hygiene, toxicology, the environmental sciences or a related field, and at least three years of documented full-time work as an IH, including field and sampling experience.
- A Master's Degree in one of the above fields, and at least two years of documented full-time work as an IH, including field and sampling experience.

The IH shall have the following responsibilities:
• Development of a written LECP, LECP updates, and preparation of monthly summary reports.
• Provide general oversight of all aspects of the LECP.
• Review all employee medical tests and exposure monitoring results. If required, take corrective actions.
• Intervention by the IH, consisting of an on-site investigation by the IH, implementation of corrective action, and notification of the Engineer in the next monthly report if either of the following conditions are encountered:
• Blood Lead Level (BLL) > 40 µg/dL (micrograms/deciliter) for one or more workers.
• BLL increase of 10 µg/dL or more between successive tests for any individual worker.
• Inspect the work site at least monthly during work which produces a potential lead exposure, except where the Contractor documents that employee lead exposure will be below the Permissible Exposure Limit (PEL).

B. Exposure Below the Action Level. If the Contractor can document by air monitoring or the use of appropriate historical data that lead exposure for all employees will be below the Action Level (10 µg/m$^3$), then the Contractor shall develop a written LECP including, but not limited to the following:

• A description of the Contractor's lead health and safety organization, including the responsibilities and qualifications of the competent person, and the project Health and Safety Officer.
• A description of OSHA required lead training provided to both supervisors and workers.
• A description of each activity which will entail a risk for lead exposure.
• An initial assessment of anticipated exposure level(s), including any relevant historical exposure monitoring data.
• A description of arrangements for ensuring that Subcontractors will comply with the LECP.
• Plans for updating the LECP.
• Plans for keeping and maintaining records.
• Exposure monitoring.

C. Exposure Above the Action Level and Below the Permissible Exposure Limit. If the Contractor can document by air monitoring or the use of appropriate historical data that the highest employee lead exposure will be above the Action Level (30 µg/m$^3$), but below the Permissible Exposure Limit (50 µg/m$^3$), then the Contractor shall develop a written LECP under the direction of an IH, with day-to-day supervision by the competent person, including, but not limited to, the items listed under paragraph B above and the following:

• Medical surveillance and removal program.
• Notifying employees and the Engineer of the results of exposure monitoring and medical tests.
• Worker and supervisor training.
• Monthly summary reports.
• Plans for worker and supervisor lead training.
• Plans for performing exposure monitoring and for notifying employees and the Engineer of results.
• A description of the Contractor's medical surveillance and removal program, including plans for notifying employees and the Engineer of results. This description shall include the names and addresses of the clinic(s) where testing will be performed and of the OSHA-approved laboratory where blood samples will be analyzed.
D. Exposure At or Above the Permissible Exposure Limit. When the highest employee lead exposure will be above the Permissible Exposure Limit (50 µg/m³), the Contractor shall develop a written LECP under the direction of an IH, with day-to-day supervision by the competent person. The LECP shall include, but not be limited to, the items listed under paragraphs B and C above and the following:

- A description of the engineering, administrative, and work practice controls which will be used to reduce exposure. All feasible engineering, administrative, and work practice controls shall be implemented before considering the use of respirators to reduce exposure.
- Decontamination facilities to be provided including a description and floor plan, a description of any hand-wash stations to be provided, and a description of mandatory hygiene practices which employees will be required to follow.
- A description of a Respirator Program including respirator-fit testing and respirator training.
- A description of Provision of Personal Protective Equipment (PPE), including required cleaning and/or replacement.
- Plans for posting and maintenance of warning signs in high-exposure areas.
- Schedule of periodic work site inspections by the IH and the competent person.

E. Monthly Summary Reports. Except where the Contractor can document that employee lead exposure will be below the Action Level, for each month of work which entails potential lead exposure, the Contractor shall submit a monthly summary report to the Engineer which has been reviewed and signed by the IH not later than the 15th of the following month. This report shall contain the following elements:

1. A summary of the work producing potential lead exposure completed in the past month.
2. A description of any interventions or deficiencies noted, and a summary of corrective actions.
3. A summary of exposure monitoring or medical testing results which were completed in the past month. To protect worker privacy, these results shall not include individual names; instead, workers shall be identified by trade and with an individual control number (not Social Security Number) to allow tracking of their exposure.
4. A certification that, with the exception of any deficiencies noted, the past month's work has been in compliance with the requirements of 29 CFR 1926.62 and this specification.

570-3.02 Medical Testing. The Contractor shall arrange for employees to receive all required medical tests. All medical tests shall be completed by, or under the supervision of, a licensed physician. Blood sampling and analysis shall meet the accuracy requirements of 29 CFR Subpart D and shall be conducted by an OSHA-approved laboratory. The Contractor shall provide the Engineer a summary of medical testing results which were completed in the past month prior to a request for payment. The Contractor shall provide documentation of any medical removals, a description of what triggered them, and the corrective measures taken. The Contractor shall provide an exit medical exam consisting of blood sampling and analysis for lead and zinc protoporphyrin (ZPP) levels for all workers who were potentially exposed within 5 work days of the time a worker completes or is removed from all work which entails a potential for lead exposure. Exit exams shall also be offered within 5 work days of seasonal shutdown or for other periods exceeding 30 calendar days in which no work involving potential lead exposure is scheduled or anticipated. The results of all medical tests shall be provided to affected workers within 5 work days of receipt, and to the Engineer in the next monthly report.

For employees who are offered an exam but choose not to participate or fail to respond, the Contractor shall provide a written declination signed by the worker or, for workers who are no longer on the payroll, a registered letter to the worker's last known address.
570-3.03 **Personal-Exposure-Monitoring Sample Analysis.** The Contractor shall conduct exposure monitoring. Exposure monitoring samples shall be obtained by the IH, a competent person under the direction of the IH, or other qualified persons as specified in the LECP. Exposure monitoring samples shall be analyzed by a laboratory selected by the Contractor, using a method which meets the accuracy requirements of 29 CFR Subpart D. The Contractor shall provide the Engineer a summary of exposure monitoring sample test results which were completed in the past month prior to a request for payment.

570-3.04 **Decontamination Facilities.** Except where the Contractor can document that employee lead exposure will be below the PEL, a minimum of one climate-controlled decontamination facility shall be provided, and shall be utilized by all workers with potential lead exposure. The number of facilities to be provided will be dictated by site conditions and by the Contractor's sequence of operations and shall be approved by the IH and the Engineer.

Each facility shall consist of a "clean" area where workers can remove and store their street clothing when they arrive on site; a shower room with hot and cold running water, soap and clean towels; and a "dirty" area where workers can remove and store their work clothing and PPE at the end of their work shift. The "clean" area and the "dirty" area shall each have a separate entrance. Decontamination facilities shall be cleaned as required, or at least once every week of use. All waste water generated from showers or as a result of cleaning operations shall either be tested and filtered through a 5 µm filter or considered as lead contaminated, and disposed of in accordance with State and Federal regulations.

570-3.05 **Environmental Ground Protection.**

**A. General.** Covers shall be provided on or over the ground under all structures that are to be cleaned and painted. Depositing or dropping waste materials into water and onto the ground or roadways outside the specified collection areas is not permitted.

The length of the cover shall be 10 feet longer on each end than the length of the work area, and the width shall be at least 10 feet wider on each side of the work area. The cover shall be positioned in such a manner as to contain and prevent the loss of waste materials.

Environmental Ground Protection shall consist of covers or other material capable of catching and holding waste materials on or over the ground under the structure in the work area. A bridge deck or a highway pavement and paved shoulder under a structure from which wastes may be collected and removed by vacuuming may be used in place of a cover providing that within that area such usage is confined to lanes and shoulders closed to traffic.

Covers on or over roadways or railroads or sidewalks or other similar areas shall not present a hazard of any kind and no cover shall remain in place overnight unless otherwise authorized by the Engineer.

**B. Containment Operations.** Cleaning or painting operations shall not be performed when the direction or velocity of prevailing winds causes waste materials to fall outside the collection area. If wind or other factors prevent collection, the Contractor may, with the approval of the Engineer, use drapes or other means to prevent drift beyond all specified collection areas.

**C. Waste Collection.** All waste materials shall be removed from the ground protection by vacuuming. Sweeping, shoveling, or other mechanical means to remove the waste materials from the ground protection is not permitted. Air exhausted from vacuuming equipment shall pass through a HEPA filtering system.

All waste materials that collect on a bridge deck, or on a highway pavement and paved shoulder under a structure or on covers shall be removed at least once a day or more frequently if directed by the Engineer. No waste material shall remain on the bridge deck, pavement, pier, pedestals, abutments, or containment covers overnight.
570-3.06 Environmental Waterway Protection.

A. General. Covers shall be provided under all structures that span bodies of water, waterways, and stream beds, and that are to be cleaned and painted in the field. Depositing or dropping waste materials into water and onto the ground or roadways outside the specified collection areas is not permitted.

A cover shall be suspended from the structure and shall, as measured over the water, be at least 10 feet greater in length and at least 10 feet wider than each side of the area on which work is underway. The cover shall be positioned in a manner so as to collect and prevent the loss of waste materials. The cover shall not remain in place overnight if it presents a hazard of any kind.

If floating waste materials form on the water surface, they shall be contained from moving upstream or downstream. Floating waste material shall be collected daily, or more frequently. Straw or screening used in the fabrication of water booms shall be replaced with clean material weekly or as otherwise directed by the Engineer.

B. Containment Operations. Cleaning or painting operations shall not be performed when the direction or velocity of prevailing winds causes waste materials to fall outside the collection area. If wind or other factors prevent collection the Contractor may, with the approval of the Engineer, use drapes or other means to prevent drift beyond all specified collection areas.

C. Waste Collection. All waste materials shall be removed from the waterway protection by vacuuming. Sweeping, shoveling, or other mechanical means to remove the waste materials from the waterway protection is not permitted. Air exhausted from vacuuming equipment shall pass through a HEPA filtering system.

All waste materials that collect on a bridge deck, or on a highway pavement and paved shoulder under a structure or on covers shall be removed at least once a day or more frequently if directed by the Engineer. No waste material shall remain on the bridge deck, pavement, pier, pedestals, abutments, or containment covers overnight.

570-3.07 Class B Containment.

A. General. The containment system includes the cover panels, screens, tarps, scaffolds, supports, and shrouds used to enclose an entire work area. The purpose of the containment is to prevent debris generated during surface preparation from entering the environment and to facilitate the controlled collection of the debris for disposal.

The containment shall meet the requirements of SSPC-Guide 6, Class 2P. The containment may have either air penetrable or impenetrable walls, rigid or flexible framing, shall have fully sealed joints, and shall have overlapping entry ways. Flexible covers for flooring shall be impermeable and will be allowed only if the ground or paved surfaces are smooth enough to vacuum debris. If a smooth surface is not available, rigid materials shall be used for the floor of the enclosure.

B. Containment Operations. All cleaning and paint removal work and all work associated with the collection of paint waste debris, including the subsequent air blow-down or vacuuming of debris from the steel surfaces on the structure in preparation for painting, shall be performed inside the containment enclosure.

The Contractor shall make every attempt to limit workers from entering or exiting the containment enclosure when paint removal operations are being performed.

C. Waste Collection. Following paint removal work, all steel surfaces inside containment shall be vacuumed of debris. All waste material that results from paint removal operations shall be cleaned up and collected from the floor, walls, and other surfaces inside of the containment enclosure by
vacuuming. Sweeping, shoveling, or other mechanical means to remove the waste materials will not be allowed. Cleanup operations shall be performed daily, prior to inspection, before new paint is applied or before a prolonged work stoppage, such as for weather interruptions.

Prior to disassembly or moving of the containment enclosure, the inside surfaces of the enclosure shall be cleaned of dust and other spent material by vacuuming. The Contractor shall take all measures necessary to prevent the release of waste material during moving or removal of the containment.

All vacuum equipment that is used for collection and clean up work shall be equipped with HEPA filters. All used filters from dust collectors, vacuums, and straw and screening from dam devices, shall be disposed of in accordance with all applicable local, State, and Federal Laws, regulations, and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.

D. Ventilation. Ventilation inside the enclosure is not specifically required and may be by natural means. It may be necessary to provide mechanical ventilation to meet OSHA requirements for worker exposure to lead and other provisions. If mechanical ventilation is provided to address these requirements, filtration of exit air is not required.

E. Lighting. Light intensity by natural or artificial means inside the containment enclosure shall be maintained at a minimum of 50 foot-candles on the steel surface. During inspection activities, light shall be maintained at a minimum of 100 foot-candles. Auxiliary lighting shall be provided as necessary. The Contractor shall provide the Engineer with one portable light meter with a scale of 0 to 100 foot-candles. This meter will be returned to the Contractor at the completion of work. All lighting used in the containment shall be explosion-proof.

F. Containment Performance. The effectiveness of the containment enclosure shall be determined by visual inspection for dust plumes or other visible evidence of emissions materials into the environment. Throughout the duration of work there shall be no visible discharges. If there is a visible discharge the Contractor shall immediately stop work and perform necessary repairs to the containment enclosure or modifications to cleaning operations to the Engineer's satisfaction.

The Engineer may direct the Contractor to stop all work activities and immediately clean up all waste materials within the enclosure when threatening weather conditions exist or are predicted. This measure may be exercised when an apparent threat exists that could cause the release of waste material to the surrounding environment, such as high winds or heavy rain.

If the wind velocity causes the containment enclosure to billow, or to emit dust, or to otherwise be a hazard in the opinion of the Engineer, the Contractor shall immediately cease work and clean up all the debris. Under severe conditions the Contractor shall disassemble the containment enclosure.

G. Releases From the Containment. For structures that are located over or adjacent to water, if floating waste materials form on the water surface, they shall be contained from moving upstream or downstream by the use of floating water booms. Floating waste material shall be collected daily, or more frequently.

Any waste material that is released outside the containment enclosure shall be immediately cleaned up using vacuums. Care shall be taken on pavement and other surfaces to collect all waste material so as to prevent it from being redistributed into the air and environment by traffic or other means.

All used filters from dust collectors, vacuums, and straw and screening from dam devices, shall be disposed of in accordance with all applicable Local, State, and Federal Laws, regulations and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.
**570-3.08 Class A Containment.** Fifteen (15) days prior to the start of any abrasive-blast cleaning or paint removal work, the Contractor shall submit for approval detailed working drawing(s) of the Class A containment system that is to be supplied for each structure. The drawings shall be prepared and stamped by a Professional Engineer. Six (6) complete copies of the working drawings shall be submitted for approval.

The working drawings shall detail the proposed containment enclosure and include the following information at a minimum:

- Plan and elevation of the containment enclosure in relation to the structure.
- The type of solid or rigid floor and working platform with appropriate safety and fall protection measures. A description of worker access to the enclosure and the procedures and equipment that will be used to provide fall-protection. If a barge or another type of floating platform is used, include details regarding its construction, such as materials and dimensions, how the platform will be tied-off, how the debris will be collected and off-loaded, etc.
- A description of how the existing drainage will be routed through the enclosure.
- A description of the type of material(s) for the containment walls, floor, and ceiling.
- The type of support structure that will be used for the floor, walls, and ceiling, including the attachment of the enclosure materials to the support structure.
- The method by which the enclosure will be supported or attached to the bridge, i.e., rollers, clamps. Welding, bolting, or similar connections will not be allowed.
- The method that will be used to seal the joints (seams) formed when fabricating the containment enclosure, and the method that will be used to seal the mating joints between the containment enclosure and the bridge structure.
- The method that will be used to seal the entryway. At a minimum, the use of multiple overlapping door tarps shall be provided to minimize dust escape through the entryway.
- The ventilation system including open-air make-up points, dust collector and exhaust fan(s), location, type of equipment, manufacturer's data sheets, and airflow capacities.
- The type, size, and configuration of auxiliary lighting provided inside the containment enclosure. All lighting must be explosion proof.
- A design analysis of the loads on the structure due to the containment enclosure including: maximum dead and live loads of the enclosure, the workers, blast abrasive, and equipment; maximum allowable load for the floor and working platform; wind loads imposed on the structure by the enclosure; and maximum wind velocity that the containment enclosure is designed to withstand.
- If the containment system is supported by the structure, the working drawing submittal shall include certification by the Professional Engineer that the loads imposed do not cause the overall stress level of any element of the bridge to exceed the Operating Rating Allowable Stresses defined in AASHTO Manual for Maintenance Inspection of Bridges.
- The analysis shall account for all loads on the structure, including the enclosure dead load, worker live load, blast-abrasive load, equipment load, wind load, structure dead load, and highway live load using H20 loading unless other-wise specified plus impact. The highway live load used for analysis purposes shall be either an HS20 truck or equivalent lane loading, whichever is greater, unless a different highway live load is shown in the contract documents. Except as noted, the analysis shall use the loadings and design assumptions in the NYSDOT Standard Specifications for Highway Bridges.
- Details on how the enclosure is assembled, disassembled and moved to a new location on the structure as surface preparation work progresses. Indicate how the dust collector will be included in the containment enclosure. All other pertinent details relating to the containment enclosure shall be included with the working drawings as notes or as written narrative.
Details on how the use of the enclosure will be coordinated with the Work Zone Traffic Control. Encroachments onto roadways and clearances over waterways and railroads shall be clearly identified.

**A. General.** The containment system includes the cover panels, screens, tarps, scaffolds, supports, and shrouds used to enclose an entire work area. The purpose of the containment is to prevent all debris generated during surface preparation from entering the environment and to facilitate the controlled collection of the debris for disposal.

The containment shall meet the requirements of SSPC-Guide 6, Class 1A. The containment shall have air impenetrable-walls, rigid or flexible framing, fully sealed joints, and resealable entry ways. Negative air shall be achieved by forced air flow. Exhaust air shall be filtered.

Flexible covers for flooring shall be impermeable and will be allowed only if the ground or paved surfaces are smooth enough to vacuum debris. If a smooth surface is not available, rigid materials shall be used for the floor of the enclosure.

**B. Containment Operations.** All abrasive-blast cleaning and paint removal work, and all work associated with the collection of paint waste debris, including the subsequent air blow-down or vacuuming of debris from the steel surfaces on the structure in preparation for painting and inspection, shall be performed inside the containment enclosure.

The Contractor shall attempt to limit workers from entering or exiting the containment enclosure when blast cleaning and paint removal operations are being performed.

**C. Waste Collection.** All waste material that results from abrasive blasting and paint removal operations shall be cleaned up and collected from the floor, walls, and other surfaces inside of the containment enclosure by vacuuming. Sweeping, shoveling, or other mechanical means to remove the waste materials will not be allowed unless the containment is intact and the vacuuming system is operating. Clean up operations shall be performed daily, prior to inspection, before new paint is applied or before a prolonged work stoppage, such as for weather interruptions.

Prior to disassembly or moving of the paint enclosure, the inside surfaces of the enclosure (walls, floors, ceiling, etc.) shall be cleaned of dust and other spent material by vacuuming. The Contractor shall take all measures necessary to prevent the release of waste material during moving or removal of the containment.

All vacuum equipment that is used for collection and cleanup work shall be equipped with HEPA filters. All used filters from dust collectors, vacuums, and straw and screening from damp devices, shall be disposed of in accordance with all applicable local, State, and Federal Laws, regulations, and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.

**D. Ventilation.** The size of the exhaust-fan system supplied shall be designed to produce an average minimum cross-draft air velocity or an average minimum downdraft air velocity inside the containment enclosure. For enclosures designed with horizontal air flow, the exhaust fan shall have the capacity to produce an average minimum cross-draft velocity of 100 fpm, based on theoretical calculations. For enclosures designed with vertical air flow, the exhaust fan shall have the capacity to produce an average minimum downdraft velocity of 50 fpm, based on theoretical calculations. Forced exhaust air shall flow into dust collectors. The dust collectors shall be used and appropriately sized for the type, size of particulate matter, volume, and velocity of air moved through the containment. All air exhausted from the containment enclosure shall pass through the dust collection system.

Proper operation of the ventilation system shall be maintained after each assembly of the containment and during all phases of work.
E. Lighting. Light intensity by natural or artificial means inside the containment enclosure shall be maintained at a minimum of 50 foot-candles on the steel surface. During inspection activities, light shall be maintained at a minimum of 100 foot-candles. Auxiliary lighting shall be provided as necessary. The Contractor shall provide the Engineer with one portable light meter with a scale of 0 to 100 foot-candles. This meter will be returned to the Contractor at the completion of work. All lighting used in the containment shall be explosion-proof.

F. Containment Performance. NYSDOT will perform air quality monitoring (AQM) for ambient particulate and lead during abrasive blasting/cleanup. Real-time AQM will be used for all Class A containments. High-volume AQM may be used in addition to real-time AQM. The effectiveness of the containment and accessory equipment in preventing unacceptable levels of particulate and lead emissions will be assessed based on established AQM criteria for both the real-time and high-volume monitoring. Throughout the duration of work, there shall be no visible discharges. If the Engineer observes a visible discharge, the Contractor shall immediately stop work and perform necessary repairs to the containment enclosure or modifications to blast cleaning operations to the Engineer’s satisfaction.

The Engineer may direct the Contractor to stop all work activities and require the Contractor to immediately clean up all waste materials within the enclosure when severe weather conditions exist or are predicted. This measure may be exercised when an apparent threat exists that could cause the release of waste material to the surrounding environment, such as high winds or heavy rain.

If the wind velocity causes the containment enclosure to billow or to emit dust, or to otherwise be a hazard in the opinion of the Engineer, the Contractor shall immediately cease work and cleanup all the debris. If severe conditions are predicted, the Contractor shall disassemble the containment enclosure.

G. Releases From the Containment. For structures that are located over or adjacent to water, if floating waste materials form on the water surface, they shall be contained from moving upstream or downstream by the use of floating water booms. Floating waste material shall be collected daily, or more frequently.

Any waste material that is released outside the containment enclosure shall be immediately cleaned up using vacuums. Care shall be taken on pavement and other surfaces to collect all waste material so as to prevent it from being redistributed into the air and environment by traffic or other means.

All used filters from dust collectors, vacuums, and straw and screening from dam devices, shall be disposed of in accordance with all applicable Local, State, and Federal Laws, regulations and codes. The cost for disposing of these materials shall be included in the lump sum price bid for this item.

570-4 METHOD OF MEASUREMENT.

570-4.01 Lead-Exposure Control Plan (LECP). The work under the Lead Exposure Control Plan will be measured for payment on a lump sum basis.

570-4.02 Medical Testing. The work under medical testing will be measured for payment on a dollars-cents basis.

The amount shown in the itemized proposal for this work will be considered the price bid even though payment will be made for actual work performed. This amount is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded, and the original price will be used to determine the total amount bid.
570-4.03 Personal-Exposure-Monitoring Sample Analysis. The work under the personal exposure monitoring sample analysis will be measured for payment on a dollars-cents basis.

The amount shown in the itemized proposal for this work will be considered the price bid even though payment will be made for actual work performed. This amount is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded, and the original price will be used to determine the total amount bid.

570-4.04 Decontamination Facilities. The quantity to be measured for payment will be in calendar weeks.

570-4.05 Environmental Ground Protection. This work will be measured for payment on a lump sum basis.

570-4.06 Environmental Water Protection. This work will be measured for payment on a lump sum basis.

570-4.07 Class B Containment. This work will be measured for payment on a lump sum basis.

570-4.08 Class A Containment. This work will be measured for payment on a lump sum basis.

570-5 BASIS OF PAYMENT.

570-5.01 Lead-Exposure Control Plan (LECP). The lump sum price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

570-5.02 Medical Testing. Payment shall include all reasonable and customary costs incurred (based on receipted bills submitted to the Engineer, plus 5% overhead and profit).

No payments shall be made for additional medical tests or laboratory analyses required due to an increase in the blood lead level of any employee above the OSHA threshold.

570-5.03 Personal-Exposure-Monitoring Sample Analysis. Payment shall include all reasonable and customary costs incurred (based on receipted bills submitted to the Engineer, plus 5% overhead and profit), for laboratory analysis of exposure monitoring samples.

570-5.04 Decontamination Facilities. The unit price bid per week for each facility shall include the cost of all labor, materials, equipment, utility, and disposal charges necessary to satisfactorily complete the work.

570-5.05 Environmental Ground Protection. The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

570-5.06 Environmental Water Protection. The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

570-5.07 Class B Containment. The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

Progress payments will be made based upon the amount of work completed using a daily rate of payment determined from the estimate of work days of cleaning and painting shown in the Contractor’s approved progress schedule and the lump sum price bid.
Should the Engineer request a revised progress schedule and use that schedule to establish a new daily rate, the lump sum price bid shall be reduced by the total of the amounts previously authorized for payment, prior to the establishment of the new daily rate.

570-5.08 Class A Containment. The lump sum price bid shall include the cost of all labor, materials and equipment necessary to complete the work.

Progress payments will be made based upon the amount of work completed using a daily rate of payment determined from the estimate of work days of cleaning and painting shown in the Contractor’s approved progress schedule and the lump sum price bid.

Should the Engineer request a revised progress schedule and use that schedule to establish a new daily rate, the lump sum price bid shall be reduced by the total of the amounts previously authorized for payment, prior to the establishment of the new daily rate.

No payment will be made for each calendar day during which there are substantial deficiencies. Substantial deficiencies are defined as: (1) The second occurrence of a visible emission for a cause which has been previously identified and corrected, or (2) air quality monitoring produces unacceptable results as defined in the Department’s Air Quality Monitoring (AQM) Protocols.

The nonpayment will be calculated as follows:

\[
\text{Payment to Contractor} = \left( \frac{\text{Lump Sum Price Bid}}{\text{Actual # of Work Days}} \right) \times \# \text{ of Days with Substantial Deficiencies}
\]

In addition to the non payment for substantial deficiencies, the costs of any extension of the Air Quality Monitoring beyond the basic monitoring program or random audits defined in the AQM Protocol, which are necessitated by unacceptable AQM results, will also be charged to the Contractor.

Both of these amounts will be deducted from monies due to the Contractor.

### Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>570.01</td>
<td>Lead-Exposure Control Plan</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>570.02</td>
<td>Medical Testing</td>
<td>Dollars-Cents</td>
</tr>
<tr>
<td>570.03</td>
<td>Personal-Exposure-Monitoring Sample Analysis</td>
<td>Dollars-Cents</td>
</tr>
<tr>
<td>570.04</td>
<td>Decontamination Facilities</td>
<td>Calendar Week</td>
</tr>
<tr>
<td>570.09nnnn</td>
<td>Environmental Ground Protection</td>
<td>Lump Sum (each structure)</td>
</tr>
<tr>
<td>570.10nnnn</td>
<td>Environmental Waterway Protection</td>
<td>Lump Sum (each structure)</td>
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<tr>
<td>570.15nnnn</td>
<td>Class A Containment</td>
<td>Lump Sum (each structure)</td>
</tr>
<tr>
<td>570.16nnnn</td>
<td>Class B Containment</td>
<td>Lump Sum (each structure)</td>
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</tbody>
</table>

**NOTE:** nnnn denotes serialized pay item.

SECTION 571 - DISPOSAL OF PAINT REMOVAL WASTE

(Last Revised January 2019)

571-1 DESCRIPTION. The work shall consist of managing, accumulating, packaging, labeling, loading, transporting, treating, and disposing paint removal waste.

571-1.01 Paint Removal Waste. Paint removal waste consists of removed paint particles combined with material used to remove the paint and any organic or inorganic materials from bridge surfaces, by either bridge washing or blast cleaning operations, without use of any added chemical solvents. All testing of the paint removal waste necessary to satisfy the requirements of the waste transporter or disposal facility shall be the responsibility of the contractor.

Paint removal waste does not include used tyvek suits, respirator filters, tarpaulins or incidental trash. These incidental wastes generated by the Contractor in completing the work are covered by §107-10 Managing Surplus Material and Waste.
A. **Hazardous Paint Removal Waste Containing Lead.** This shall apply to spent abrasives, coatings and paint chips removed from steel substrates on bridges designated in the contract documents as being lead-based. This does not include waste containing a mixture of lead and asbestos. Waste containing a mixture of lead and asbestos shall be disposed of in accordance with Section 210 *Removal and Disposal of Asbestos-Containing Material (Buildings, Bridges and Highways).*

B. **Non-Hazardous Industrial Solid Paint Removal Waste.** This shall apply to spent abrasives and coatings removed from steel substrates on bridges designated in the contract plans as being non-lead-based.

571-2 MATERIALS. The Contractor shall use containers or roll-offs acceptable to the Waste Disposal Facility. The capacity of each container shall be clearly marked on each container in an easily visible location.

571-3 CONSTRUCTION DETAILS.

571-3.01 General. The Engineer will provide the Contractor with the Generator site identification number(s) issued by the USEPA. All paint removal waste shall be deposited and sealed in containers or roll-offs concurrent with generation. The paint removal waste shall be accumulated in clean, dry, weatherproof, watertight containers or roll-offs furnished by the Contractor and shall not be left exposed to the elements at the end of the working shift. All equipment and containers or roll-offs shall meet the requirements of USDOT for transport.

Paint removal waste shall be accumulated, handled, packaged, documented, loaded, transported, treated and disposed in accordance with all applicable Federal and State laws, rules, and regulations.

571-3.02 Paint Removal Waste Composition.

A. **Hazardous Paint Removal Waste Containing Lead.** Paint chips are known to contain lead and the combined paint removal waste stream is therefore categorized as hazardous waste. The Department has presumed that the waste will test as hazardous. The Contractor shall ensure that only solid paint removal waste is deposited into the containers or roll-offs. The determination has been made that such waste contains less than 2% by weight of organic material. Disposal facilities may refuse to accept paint removal waste that is different than the Typical Paint Waste Composition. Paint removal waste containing additional contaminants added by the Contractor or by the Contractor’s operations shall be the responsibility of the Contractor. All testing of the paint removal waste necessary to satisfy the requirements of the chosen Disposal Facility or Transporter shall be the responsibility of the Contractor.

Provided is typical lead-based paint waste information which provides typical chemical and physical properties of paint removal waste based on previous testing, as follows:

**Lead-Based Paint Waste Profile:** Lead-based paint waste generated by the removal of paint consists of a mixture of abrasive blast media such as boiler slag or steel grit and paint chips. This supplemental information about the waste is provided in accordance with Resource Conservations and Recovery Act (RCRA) regulations. This composition profile does not include waste resulting from removal by chemical strippers for which the resulting waste will contain components of the stripper. Based on the knowledge of the process and the resulting waste material, and on previous testing of typical waste by independent laboratories approved by the NYS Department of health, this composition waste material information has been developed for typical lead-based paint waste.
**Process Generating Waste:** The waste results from removal of lead-based coatings from painted structures, typically steel bridges, by abrasive blasting, manual, shrouded mechanical, or high-pressure (hp) water methods. The North American industry Classification System Code (NAICS) typically assigned for the site is 23731-Highway, Street, and Bridge Construction.

**Composition:** To the Department’s knowledge, the waste does not contain PCBs, pesticides, cyanides, organic TCLP constituents, dioxins, asbestos, ozone depleting substances, volatile organics or greater than 1000 ppm halogenated organic compounds. The waste is not a RCRA reactive, corrosive or ignitable, or source-listed or chemical product-listed waste. It is not radiological, etiological, explosive, water reactive, or shock sensitive. The specific composition will vary based on the removal method used, abrasive used, the proportion of paint chips to abrasives and other variables determined by the Contractor’s operation. For wastes resulting from any chemical stripping of paint, the Contractor shall consider the components and properties of the stripper and the resulting waste mixture to characterize the waste.

**The waste typically contains the following:**

<table>
<thead>
<tr>
<th>Removal Method</th>
<th>Approximate %</th>
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<tbody>
<tr>
<td>Boiler Slag (an amorphous mixture of Fe, Al and Ca silicates)</td>
<td>90-95% Abrasive, 5-10% Paint Chips</td>
</tr>
<tr>
<td>Steel Grit (% varies by degree of grit recycling)</td>
<td>40-90% Abrasive, 10-60% Paint Chips</td>
</tr>
<tr>
<td>No Abrasive (manual, shrouded mechanical and water methods)</td>
<td>0% Abrasive, 100% Paint Chips</td>
</tr>
</tbody>
</table>

**Paint Chips:** Paint chips contain basic lead silico chromate, titanium dioxide, chromate dioxide, magnesium silicate, linseed oil, alkyd resin, fillers, driers, and other miscellaneous materials.

**Other Components:** Water may be present from water used during removal. Iron oxide (rust, mill scale) may be present. Animal waste (i.e., feces, guano, nesting materials, etc.) and dirt/miscellaneous debris may also be potentially present.

**RCRA Metals:** The waste is presumed to contain lead at levels exceeding the regulatory limit of 5 milligrams per liter (approximately 5 ppm) by the Toxicity Characteristic Leaching Procedure (TCLP) test for lead (unless contract documents provided for testing to determine lead toxicity characteristic). Chromium is considered present as an underlying characteristic.

**Typical Physical Characteristics:**
- Physical State – Solid
  - Color – Black for boiler slag component, or metallic grey/black for steel grit component.
  - Color varies for paint chips.
- Odor – None
- pH – Not Applicable
- Liquid Flash Point – Not Applicable
- Specific Gravity – Approximately 2.7 (boiler slag) and Approximately 7.5 (steel grit)
- Bulk Density – Approximately 1.2 kg/l (boiler slag)
  - Approximately 3.6 kg/l (steel grit)
- Free Liquids – None (moisture may be present from water added during removal)

**Consolidated Hazardous Waste Information:** The following consolidated information for hazardous lead-based paint waste can be used in completing the required items needed for its proper shipment and disposal:

- USDOT Shipping Description – RQ Hazardous Waste, Solid, n.o.s. (D008); 9; NA3077; PG III
n.o.s. = Not Otherwise Specified, PG = Packing Group

- Hazard Label on containers – Class 9
- Placard for shipments exceeding 455 kg or bulk – Class 9
- Hazardous Waste due to the Characteristic Lead Toxicity, Waste Code D008
- Constituents of Concern – Lead and Chromium
- Treatability Group – Non-wastewater
- Treatment Standard – 0.75 mg/L Lead and 0.06 mg/L Chromium by TCLP test
- Reportable Quantity – 4.54 kg or greater
- Markings on Container –
  Hazardous waste, solid, n.o.s. (D008); NA3077
  HAZARDOUS WASTE – Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the Environmental Protection Agency.
  Generator’s Name: NYSDOT Region (   )
  EPA ID Number (         )
  Manifest Document Number (         )
  Accumulation Start Date (                )

USDOT Emergency Response Guidebook Guide: 171, Substances (Low to Moderate Hazard)

B. Non-Hazardous Industrial Solid Paint Removal Waste. The Contractor shall ensure that only solid paint removal waste is deposited into the containers or roll-offs. All testing of the paint removal waste necessary to satisfy the requirements of the disposal facility or transporter shall be the responsibility of the Contractor.

571-3.03 Hazardous Paint Removal Waste Containing Lead - Management Requirements. Employees handling hazardous paint removal waste shall be trained in accordance with 6 NYCRR Part 373-3.2(g) in hazardous waste management procedures including hazardous waste accumulation, preparedness and prevention, contingency and emergency procedures. The Contractor’s Preparedness and Prevention Plan, Contingency Plan and Emergency Procedures, and Personnel Training Records, as required by 6 NYCRR Part 373-1.1(d)(1)(iii), shall be submitted to the Engineer for acceptance prior to the generation of any hazardous waste. Containers in storage shall be inspected on at least a weekly basis in accordance with 6 NYCRR Part 373-3.9(b)-(d).

571-3.04 Containers and Labeling. No roll-off shall be filled to a capacity in excess of that marked on the roll-off as the maximum capacity. Once the Engineer determines the quantity within a specific container or roll-off, that container or roll-off shall be properly sealed and not thereafter be tampered with. No additional waste shall be placed in it, nor shall any be removed from it (except for analytical sampling). All containers or roll-offs shall be located in a place secured from traffic and in a manner acceptable to the Engineer. The Contractor shall take measures to prevent the blowing or dispersion of the waste during each loading operation and while being transported.

The Contractor shall label, mark, and placard all containers or roll-offs prior to shipment in accordance with USDOT and NYSDEC regulations. Each container shall have an appropriate label prior to filling with the applicable words identifying its contents as paint removal waste providing the presumed waste classification of hazardous or non-hazardous industrial waste, and indicating the hazard of the contents (RCRA Toxicity). The accumulation start date shall be completed at the time when waste is first deposited into each container. All label markings shall be permanent, printed in English, and displayed on a background of contrasting color un-obscured by other labels or attachments. Labeling shall be located away from other markings that could substantially reduce its effectiveness.

571-3.05 Document Preparation.
A. **Hazardous Paint Removal Waste Containing Lead.** The Contractor shall prepare and distribute all documentation including the Uniform Hazardous Waste Manifest. The Engineer will sign the Generator's Certification on the Uniform Hazardous Waste Manifest. The LDR (Land Disposal Restricted) certification shall be completed and attached to the manifest, as required by 40 CFR Part 268 Land Disposal Restrictions.

B. **Non-Hazardous Industrial Solid Paint Removal Waste.** The Contractor shall prepare and distribute all documentation, including the disposal record forms.

**571-3.06 Paint Removal Waste Transport.** All paint removal waste shall be in transit to the disposal site from the site of generation no later than 45 calendar days unless otherwise approved by the Engineer, but no longer than 90 days. Any additional required shipment information, including manifest number, shall be entered on the container label(s) prior to shipment offsite. The Contractor shall present evidence that the vehicle that will be used for the shipment is permitted to transport the designated waste in accordance with 6NYCRR Part 364.

Conditions for hazardous paint removal waste transporting vehicles to pick up paint waste debris, in bulk, from one or more bridge sites (multiple collection) for delivery to an authorized Treatment, Storage and Disposal Facility (TSDF) include the following:

A. **Hazardous Paint Removal Waste Containing Lead.**

- The materials picked up at each site shall be essentially identical in physical and chemical characteristics. No materials, other than paint waste debris, may be included if wastes from several individual generating sites are to be combined on the same truck.
- All of the component shipments are presumed to be D008 hazardous wastes, and disposed as such.
- A manifest is prepared for each generating bridge site. Each manifest shall reflect a bulk shipment, and all manifests being carried by the same transporting vehicle must express the quantity in pounds. In sum total, the manifests accompanying the shipment shall account for the entire quantity transported.
- All component shipments are intended to be conveyed to the same TSDF, and the TSDF has agreed to accept consolidated bulk loads.
- All component shipments shall have originated at sites where the Department is the waste generator. No loads may be included that were generated at a site for which another agency is the waste generator.
- Measures shall be taken to prevent the blowing or dispersion of the paint removal waste during each loading operation and while being transported.
- The weight of waste shall be provided by the disposal facility.

B. **Non-Hazardous Industrial Solid Paint Waste.** Conditions for non-hazardous waste transporting vehicles to pick up paint waste debris, in bulk, from one or more bridge sites (multiple collection) for delivery to an authorized disposal facility include the following:

- The materials picked up at each site shall be essentially identical in physical and chemical characteristics. No materials, other than paint waste debris, may be included if wastes from several individual generating sites are to be combined on the same vehicle.
- All component shipments are intended to be conveyed to the same disposal facility, and the disposal facility has agreed to accept consolidated bulk loads.
- All component shipments shall have originated at sites where the Department is the waste Generator. No loads may be included that were generated at a site for which another agency is the waste Generator.
• Measures shall be taken to prevent the blowing or dispersion of the waste during each loading operation and while being transported.
• The weight of waste shall be provided by the disposal facility.

571-3.07 Conditionally Exempt Small Quantity Generator (CESQG) Exemption. Shipments of non-hazardous paint removal wastes of less than 2000 pounds shipped in a single load may be transported without a waste transporter permit as allowed by the Small Quantity Waste Transporter Exemption at 6 NYCRR Part 364-2.1(b)(5). For activities with generation of hazardous paint removal wastes that meet Conditionally Exempt Small Quantity Generator (CESQG) status (generate less than 220 pounds in any month and store less than 2205 pounds on site at any time), no USEPA ID number is required, the waste can be shipped without a manifest, and a CESQG can self-transport up to 220 pounds of waste in any calendar month to a disposal facility. CESQGs can dispose of their waste at a permitted hazardous waste facility or municipal or industrial solid waste facilities that are permitted to accept that type of waste.

571-3.08 Hazardous Paint Removal Waste Containing Lead Stabilization. Treatment of hazardous paint removal waste, as required by Federal regulations, is presumed to require stabilization of the waste such as mixing it with portland cement and water at a permitted Hazardous Waste Treatment or Disposal Facility. The stabilized waste shall meet the treatment standards of the Federal regulations prior to disposal in a permitted Hazardous Waste Disposal Facility.

571-3.09 Non-Hazardous Industrial Solid Paint Waste Sampling and Analysis. The Contractor shall conduct all sampling and analysis as required by the designated authorized disposal facility as soon as feasible upon waste generation at each non-hazardous designated bridge. Sampling shall be conducted by individuals thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements. Accepted sampling practices shall be used to obtain representative composite sample(s) as required for the specific analysis to be completed. Each composite sample shall include a minimum of four distinctly different sampling points. Analyses shall be completed at a NYSDOH Environmental Laboratory Accreditation Program (ELAP) certified laboratory using NYSDEC Analytical Services Protocols (ASPs). The analysis must include, at a minimum, the RCRA heavy metals analysis using the Toxicity Characteristic Leaching Procedure (TCLP) and a total weight analysis. If analytical results indicate that the waste is hazardous, the waste shall be disposed of as such and the hazardous waste pay item shall be used.

571-3.10 Waste Disposal Facility.

A. Hazardous Paint Waste Containing Lead. Prior to generating any hazardous paint removal waste, the Contractor shall provide the Engineer with a letter from a permitted Hazardous Waste Disposal Facility, stating that the Facility has agreed to accept the hazardous waste generated by the work requirements of this contract; is authorized to accept the hazardous waste under the laws of the State of residence; has the required capacity to treat and dispose of the material; and will provide, or assure the ultimate disposal method indicated on the Uniform Hazardous Waste Manifest. The letter shall be signed by a representative of the Disposal Facility who is legally authorized to sign such an agreement.

B. Non-Hazardous Industrial Solid Paint Waste. Prior to generating any non-hazardous paint removal waste, the Contractor shall provide the Engineer, in writing, the name and location of the permitted solid waste management facility selected for disposal.

571-4 METHOD OF MEASUREMENT.
571-4.01 **Hazardous Paint Waste Containing Lead.** The quantity of paint removal waste to be measured for payment will be in net pounds of waste disposed of, based on disposal facility weight tickets of the waste as manifested, not including the weight of the containers.

571-4.02 **Non-Hazardous Industrial Solid Paint Waste.** The quantity of paint removal waste to be measured for payment will be in net pounds of waste disposed of, based on disposal facility weight tickets, not including the weight of the containers.

571-5 **BASIS OF PAYMENT.**

571-5.01 **Hazardous Paint Waste Containing Lead.** The unit price bid per pound of paint removal waste shall include the cost of all labor, materials, equipment, sampling, testing, and fees necessary to complete the work based on the assumption that treatment by stabilization will satisfy the applicable Federal regulations. Only waste for which manifest copies (not applicable for CESQG exemption) and weight ticket(s) are returned to the Engineer by the Contractor and Disposal Facility will be authorized for payment. If the Department is fined or penalized as a result of the Contractor's performance or lack thereof, in addition to other remedies the Department may possess, said fine or penalty will be deducted from monies due the Contractor.

571-5.02 **Non-Hazardous Industrial Solid Paint Waste.** The unit price bid per pounds of paint removal waste shall include the cost of all labor, materials, equipment, sampling, testing, and fees necessary to complete the work. Only waste for which weight ticket(s) are returned to the Engineer by the Contractor and Disposal Facility will be authorized for payment. If the Department is fined or penalized as a result of the Contractor's performance or lack thereof, in addition to other remedies the Department may possess, said fine or penalty will be deducted from monies due the Contractor.

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SECTION 572 - STRUCTURAL STEEL PAINTING: SHOP APPLIED

572-1 **DESCRIPTION.** This work shall consist of preparing and painting new steel surfaces in a permanent facility, enclosure, or building, with four walls to grade and a roof, where surface preparation and painting activities are conducted in an environment not subject to outdoor weather conditions and/or blowing dust. All painting work, except field touchup and bolt painting, shall be conducted inside this facility. See special note entitled “Structural Painting Details” for the description and requirements of serialized items.

572-2 **MATERIALS**

572-2.01 **Paints.** Paints shall meet the requirements of §708-01 Structural Steel Paints – Class 1, and shall appear on the Department’s Approved List, “Structural Steel Paints - Class 1”. All new paint applied to a single structure shall be the same paint system produced by the same manufacturer. The Contractor shall assure this to be the case in the event that multiple paint items are specified on a single structure. This includes both shop and field components of the structure.

A. **Shelf Life.** The shelf life of all components of the coating system shall be a maximum of 12 months from the date of manufacture. The shelf life of factory sealed containers of thinner shall be the manufacturer’s recommendation or 3 years from the date of manufacture, whichever is less, and a
maximum of 7 months after the factory seal has been broken. Paint and thinner shall arrive at the work site in new, unopened containers. The label shall include the manufacturer’s name, batch number, color, paint name, and date of manufacture.

B. Paint Storage. Paint in storage shall be protected from damage and maintained in accordance with manufacturer’s recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.

C. Color. Each single coat of paint shall be a different color and provide substantial contrast with the underlying substrate and previous coats. The colors of the primer, stripe coat, and intermediate coat will be the Contractor’s option. The color of the finish coat shall be as specified in contract documents.

D. Data Sheets. The Contractor shall supply the Department’s representative with the paint manufacturer’s material safety data sheets for each paint to be applied. The material safety data sheets shall be delivered to the Department’s representative a minimum of five work days prior to beginning of work. The Department’s representative and Contractor shall use the product data sheets posted on the Structural Steel Paints Class 1 Approved List.

572-2.02 Abrasive for Blast Cleaning. Abrasive material for blast cleaning shall be selected by the Contractor. Silica sand and other types of nonmetallic abrasive containing more than one percent free silica, by weight, will not be allowed. The abrasive blasting shall produce an angular anchor profile suitable for the paint system to be applied.

572-2.03 Paint Inspection Equipment. Prior to the start of work, the Contractor shall supply the Engineer with the following specifications and equipment in good working order:

1. One bound copy of the Steel Structures Painting Council, surface preparation specification, SSPC-SP 10 - Near-White Metal Blast Cleaning.
2. One bound copy of the Steel Structures Painting Council, surface preparation specification, SSPC SP-1 - Solvent Cleaning.
3. One bound copy of the most current Steel Structures Painting Council Pictorial Standards, SSPC-VIS 1, Guide and Reference photographs for steel surfaces prepared by dry-abrasive blast cleaning.
4. One bound copy of the Steel Structures Painting Council method SSPC-PA2, Paint Application Specification No. 2 - Measurement of Dry Film Thickness With Magnetic Gages.
5. One copy of ASTM D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
6. One copy of ASTM D4285 Test Method for Indicating Oil or Water in Compressed Air
7. One Air Thermometer, pocket type, 10°F to 110°F.
8. One non-contact Infrared Thermometer, 10°F to 110°F.
9. One Contact Thermometer, 10°F to 110°F.
10. One Magnetic Dry-Film Thickness Gage, Type 2 (as defined per SSPC PA-2), with a display capable of measuring 0 to 60 mils in 0.1 mil increments, with calibration shims.
11. Two Wet-Film Thickness Gages, Prong-Type, capable of measuring 1 to 10 mils in 1 mil increments.
13. Profile micrometer with extra coarse replica tape.

All equipment will be returned to the Contractor upon completion of the work.

572-3 CONSTRUCTION DETAILS. All structural steel members and other miscellaneous steel items shall be cleaned and painted as per contract documents.
The Contractor shall provide adequate access, suitable lighting, and time for inspections to be made. Any work completed while the Engineer has been restricted from access, shall be recleaned and repainted at no additional cost to the State.

572-3.01 Quality Control Plan. The Contractor shall provide the Engineer with a copy of the Contractor's Quality Control (QC) procedures and/or Quality Control Plan (QCP). The QCP describes the minimum QC activities that will be performed by Contractor's QC personnel to ensure compliance. The QCP shall at a minimum, include operating procedures and maintenance records for equipment on site, proof of formal QC training for the Contractor’s QC personnel on site, and daily reports including the following information:

- Compressed Air Cleanliness
- Dry Film Thickness
- Air Temperature
- Humidity and Dew Point
- Surface Temperature
- Abrasive Cleanliness Checks
- Degree of Cleanliness Achieved
- Surface Profile
- Batch Numbers of Paint Used
- Batch Numbers of Thinner Used
- Mixing According to Specification

The Contractor shall provide daily reports to the Engineer upon request. The reports shall be submitted no later than 24 hours following the completion of the day’s work.

572-3.02 SURFACE PREPARATION.

A. Abrasive Blast Cleaning.

1. Atmospheric Conditions. Abrasive blast cleaning operations shall not be conducted under the following conditions:
   a. The relative humidity exceeds 85%.
   b. When the substrate is damp or covered by frost.
   c. The surface temperature is less than 5°F above the dew point.

2. Solvent Cleaning. Before abrasive blast cleaning begins, steel shall be solvent cleaned of all deposits of oil, grease, dirt, salt, or other contaminants by methods specified in SSPC-SP1, Solvent Cleaning.

3. Steel Cleanliness and Profile. All structural steel surfaces to be painted shall be abrasive-blast cleaned in accordance with SSPC-SP10, Near-White Metal Blast Cleaning. All abrasive blast cleaning and painting shall be performed at the same facility.

   The anchor profile shall be measured in accordance with ASTM D4417, Method C. The Contractor shall ensure that the anchor profile is within the range indicated on the paint manufacturer’s data sheets. The profile shall, at a minimum, be measured once per shift and three times in various locations for every 2150 square feet prepared, unless otherwise ordered by the Engineer. The anchor profile shall not exceed 3 mils.
All fins, tears, slivers, burred and sharp edges that are present or occur during the blasting operation shall be removed by grinding, and then the area shall be reblasted to provide the required profile.

4. Equipment. All equipment and compressors used in the cleaning operation shall be equipped with filters and traps to prevent moisture, oil, and other contaminants from being deposited on clean surfaces. The air cleanliness shall be verified by the Contractor with the white blotter test in accordance with ASTM D4285 at least once per shift for each compressed air system.

B. Cleaning Area. The area cleaned shall be limited to that which can be cleaned and prime coated within an 8-hour period. Cleaned areas shall be approved by the Engineer prior to priming. Areas that exhibit flash rusting within the 8-hour period shall be recleaned.

C. Visual Standards. After abrasive blasting is completed, cleaned surfaces shall be compared to SSPC-Vis 1, "Guide and Reference Photographs for Steel Surfaces Prepared By Dry Abrasive Blast Cleaning" Pictorial Standards as applicable. All surfaces shall be free of blasting products and other residues when blasting operations are completed. Surfaces shall be cleared of all foreign matter by means of oil-free, moisture-free, compressed air or vacuum systems.

572-3.03 PAINTING. The Contractor shall apply three full coats and a stripe coat of paint to all surfaces cleaned to SP-10. In addition, all cleaned steel surfaces within 6 feet from a bridge joint shall receive an additional coat of intermediate paint, resulting in four coats of paint in these areas. The paint shall be applied in the following order: primer, intermediate, stripe, and the finish coat. Damage resulting from fabrication, handling and storage in the shop shall be restored before leaving the shop. Painted steel shall not be placed outside the shop until all paint coats have dried “through/to-handle” or “minimum time to recoat” per paint manufacturer’s recommendations, whichever is greater.

Unless otherwise noted, the contractor shall adhere to the procedures and methods for application as described in SSPC-PA 1, Section 7.

A. Atmospheric Conditions. Paint shall be applied only if surface and ambient temperatures are greater than or equal to 40°F and rising. Paint shall not be applied when surface or ambient temperatures are greater than 100°F. If the temperature range listed on the manufacturer’s data sheets is more restrictive, the manufacturer’s range shall be used. The use of accelerator additives is prohibited. No paint shall be applied unless the receiving surface is dry.

Paint shall not be applied when the relative humidity is more than 85% or the receiving surface is less than 5°F above the dew point temperature. If the manufacturer’s data sheets have a more restrictive range then they shall be followed.

B. Paint Mixing. All paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer's recommendations. After mixing, the bottom of the container shall be free of any unmixed pigment prior to use.

C. Solvents and Thinners. Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The primer shall not be thinned such that the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205, §205.3 for metallic pigmented coatings. Intermediate and finish coats shall not be thinned where the resulting VOC level exceeds the maximum allowable §205.3 limit for industrial maintenance coatings. The manufacturer’s data sheets shall advise the Contractor and Engineer of the maximum amount of thinner allowed.

Use of unauthorized thinners, or using excess amounts of thinners is prohibited. Any area where unauthorized solvents or thinners are used shall be recleaned and repainted at no additional cost.
D. **Paint Application.** Painting shall not begin until cleaned surfaces have been inspected and approved by the Engineer. Paint may be applied using spray, brush, or roller, unless otherwise indicated by the contract documents. All paint shall be applied so as to produce a uniform, even coating free of runs, sags, drips, ridges, or other defects. Roller nap shall be limited in accordance with the paint manufacturer’s recommendation. Brushes and rollers used to apply the paint must be of a quality to produce a smooth uniform coating without leaving fibers in the coating.

All steel surfaces that will be in contact with concrete shall not be painted. Priming shall begin only after all welding and fabrication work is completed.

E. **Stripe Coat.** A stripe coat shall extend a minimum of 1 inch away from the following surfaces: all welds, rivets, bolts, nuts, edges of plates and structural members, angles, bearings, lattice pieces or other shapes, corners, and crevices. To provide contrast, paint for stripe coating shall be a different color than the receiving surface. The stripe coat shall use the intermediate paint and be applied after the intermediate coat. The stripe coat shall be brush applied without being thinned. The stripe coat will be applied in accordance with manufacturer’s recommendations, with particular attention to the film thickness, recoat window, and cure schedule. Areas near bridge joints that are to receive an additional coat of intermediate paint shall also receive a stripe coat where necessary as described above.

A stripe coat shall not be applied to any slip critical surfaces.

F. **Paint Film Thickness.** Paint shall be applied to produce the specified dry-film thickness as directed by the range listed on the paint manufacturer’s data sheets. The dry-film thickness (DFT) shall be determined in accordance with SSPC-PA 2, Paint Application Specification No. 2 - *Measurement of Dry Film Thickness with Magnetic Gages*, using a Type 2 fixed probe magnetic gages. Dry film thickness gauges shall be calibrated over a blasted, approved surface on the structure using two NIST traceable shims as described in the “two point calibration adjustment” section of Appendix 2 of SSPC-PA 2. The two shims must be just below and above the recommended thickness range of the prime coat, or the combined thickness of successive coats, as applicable. DFTs of the intermediate and finish coats shall be determined by subtracting the average DFT readings of the previous coat(s) from the actual DFT reading. An average DFT value shall be recorded and calculated for every 1000 square feet prepared. The average shall be calculated using a minimum of 5 spot measurements as defined by SSPC-PA2. At least one of the spot measurements shall be performed on the bottom face of the bottom flange of stringers, girders or floor beams if these elements are in the work area.

Areas failing to meet the specified minimum dry-film thickness shall be top coated with the same paint to produce the total dry-film thickness required. The top coating must be performed within the paint manufacturer’s specified recoat window.

The Engineer may require any area exceeding the manufacturer’s recommended dry-film thickness to be blast cleaned to the SP-10 condition.

**Slip Critical Connections.** The policy for coating slip-critical contact surfaces is specified in the New York State Steel Construction Manual. All metal to metal, slip-critical contact surfaces shall not be painted unless specified in the Contract Documents and allowed by the New York State Steel Construction Manual.

G. **Painting Schedule.** Primer shall be applied to approved, abrasive-blasted surfaces within 8 hours of the final cleaning operation. If the Contractor fails to apply primer to the surface within 8 hours of cleaning, the surface shall be restored in accordance with the SP-10 requirements, at no additional cost to the State.

To prevent intercoat adhesion failure, recoating must be performed within the manufacturer’s recommended recoat window, or 14 days, whichever is shorter. If the contractor fails to recoat within
the specified time period, the surface to be painted shall be cleaned and abraded, in accordance with manufacturer’s recommendations, to ensure adhesion of the following coat at no additional cost. If the steel has become dirty between coats, the Contractor shall wash the structure at no additional cost to the State. Manufacturer’s recommendations shall be observed for cure to handle, and cure to top coat schedules.

**H. Stenciling.** The following information shall be stenciled on at least one steel element or on the inside web of a fascia member coated under this specification, unless otherwise directed by the Engineer:

1. Month and year of completion
2. Contract number
3. SP10
4. Name of Paint Manufacturer
5. Name of Shop that performed painting
6. Primer, Intermediate, and Finish coat names

The stenciled lettering should be approximately 6 inches in height and be a contrasting paint color to the top coat.

**572-3.04 Field Painting.** The only field work allowed is touch-up work after steel erection and subsequent concrete placement has been completed. All field painting shall be done at no additional cost to the State. All the requirements of this specification shall apply to field painted material with the following modifications:

**A. Hardware.** Bolt heads, washers, nuts, bolt thread extensions, and other miscellaneous steel surfaces not painted in the shop shall be cleaned as per SSPC SP-1 and painted after the bolts have been installed and accepted. Abrasive blasting of the bolts is not required. Any dye present on galvanized hardware shall be cleaned in accordance with manufacturer’s recommendation prior to painting. The Contractor shall submit the dye-cleaning procedure to the Engineer five days prior to cleaning.

**B. Surface Preparation of Damaged Areas.** All visible dirt, grease, and other foreign matter shall be removed first by pressure washing and solvent cleaning as per SSPC SP-1 as needed. Areas exhibiting damaged or deteriorated paint not extending to the steel surface shall be hand or power-tool cleaned as necessary to remove damaged or deteriorated, loosely adhered paint. Loosely adhered paint will lift when scraped with a dull putty knife. All edges of paint surrounding the repair area shall be tightly adherent and feathered. These edges and the surrounding painted surfaces to receive a (repair) topcoat(s) shall be abraded to provide a suitable anchor profile for the paint. Areas that exhibit damage of the paint system down to the steel surface shall be cleaned with power tools to SSPC SP-11 and shall exhibit a suitable anchor profile for the primer paint. All power and blasting tools will be vacuum-sealed units. All surrounding steel that has been previously painted in the shop shall be protected from damage during cleaning operations. Repairs shall be smoothly transitioned into surrounding new paint.

**C. Application.** Application shall be made by brush and roller only. Areas of steel exhibiting damage not extending down to the steel surface shall receive two coats of paint: intermediate and finish coat. Damage extending to the steel surface shall receive three coats of paint: primer, intermediate and finish coat. These coats of paint shall be applied at a dry film thickness as recommended by the paint manufacturer for such (repair) application.
572-4 METHOD OF MEASUREMENT

572-4.01 Shop Applied – Square Feet. The measurement of this item will include the area requiring surface preparation and painting to the nearest whole square foot.

572-4.02 Shop Applied – Lump Sum. The work under this item will be measured on a lump sum basis, per structure.

572-5 BASIS OF PAYMENT. The unit or lump sum price bid shall include the cost of all labor, materials, and equipment necessary to complete the work.

Progress payments will be made for 80% of total payment quantity upon delivery of shop painted steel to the job site. Shop painted steel will be considered properly painted only when accompanied by the Engineer’s or Inspector’s written certification. The remaining 20% of payment will be made upon completion of cleaning and field painting all bolt heads, nuts, washers, bolt thread extensions, and damaged areas.

Payment will be made under:

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NOTE: nnnn denotes a serialized pay item.

SECTION 573 - STRUCTURAL STEEL PAINTING: FIELD APPLIED - TOTAL REMOVAL

573-1 DESCRIPTION. This work shall consist of pressure washing, abrasive blast cleaning to remove all paint, rust, rust scale, mill scale, corrosion producing contaminants, and other foreign matter, and painting structural steel surfaces. See Special Note entitled Structural Painting Details for the description and requirements for serialized items.

573-2 MATERIALS

573-2.01 Paints. Paints shall meet the requirements of §708-01 Structural Steel Paints – Class 1, and shall appear on the Department’s Approved List, ‘Structural Steel Paints – Class 1’. All new paint to be applied to a single structure shall be the same paint system produced by the same manufacturer. The Contractor shall assure this to be the case in the event that multiple paint items are specified on a single structure. This includes both shop and field painted components of the structure.

A. Shelf Life. The shelf life of all components of the coating system shall be a maximum of 12 months from the date of manufacture. The shelf life of factory sealed containers of thinners shall be per manufacturer’s recommendations or 3 years from the date of manufacture, whichever is less, and a maximum of 7 months after the factory seal has been broken. Paint and thinner shall arrive at the work site in new, unopened containers. The label shall include the manufacturer’s name, batch number, color, paint name, and date of manufacture.

B. Paint Storage. Paint in storage shall be protected from damage and maintained in accordance with manufacturer’s recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.
**C. Color.** Each single coat of paint shall be a different color and provide substantial contrast with the underlying substrate and previous coats. The colors of the primer, stripe coat, and intermediate coat will be the Contractor's option. The color of the finish coat shall be as specified in contract documents.

**D. Data Sheets.** The Contractor shall supply the Department’s representative with the paint manufacturer’s material safety data sheets for each paint component to be applied. The material safety data sheets shall be delivered to the Department’s representative a minimum of five work days prior to beginning of work. The Department’s representative and Contractor shall use the product data sheets posted on the Structural Steel Paints Class 1 Approved List.

573-2.02 Water for Washing. Water for pressure washing shall be potable water. Any detergent or soluble salt remover used must receive approval by the paint manufacturer and the Materials Bureau. Water shall not be recycled.

573-2.03 Abrasive for Blast Cleaning. Abrasive blast media for blast cleaning shall be recyclable, ferrous metallic, abrasive grit. All new metallic abrasive shall be in compliance with the specifications of SSPC-AB 3 Ferrous Metallic Abrasive. All ferrous metallic abrasive used shall be recycled and cleaned in accordance with SSPC-AB 2. The Contractor shall select the size, blend, and hardness of the abrasive to produce an angular anchor profile of a recommended depth as indicated on the manufacturer’s data sheets.

All ferrous metallic abrasive arriving on the job site shall be new, and invoices shall be submitted for acceptance. All recycling equipment shall arrive empty and clean.

573-2.04 Paint Inspection Equipment. Prior to the start of work the Contractor shall supply the Engineer with the following specifications and equipment in good working order:

1. One bound copy of the Steel Structures Paining Council surface preparation specification, SSPC SP-1 – Solvent Cleaning.
2. One (1) bound copy of the Steel Structures Painting Council surface preparation specification, SSPC-SP 10 – Near-White Metal Blast Cleaning.
3. One bound copy of the most current Steel Structures Painting Council Pictorial Standards, SSPC-VIS 1, *Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning*.
4. One bound copy of the Steel Structures Painting Council specification SSPC-PA2, Paint Application Specification No. 2 - Measurement of Dry Film Thickness With Magnetic Gages.
5. One bound copy of Steel Structures Painting Council specification SSPC AB-2 *Specification for Cleanliness of Recycled Ferrous Metallic Abrasives*.
6. One bound copy of Steel Structures Painting Council specification SSPC AB-3 *Specification for Newly Manufactured or Re-Manufactured Steel Abrasive*.
7. One copy of ASTM D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
8. One copy of ASTM D4285 Test Method for Indicating Oil or Water in Compressed Air.
9. One Air Thermometer, pocket type, 10°F to 110°F.
10. One noncontact Infrared Thermometer, 10°F to 110°F.
11. One Contact Thermometer, 10°F to 110°F.
12. One Magnetic Dry-Film Thickness Gage, Type 2 (as defined per SSPC PA-2), with a display capable of measuring 0 to 60 mils in 0.1 mil increments, with calibration shims.
13. Two Wet-Film Thickness Gages, Prong-Type, capable of measuring 1 to 10 mils in 1 mil increments.
15. Profile micrometer with extra coarse and extra coarse plus replica tape.
All equipment will be returned to the Contractor upon completion of the work.

573-3 CONSTRUCTION DETAILS. The Contractor shall clean and paint all structural steel members, railings, downspouts, and other miscellaneous steel items as indicated in the contract documents.

The Contractor shall provide adequate access, suitable lighting, and time for inspections to be made. Any work done while the Engineer has been restricted from access, shall be re-cleaned and repainted, at no additional cost to the State to the State.

573-3.01 Quality Control Plan. The Contractor shall provide the Engineer with a copy of the Contractor’s Quality Control (QC) procedures and/or Quality Control Plan (QCP). The QCP describes the minimum QC activities that will be performed by Contractor's QC personnel to ensure compliance. The QCP shall minimally include operating procedures and maintenance records for equipment on site, proof of formal QC training for the Contractor’s QC personnel on site, and daily reports including the following information:

- Compressed Air Cleanliness
- Dry Film Thickness
- Air Temperature
- Humidity and Dew Point
- Surface Temperature
- Abrasive Cleanliness Checks
- Degree of Cleanliness Achieved
- Surface Profile
- Batch Numbers of Paint Used
- Batch Numbers of Thinner Used
- Mixing According to Specification

The Contractor must provide daily reports to the Engineer at the conclusion of cleaning work and painting work and prior to inspection of such work by the Engineer. Reports at the conclusion of cleaning and painting work shall include all pertinent information listed above that relate to such work and shall be in a format previously agreed to under the QCP.

573-3.02 Surface Preparation. Steel surfaces shall be prepared for painting by a combination of pressure washing, solvent cleaning, and abrasive blast cleaning.

Pressure washing shall be performed first, followed by abrasive blast cleaning to remove all paint, rust, rust scale, and mill scale, as per SSPC SP-10, Near-White Metal. If heavy deposits of rust and scale are present, they shall be removed by hand or power tool prior to pressure washing. Deposits of bird droppings taller than 1/2 inch shall be removed prior to pressure washing.

A. Pressure Washing and Solvent Cleaning. All steel surfaces to be painted shall be pressure washed, using an operating pressure range of 1800 to 2000 psi, a minimum flow of 3.5 gal/minute, and a water temperature of 185°F to 200°F. The nozzle shall be held at a distance of 6 to 12 inches from the steel surface. Pressure washing shall only be allowed when ambient air temperatures are greater than 40°F and rising. In no case will pressure washing be conducted when spent wastewater could freeze on roadway or bridge surfaces or in any other way create a hazardous situation. The washing is intended to remove contaminants from the surface, not to remove tightly adhered paint. Oil and grease shall be removed by solvent cleaning as described in SSPC SP1, Solvent Cleaning. The areas shall be pressure washed again following this cleaning.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil, grease, animal waste, salts, and other debris.
A containment shall be suspended around and beneath the work area during pressure washing. The containment for pressure washing is intended to capture solid paint chips and other solid debris that may become dislodged from washing operations. Unless otherwise noted, spent wash water will not require collection and will be allowed to fall to the underlying ground or waterway, provided that the other requirements of this specification are met.

Special note, Structural Painting Details, will provide scheduling requirements for washing a structure over a body of water. Spent wash water over a public water supply or the New York City watershed shall be collected and diverted to the adjoining land mass.

If steel surfaces become contaminated or 7 calendar days elapse between washing and abrasive blasting cleaning, they shall be rewash at no additional cost to the State.

The surface shall be allowed to dry before subsequent abrasive blast cleaning begins.

B. Abrasive Blast Cleaning.

1. Atmospheric Conditions. Blast cleaning operations shall not be conducted under the following conditions:

   a. The relative humidity exceeds 85%.
   b. When the substrate is damp or covered by frost.
   c. The surface temperature is less than 5°F above the dew point.

2. Steel Cleanliness and Profile. All structural steel surfaces shall be blast cleaned to SSPC SP-10, Near-White Metal.

   The anchor profile shall be measured in accordance with ASTM D4417, Method C. The Contractor shall ensure that the anchor profile is within the range indicated on the paint manufacturer’s data sheets. The profile, at a minimum, shall be measured five times in various locations every 2000 square feet prepared and once per work shift, unless otherwise ordered by the Engineer. The anchor profile shall not exceed 4 mils unless approved by the Engineer. The Engineer may approve a profile greater than 4 mils if an area is severely corroded or pitted. If the Contractor exceeds the 4 mils profile, the Contractor will be required to measure the profile using extra-coarse-plus replica tape and apply an additional mist coat of primer in accordance with manufacturer’s recommendations to obtain a minimum 2 mils film build over the profile peaks, at no additional cost to the State.

   All fins, tears, slivers, flame-cut edges, burred and sharp edges that are present or occur during the blasting operation shall be removed by grinding, and then the area shall be reblasted to provide the required profile.

   Special attention shall be given to the edges of beam flanges, angles and plates, bearings, rivets, the heads of nuts and bolts, structural steel surrounding bridge joints, and similar surfaces that are marginally accessible and difficult to clean.

   Upon completion of blast cleaning and prior to inspection, the containment shall be vacuumed and the cleaned surfaces shall be free of all blasting products and paint debris. Surfaces shall be free of all abrasive prior to inspection. Surfaces shall be cleared of all foreign matter by means of oil-free, moisture-free, compressed air or vacuum systems.

   All cleaned surfaces will be inspected by the Engineer prior to painting. Any areas that are painted before being inspected shall be cleaned and restored to the SP-10 standard and repainted at no additional cost to the State. If the cleaned surface begins to rust or becomes contaminated in any matter prior to applying primer, the surface shall be restored to SP-10 standard.

3. Steel Grit. The recyclable abrasive shall be cleaned of all paint, chips, rust, mill scale, and other foreign material after each use, prior to reuse. The cleanliness of the recycled abrasive during use shall be confirmed in accordance with SSPC-AB2. The Contractor shall execute,
record, and provide the Engineer results of the nonabrasive residue test, water soluble test, and oil content test daily. The Engineer may be present during this testing. The Contractor shall also execute and provide lead content test results weekly. All equipment used for cleaning abrasive shall be specifically designed for this purpose and accepted by the Engineer.

The Contractor shall maintain a balance in the size distribution of the abrasive work mix for the duration of the abrasive blasting operations to maintain a uniform profile across the surfaces to be blasted. The work mix shall not be predominantly coarse or fine, and shall be maintained through proper removal of expended abrasive and its timely replenishment.

4. **Protection of Newly Painted Surfaces.** Throughout abrasive blast cleaning work, care shall be taken to protect newly painted surfaces from the cleaning operations. Tarps, covers, or other devices shall be used to protect new paint from contamination or damage. Contaminated areas of new paint shall be cleaned as necessary prior to the next coat of paint. Damaged paint shall be blast cleaned to the required condition, and then repainted at no additional cost to the State.

5. **Vacuuming.** After cleaning operations are completed, all debris generated by the cleaning work shall be removed by vacuuming using HEPA-filtered vacuums. A HEPA filter shall be defined as a filter that is at least 99.97% efficient for particles that are 0.3μm in diameter, or larger.

6. **Equipment.** All equipment and compressors used in the cleaning operation shall be equipped with filters and traps to prevent moisture, oil, and other contaminants from being deposited on clean surfaces. The air cleanliness shall be verified by the Contractor with the white blotter test in accordance with ASTM D4285 at least once per shift for each compressed air system.

7. **Cleaning Area.** The area cleaned shall be limited to that which can be cleaned, inspected and prime coated within a 10-hour period. Cleaned areas shall be inspected by the Engineer prior to priming. Areas that exhibit flash rusting or fail to meet the local standard prior to painting shall be re-cleaned to the approved standard at no additional cost to the State.

C. **Visual and Project Standards.** The Contractor shall prepare at least one project cleaning standard for each representative area on the structure that is being prepared for painting. Multiple standards may be required if the cleaned steel differs significantly from the photographic standards due to surface conditions, or other factors such as distance of the standard from the work area. The prepared cleaning standard shall conform to SSPC VIS 1, "Guide and Reference Photographs for Steel Surfaces Prepared By Dry Abrasive Blast Cleaning" Pictorial Standard as applicable, and shall be approved by the Engineer before the start of general cleaning work. Each cleaning standard shall be at least 12 x 12 inches in size, and shall be located in an area of the structure that is easily accessible, and approved by the Engineer. The Contractor shall protect the work standard from corrosion and contamination throughout the duration of work by applying a clear coat of polyurethane. At the completion of cleaning work, the cleaning standard shall be cleaned and painted. If the project standard becomes deteriorated, or otherwise ineffective, it shall be reestablished at no additional cost to the State. In case of a dispute over the visual standard, the written standard shall take precedence.

573-3.03 **PAINTING.** The Contractor shall apply three full coats of new paint and one stripe coat to all surfaces cleaned to SP-10. The paint shall be applied in the following order: primer, intermediate coat, stripe coat, and the finish coat. All steel surfaces within 6 feet of a bridge joint shall receive an additional full coat of intermediate paint.
A. Atmospheric Conditions. Paint shall be applied only if surface and ambient temperatures are greater than or equal to 40°F and rising. Paint shall not be applied when surface or ambient temperatures are greater than 100°F. If the temperature range listed on the manufacturer’s data sheets is more restrictive, the manufacturer’s range shall be used. The use of accelerator additives is prohibited. No paint shall be applied unless the receiving surface is absolutely dry.

Paint shall not be applied when the relative humidity is more than 85% or the surface temperature is less than 5°F above the dew point. If manufacturer’s requirements are more restrictive then they shall be followed. No paint shall be applied during rain or when rain is forecast to occur by the National Weather Service for the project location during painting operations. All painted surfaces shall be protected from direct exposure to rain for the time interval recommended by the paint manufacturer for proper cure. The Contractor shall observe the dew point and humidity restrictions listed on the manufacturer’s data sheets.

If an epoxy coating is exposed to temperatures or humidity conditions outside of the manufacturer’s recommended values prior to cure, all affected surfaces shall be visually examined for greased or oily surfaces which may have formed. The Engineer may require the Contractor to use a commercially available amine blush test kit at locations chosen by the Engineer. If testing indicates the presence of an amine blush or if there is any oily film on the surface, the surfaces shall be cleaned and prepared for topcoating in accordance with paint manufacturer’s recommendations at no additional cost to the State.

B. Paint Mixing. All paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer's recommendations. After mixing, the bottom of the container shall be free of any unmixed pigment prior to use.

C. Solvents and Thinners. Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The primer shall not be thinned such that the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205, §205.3 for metallic pigmented coatings. Intermediate and finish paints shall not be thinned such that the resulting VOC level exceeds the maximum allowable §205.3 limit for industrial maintenance coatings. The manufacturer’s data sheets shall advise the Contractor and Engineer of the maximum amount of thinner allowed. Use of unauthorized thinners, or using excess amounts of thinners is prohibited. Any area where unauthorized or improper amounts of solvents or thinners are used shall be recleaned and repainted at no additional cost to the State. All thinning shall be performed in the presence of the Engineer.

D. Paint Application. Painting shall not begin until cleaned surfaces have been inspected and approved by the Engineer. Paint may be applied using spray or brush and roller, unless otherwise indicated by the contract documents. All paint shall be applied so as to produce a uniform, even coating free of runs, sags, drips, ridges, or other defects. Roller nap shall be limited in accordance with the paint manufacturer’s recommendation. Brushes and rollers used to apply the paint must be of a quality to produce a smooth uniform coating without leaving fibers in the coating.

Protection against paint spatter, spillage, wind blown paint, or similar releases of paint shall be provided. Covers, tarps, mesh, and similar materials shall be placed around the work area to protect public and private property, pedestrian, vehicular or marine traffic, all portions of the bridge, highway appurtenances, waterways, and similar surrounding areas and property, upon, beneath, or adjacent to the structure. The use of spray equipment for paint application shall be allowed within containments provided that the aforementioned protection against paint release is provided, all equipment used (including tarps, mesh and similar materials) meets all safety requirements for such enclosed use with paint spraying, and all OSHA requirements for safety and ventilation are met.

E. Stripe Coat. A stripe coat shall extend a minimum of 1 inch away from the following surfaces: all welds, rivets, bolts, nuts, edges of plates and structural members, angles, bearings, lattice pieces or
other shapes, corners, and crevices. Areas near bridge joints that are to receive an additional coat of intermediate paint shall also receive a stripe coat where necessary as described above. To provide contrast, paint for stripe coating shall be a different color than the receiving surface. The stripe coat shall use the intermediate paint and be applied after the intermediate coat. The stripe coat shall be brush applied without being thinned. The stripe coat will be applied in accordance with the manufacturer’s recommendations, with particular attention to the film thickness, recoat window and cure schedule.

F. Paint Film Thickness. Paint shall be applied to produce the specified dry-film thickness as directed by the range listed on the paint manufacturer’s data sheets. The dry-film thickness shall be determined in accordance with SSPC-PA 2, Paint Application Specification No. 2 - Measurement of Dry Film Thickness with Magnetic Gages, using a Type 2 fixed probe magnetic gages. Dry film thickness gauges shall be calibrated over a blasted, approved surface on the structure using two NIST traceable shims as described in the “two point calibration adjustment” section of Appendix 2 of SSPC-PA 2. The two shims must be just below and above the recommended thickness range of the prime coat, or the combined thickness of successive coats, as applicable. DFTs of the intermediate and finish coats shall be determined by subtracting the average DFT readings of the previous coat(s) from the actual DFT reading. An average DFT value shall be recorded and calculated for every 1000 square feet prepared. The average shall be calculated using a minimum of 5 spot measurements as defined by SSPC-PA2. At least one of the spot measurements shall be performed on the bottom face of the bottom flange of stringers, girders or floor beams if these elements are in the work area.

Areas failing to meet the specified minimum dry-film thickness shall be top coated with the same paint to produce the total dry film thickness required. The top coating must be performed within the paint manufacturer’s specified recoat window.

The Engineer may require any area exceeding the manufacturers recommended dry-film thickness to be blast cleaned to the SP-10 condition.

G. Painting Schedule. Primer shall be applied to approved, abrasive-blasted surfaces according to section §573-3.02, B. 7 of this specification.

Each area as defined by §573-3.02, B. 7 shall receive an intermediate coat of paint within 72 hours after priming. To prevent intercoat adhesion failure, the topcoat shall be applied within the manufacturer’s recommended recoat window, or 14 days, whichever is shorter. If the contractor fails to topcoat within the specified time period, the surface to be painted shall be cleaned and abraded, in accordance with manufacturer’s recommendations, to ensure adhesion of the following coat at no additional cost.

If the steel has become dirty between coats, the Contractor shall wash the bridge again at no additional cost to the State.

Manufacturer’s recommendations shall be observed for cure to handle, and cure to top coat schedules.

H. Stenciling. After the finish coat of paint has cured, the Contractor shall stencil the following information on the inside web of the fascia member, near the BIN plate, unless otherwise directed by the Engineer:

1. Month and year of completion
2. Contract number
3. SP10
4. Name of Paint Manufacturer
5. Name of Contractor
6. Primer, Intermediate, and Finish coat names
The stenciled lettering should be approximately 6 inches in height and be a contrasting paint color to the top coat.

573-4 METHOD OF MEASUREMENT
The work under this item will be measured on a lump sum basis per structure.

573-5 BASIS OF PAYMENT
The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work, including the cost of providing protection against damage to public and private property during surface preparation and paint application. Payment for the containment, collection and disposal of dust and paint waste generated by surface preparation work shall be paid for separately.

Progress payments will be based on the percentage of steel cleaned and painted. No more than 60% of the quantity will be paid for surface preparation and priming. The remaining amount will be paid following the satisfactory completion of work.

Payment will be made under:

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<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>573.01nn</td>
<td>Structural Steel Painting Field Applied - Total Removal</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

NOTE: nnn denotes a serialized pay item.

SECTION 574 - STRUCTURAL STEEL PAINTING: OVERCOATING AND LOCALIZED

574-1 DESCRIPTION. This work shall consist of pressure washing and power-tool or vacuum-blast cleaning of damaged paint areas and corroded structural steel surfaces, and painting surfaces described in contract documents. See Special Note entitled Structural Painting Details for the description and requirements of serialized items.

574-2 MATERIALS

574-2.01 Paints. Paints shall meet the requirements of §708-02 Structural Steel Paints Class 2 and shall appear on the Department’s Approved List, Structural Steel Paints – Class 2 for localized and overcoat painting, or on the Structural Steel Paints – Class 1 Approved List for localized painting only.

All new paint to be applied to a single structure shall be the same paint system produced by the same manufacturer. The Contractor shall assure this to be the case in the event that multiple paint items are specified on a single structure. This includes both shop and field painted components of the structure.

A. Shelf Life. The shelf life of all components of the coating system shall be a maximum of 12 months from the date of manufacture. The shelf life of factory sealed containers of thinners shall be per manufacturer’s recommendations or 3 years from the date of manufacture, whichever is less, and a maximum of 7 months after the factory seal has been broken. Paint and thinner shall arrive at the work site in new, unopened containers. The label shall include the manufacturer’s name, batch number, color, paint name, and date of manufacture.

B. Paint Storage. Paint in storage shall be protected from damage and maintained in accordance with manufacturer’s recommendations. Paint will be considered in storage if it is onsite for more than 8 hours prior to application.


**C. Color.** Each single coat of paint shall be a different color and provide substantial contrast with the underlying substrate and previous coats. The color of the finish coat shall be as specified in contract documents. The color of the other coats will at the Contractor’s option.

**D. Data Sheets.** The Contractor shall supply the Department’s representative with the paint manufacturer’s material safety data sheets for each paint to be applied. The material safety data sheets shall be delivered to the Department’s representative a minimum of five work days prior to beginning of work. The Department’s representative and Contractor shall use the product data sheets posted on the Structural Steel Paints Class 1 or Class 2 Approved List, as applicable.

**574-2.02 Water for Washing.** Water for pressure washing shall be potable water. Any detergent or soluble salt remover used must receive approval by the paint manufacturer and the Materials Bureau. Water shall not be recycled.

**574-2.03 Abrasive for Blast Cleaning.** Abrasive material for blast cleaning shall be selected by the Contractor. Silica sand and other types of nonmetallic abrasive containing more than one percent free silica, by weight, will not be allowed. The abrasive blasting shall produce an angular anchor profile suitable for the paint system to be applied.

**574-2.04 Paint Inspection Equipment.** Prior to the start of work the Contractor shall supply the Engineer with the following specifications and equipment in good working order:

1. One bound copy of the Steel Structures Painting Council surface preparation specification, SSPC SP-1 – *Solvent Cleaning*.
2. One (1) bound copy of the Steel Structures Painting Council surface preparation specification, SSPC-SP 11 – *Power Tool Cleaning to Bare Metal*.
3. One (1) bound copy of the Steel Structures Painting Council surface preparation specification, SSPC-SP 10 – *Near-White Metal Blast Cleaning*.
5. One bound copy of the most current Steel Structures Painting Council pictorial standards, SSPC-VIS 1, *Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning*.
7. One copy of ASTM D4417*Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel*.
9. One Air Thermometer, pocket type, 10°F to 110°F.
10. One noncontact Infrared Thermometer, 10°F to 110°F.
11. One Contact Thermometer, 10°F to 110°F.
12. One Paint Thermometer, 10°F to 110°F.
13. One Magnetic Dry-Film Thickness Gage, Type 2 (as defined per SSPC PA-2), with a display capable of measuring 0 to 60 mils in 0.1 mil increments, with calibration shims.
14. Two Wet-Film Thickness Gages, Prong Type, capable of measuring 1 to 10 mils in 1 mil increments.
16. Profile micrometer with extra coarse replica tape.

All equipment will be returned to the Contractor upon completion of the work.

**574-3 CONSTRUCTION DETAILS.** Overcoating is defined as treating corroded areas by spot cleaning and applying two coats of primer, followed by applying intermediate and topcoats of paint to all prepared steel surfaces, both cleaned and primed previously corroded areas and cleaned existing intact
Painted surfaces. Localized cleaning and painting is defined by spot cleaning and applying four coats of paint, including two coats of primer, intermediate and topcoat, to spot-cleaned steel only.

The Contractor shall provide adequate access, suitable lighting, and time for inspections to be made. Any work done while the Engineer has been denied, or restricted from access, shall be recleaned and repainted at no additional cost to the State.

574-3.01 Quality Control Plan. The Contractor shall provide the Engineer a copy of the Contractor’s Quality Control (QC) procedures and/or Quality Control Plan (QCP). The QCP describes the minimum QC activities that will be performed by Contractor’s QC personnel to ensure compliance. The QCP shall minimally include operating procedures and maintenance records for equipment on site, proof of formal QC training for the Contractor’s QC personnel on site, and daily reports including the following information:

- Compressed Air Cleanliness
- Dry-Film Thickness
- Air Temperature
- Humidity and Dew Point
- Surface Temperature
- Abrasive Cleanliness Checks
- Degree of Cleanliness Achieved
- Surface Profile
- Batch Numbers of Paint Used
- Batch Numbers of Thinner Used
- Mixing According to Specification

The Contractor must provide daily reports to the Engineer upon request. The reports shall be submitted no later than 24 hours following the completion of the days work.

574-3.02 Surface Preparation for Overcoating. Steel surfaces shall be prepared for painting by a combination of pressure washing and power-tool or vacuum-shrouded blast cleaning. Pressure washing of all areas to be painted shall be performed first, followed by power-tool cleaning of areas demonstrating corrosion of the steel substrate to remove all paint, rust, rust scale, and mill scale, as per SSPC SP-11, Power Tool Cleaning to Bare Metal or SSPC SP-10, Near-White Metal Blast Cleaning as applicable. If heavy deposits of rust and scale are present, they shall be removed by hand or power tool prior to pressure washing. Areas of tightly adhered coating to remain shall be abraded to provide an anchor profile for overcoat paint. Large deposits of bird droppings shall be removed prior to pressure washing.

A. Pressure Washing and Solvent Cleaning. All steel surfaces to be painted shall be pressure washed, using an operating pressure range of 1800 to 2000 psi, a minimum flow of 3.5 gal/minute, and a water temperature of 185°F to 200°F. The nozzle shall be held at a distance of 6 to 12 inches from the steel surface. Pressure washing shall only be allowed when ambient air temperatures are greater than 40°F and rising. In no case will pressure washing be conducted when spent wastewater could freeze on roadway or bridge surfaces or in any other way create a hazardous situation. The washing is intended to remove contaminants from the surface, not to remove tightly adhered paint. Oil and grease shall be removed by solvent cleaning as described in SSPC SP1, Solvent Cleaning. The areas shall be pressure washed again following this cleaning.

When the washing is completed, the cleaned surfaces shall be free of dust, dirt, oil, grease, animal waste, salts, and other debris

A containment shall be suspended around and beneath the work area during pressure washing. The containment for pressure washing is intended to capture solid paint chips and other solid debris.
that may become dislodged from washing operations. Unless otherwise noted, spent wash water will not require collection and will be allowed to fall to the underlying ground or waterway, provided that the other requirements of this specification are met.

Special note, Structural Painting Details, will provide scheduling requirements for washing a structure over a body of water. Spent wash water over a public water supply or the New York City watershed shall be collected and diverted to the adjoining land mass.

If steel surfaces become contaminated or 7 calendar days elapse between washing and abrasive blasting cleaning, they shall be rewashed at no additional cost to the State.

B. Power Tool Cleaning. Power tools as described in SSPC-SP 11 shall be used to clean corroded steel. Vacuum-shrouded abrasive blasting may be allowed. Steel cleaned using vacuum-shrouded blasters shall be cleaned to SSPC-SP 10.

1. Atmospheric Conditions. No cleaning operations will be conducted under the following conditions:
   - The relative humidity exceeds 85%.
   - When the substrate is damp or covered by frost.
   - The surface temperature is less than 5°F above the dew point.

2. Steel Cleanliness and Profile. Surfaces which have become visibly corroded shall be cleaned in accordance with SSPC-SP 11 or SSPC-SP 10, as applicable. Areas where the existing paint has peeled, flaked, blistered, or otherwise become deteriorated shall be cleaned until only sound paint, tightly adherent paint remains. These areas need not be cleaned to SP-11 or SP-10 if the damage does not extend to the steel surface and corrosion of the steel substrate or the mill scale is not evident.

   Equipment used shall produce an anchor profile meeting the manufacturer’s requirements as reported on the manufacturer’s data sheets. The anchor profile shall be measured in accordance with ASTM D4417, Method C.

   Special attention shall be given to the edges of beam flanges, angles and plates, bearings, rivets, the heads of nuts and bolts, structural steel surrounding bridge joints, and similar surfaces that are marginally accessible and difficult to clean.

   The edges of intact paint shall be feathered back and the adjoining paint must be tightly adhered. Ragged or lifting edges on adjoining paint will not be allowed. Adherence will only be considered satisfactory if the adjoining paint is smoothly feathered back, and cannot be removed by lifting with a dull putty knife.

3. Vacuuming. The vacuum assembly on all tools shall be capable of containing all visible dust and debris produced by the operation of the cleaning equipment. Air passing through the vacuum assembly shall be exhausted through a HEPA filter. A HEPA filter shall be defined as a filter that is at least 99.97% efficient for particles that are 0.3 µm in diameter, or larger.

4. Preparation of Remaining Coating. Areas exhibiting damaged or deteriorated paint not extending to the steel shall be power-tool cleaned to remove all damaged or loosely adhered paint and provide a suitable surface for top coating. Loosely adhered paint will lift when scraped with a dull putty knife.

   After cleaning and feathering edges, all remaining tightly adhered coating shall be abraded. The abrading operation shall not fracture or remove a significant amount of existing coating, only provide surface profile suitable to receive additional coats of paint. The degree of abrasion shall be in accordance with the manufacturer’s recommendations.

   The Contractor shall choose the method of abrasion. No additional payment will be made for the appropriate containment and waste collection required to abrade the surface. Open
abrasive blasting to abrade the surface shall require a Class A containment, in accordance with Section 570 Paint Removal Operations. All other methods of abrasion shall minimally require the same level of containment as specified in contract documents for a particular structure.

If the Contractor chooses a wet-abrasive method for abrasion, the containment must meet the requirements of SSPC – Guide 6, Class 2W. All water and abrasive must be collected and disposed of as hazardous waste.

All dust, powder, or residual abrasive remaining on the surface after the abrading operation shall be thoroughly removed and the remaining surface clean prior to painting.

5. Cleaning Area. The area cleaned shall be limited to that which can be cleaned, inspected and prime coated within a 10 hour period. Cleaned areas shall be inspected by the Engineer prior to priming. Areas that exhibit flash rusting within the 10-hour period or fail to meet the project cleaning standard prior to painting shall be recleaned.

C. Visual and Project Standards. The Contractor shall prepare at least one project cleaning standard for each representative area on the structure that is being prepared for painting. Multiple standards may be required if the cleaned steel differs significantly from the photographic standards due to surface conditions, location from work area, or other factors such as distance of the standard from the work area.

The prepared standard shall generally conform to SSPC VIS 3, Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning or SSPC VIS 1, Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning, as appropriate, and shall be approved by the Engineer before the start of general cleaning work. Each cleaning standard shall be at least 12 x 12 inches in size, and shall be located in an area of the structure that is accessible to, and approved by the Engineer. The Contractor shall protect the cleaning standard from corrosion and contamination throughout the duration of work by applying a clear coat of polyurethane. At the completion of cleaning work, the project standard shall be recleaned and painted. If the project cleaning standard becomes deteriorated, or otherwise ineffective, it shall be reestablished at no additional cost to the State. Corroded and deteriorated surfaces that have been cleaned using power tools shall be accepted by visual comparison to the project prepared standard(s) for each structure. In case of a dispute over the visual standard, the written standard shall take precedence.

574-3.03 Surface Preparation for Localized Cleaning and Painting. All of the requirements of §574-3.02 shall apply with the exception of abrading the remaining coating. Only tightly adherent existing coating within 6 inches of a power tool cleaned surface shall be abraded.

574-3.04 Overcoat Painting. The paint shall appear on the Department’s Approved List, ‘Structural Steel Paints - Class 2’ and be approved for overcoating application.

The Contractor shall apply each coat of paint in the order listed on the Department’s Approved List ‘Structural Steel Paints - Class 2.’

A. Atmospheric Conditions. Paint shall be applied only if surface and ambient temperatures are greater than or equal to 40°F and rising. Paint shall not be applied when surface or ambient temperatures are greater than 100°F. If the temperature range listed on the manufacturer’s data sheets is more restrictive, the manufacturer’s range shall be used. The use of accelerator additives is prohibited. No paint shall be applied unless the receiving surface is absolutely dry. Paint shall not be applied when the relative humidity is more than 85% or the surface temperature is less than 5°F above the dew point. If the manufacturer’s requirements are more restrictive they shall be followed. No paint shall be applied during rain.

The Contractor shall observe the dew point restrictions listed on the manufacturer’s data sheets.
If an epoxy coating is exposed to cold temperatures or humid conditions outside of the manufacturer’s recommended values prior to cure, the surface shall be visually examined for greased or oily surfaces which may have formed. The Engineer may also require the Contractor to use a commercially available amine blush test kit in various locations. If testing indicates the presence of an amine blush or if there is any oily film on the surface, the surfaces shall be cleaned in accordance with paint manufacturer’s recommendations at no additional cost to the State.

**B. Paint Mixing.** All paint shall be thoroughly mixed with mechanical mixers in accordance with the manufacturer's recommendations. After mixing the bottom of the container shall have no unmixed pigment.

**C. Solvents and Thinners.** Paint may be thinned if recommended by the manufacturer and approved by the Engineer. The primer, if classified as metallic pigmented, shall not be thinned such that the resulting VOC level exceeds the maximum allowable limit set by 6 NYCRR Part 205, §205.3 for metallic pigmented coatings. All other coats of paint shall not be thinned such that the resulting VOC level exceeds the maximum allowable §205.3 limit for industrial maintenance coatings. Use of unauthorized thinners, or using excess amounts of thinners is prohibited. Any area where unauthorized solvents or thinners are used shall be reclened and repainted at no additional cost to the State. All thinning shall be performed in the presence of the Engineer.

**D. Paint Application.** Painting shall not begin until cleaned surfaces have been inspected and approved by the Engineer. Paint may be applied using spray, brush, or roller, unless otherwise indicated by the contract documents or prohibited by the paint manufacturer. All paint shall be applied so as to produce a uniform, even coating, free of runs, sags, drips, ridges or other defects. Roller nap shall be limited in accordance with the paint manufacturer’s recommendation. Areas exhibiting trapped fiber or bristles shall be rejected. Prepared areas that exhibited damaged paint not extending to the steel substrate shall receive two coats of paint: intermediate and finish coat.

Complete protection against paint spatter, spillage, wind-blown paint, or similar releases of paint shall be provided. Covers, tarps, mesh, and similar materials shall be placed around the work area to protect public and private property, pedestrian, vehicular, marine, or other traffic, all portions of the bridge, highway appurtenances, waterways, and similar surrounding areas and property, upon, beneath, or adjacent to the structure. The use of spray equipment for paint application shall be allowed within containments provided that the aforementioned protection against paint release is provided, all equipment used (including tarps, mesh and similar materials) meets all safety requirements for such enclosed use with paint spraying, and all OSHA requirements for safety and ventilation are met.

**E. Paint Film Thickness.** Paint shall be applied to produce the specified dry-film thickness (DFT) as directed by the range listed on the paint manufacturer’s data sheets. The dry-film thickness shall be determined in accordance with SSPC-PA 2, Paint Application Specification No. 2 - Measurement of Dry Film Thickness with Magnetic Gages, using a Type 2, fixed-probe magnetic gages. Dry film thickness gauges shall be calibrated over a cleaned, approved surface on the structure using two NIST traceable shims as described in the “two point calibration adjustment” section of Appendix 2 of SSPC-PA 2. The two shims must be just below and above the recommended thickness range of the prime coat, or the combined thickness of successive coats, as applicable.

DFTs of the all coats applied subsequent to the primer shall be determined by subtracting the average DFT readings of the previous coat(s) from the actual DFT readings. An average DFT value shall minimally be recorded and calculated for every 1000 square feet prepared. The average shall be calculated using a minimum of 5 spot measurements as defined by SSPC-PA2. At least one of the spot measurements shall be performed on the bottom face of the bottom flange of stringers, girders or floor beams if these elements are in the work area.
Areas failing to meet the specified minimum dry-film thickness shall be top coated with the same paint to produce the total dry film thickness required. The top coating must be performed within the paint manufacturer’s specified recoat window.

The Engineer may require any area exceeding the manufacturers recommended dry film thickness to be cleaned to the SSPC-SP 11 or SSPC-SP 10 condition.

**F. Painting Schedule.** Primer shall be applied as per §574-3.02, B.5 of this specification. The second coat of primer shall be applied within 72 hours of the application of the initial prime coat.

The intermediate coat shall be applied within 72 hours of prime coating of the areas as defined by §574-3.02, B.5. All areas of adherent existing paint to be overcoated shall receive the intermediate coat within 72 hours of that area’s cleaning operation.

To prevent intercoat adhesion failure, top coat must be applied within the manufacturer’s recommended recoat window, or 14 days, whichever is shorter. If the contractor fails to recoat within the specified time period, the surface to be painted shall be cleaned and abraded in accordance with manufacturer’s recommendations. This work shall be done at no additional cost to the State.

If the steel has become dirty between coats, the Contractor shall wash the bridge again at no additional cost to the State.

**574-3.05 Painting for Localized Cleaning and Painting.** The paint shall appear on the Department’s Structural Steel Paints – Class 1 Approved List, or Structural Steel Paints – Class 2 Approved List and be approved for localized application.

The Contractor shall apply each coat of paint in the order listed on the Department’s Approved List.

All of the requirements of §574-3.04 shall apply with the exception of area painted. Only areas that have been cleaned shall be painted. Paint shall not extend more than 6 inches beyond all power-cleaned areas.

**574-4 METHOD OF MEASUREMENT**

**574-4.01 Overcoating - Lump Sum.** The work under this item will be measured on a lump sum basis, per structure.

**574-4.02 Overcoating - Square Feet.** The measurement of this item will include the area requiring overcoating, measured to the nearest whole square feet.

**574-4.03 Localized - Square Feet.** The quantity to be measured will be in square feet of area of steel cleaned and painted, measured the nearest whole square feet.

**574-5 BASIS OF PAYMENT**

The lump sum price bid shall include the cost of all labor, materials, and equipment necessary to complete the work, including the cost of providing protection against damage to public and private property during pressure washing and paint application. Payment for the containment, collection and disposal of dust and paint waste generated by surface preparation work shall be paid for separately.

Progress payments will be based on the percentage of steel cleaned and painted. 60% of the quantity will be paid for surface preparation and priming. The remaining amount will be paid following the satisfactory completion of work.

**Payment will be made under:**

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<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<td>574.02nnn</td>
<td>Structural Steel Painting: Overcoating</td>
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<tr>
<td>574.03nnn</td>
<td>Structural Steel Painting: Localized</td>
<td>Square Foot</td>
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</table>
NOTE: nnnn denotes a serialized pay item.

SECTION 575 (VACANT)

SECTION 576 - BRIDGE DRAINAGE SYSTEM

576-1 DESCRIPTION. This work shall consist of furnishing and placing scuppers, drainage troughs and downspout systems for bridge drainage as shown on the plans and in accordance with the specifications.

576-2 MATERIALS

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<tr>
<th>Material Description</th>
<th>Specification</th>
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<td>Fabricated Steel Scuppers (Except Gratings)</td>
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<td>ASTM A36 and 715-01</td>
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<td>ASTM A108, Grade 1015 or 1020</td>
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<td>Grating Plates and Bars</td>
<td>ASTM A36, A242, or A572, and 715-01</td>
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<td>Bars²(A1, A2) and Plates²(B1, B2, C1 and C2)</td>
<td>ASTM A575, Grades 1015 and 1020</td>
</tr>
<tr>
<td>Rods (fully threaded) and Bolts³</td>
<td>ASTM A307</td>
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<tr>
<td>Clamps, Malleable Iron</td>
<td>ASTM A47/A47M, Grade 32510 and 715-09</td>
</tr>
<tr>
<td>Ductile Iron Downspout Pipe and Pipe Fittings</td>
<td>ASTM A377 (ANSI 21.51)³</td>
</tr>
<tr>
<td>Pipe Couplings³ (Ductile Iron or Malleable Iron)</td>
<td>ASTM A536 or A47/A47M Grade 32510</td>
</tr>
<tr>
<td>Hoppers⁶</td>
<td>ASTM A36 and 715-01</td>
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<tr>
<td>Pipe Brackets and Supports</td>
<td>ASTM A575, Grade 1015 and 1020</td>
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<tr>
<td>Anchors</td>
<td>GSA FS-S-325 Group I, Type I, Class I</td>
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<tr>
<td>Nuts and Bolts⁶</td>
<td>ASTM A307</td>
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<tr>
<td>PVC Downspout Pipe, Fittings and Solvent Cement</td>
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</tr>
<tr>
<td>Protective Cover (Cellular Polystyrene)</td>
<td>706-16</td>
</tr>
</tbody>
</table>

NOTES:
1. In addition to the requirements of 715-01, Structural Steel, the Contractor will be required to furnish the Deputy Chief Engineer (Structures), two (2) certified copies of the records of the chemical analysis of the steel.
2. Bars shall be 5/8 inch diameter. Plates shall be 2 x 1/4 inch.
4. All pipe shall be groove cut around the full pipe circumference at both ends. The grooves shall be radius cut in accordance with AWWA C606. The grooves shall be such that a keyed housing clamp coupling shall fit into them. The grooves shall be such that a keyed housing clamp coupling shall fit into them. Unless otherwise approved, all pipe bends (elbows) shall be of the long radius type.
5. All couplings shall be gasketed, double keyed, housing clamps designed to lock and seal the joint between two grooved pipes, or fittings, when the housing clamp is bolted and tightened in place. The gasket shall be a molded or extruded compound of Butyl or EPDM, suitable for water service.
6. Galvanized in accordance with the requirements of 719-01. Nuts and bolts shall be galvanized in accordance with 719-01, Type II.

576-3 CONSTRUCTION DETAILS

576-3.01 Fabrication
A. Shop Drawings. Shop drawings will not be required for scuppers, drainage troughs or downspout systems.

B. Welding

1. Fabricated Steel Scuppers, Gratings. Welding shall conform to the provisions of the SCM. Weld inspection shall be done in accordance with the requirements of the SCM but radiographic testing will not be required. All groove welds shall be complete joint penetration groove welds unless otherwise approved by the DCES.

2. Drainage Troughs. Field Welding (by heat) of the polyvinyl chloride trough material shall not be allowed without written permission of the Deputy Chief Engineer (Structures).

C. Galvanizing

1. Scuppers and Troughs. Galvanizing shall conform to the requirements of §719-01, Galvanized Coatings and Repair Methods. Galvanizing shall be done after all welding and fabrication is completed.

2. Bolts, Fully Threaded Rods and Nuts. All bolts and rods shall have a ANSI B1.13M Class 6H thread. All galvanized nuts shall have a standard oversize tap to allow for the galvanizing on the bolts, rods and nuts.

D. Gratings. Gratings for Types B1 and B2 scuppers shall have a full and even bearing on the underlying surface.

E. Basis of Acceptance. Scuppers, drainage troughs and downspouts shall be accepted at the work site by the Engineer-in-Charge upon certification of the manufacturer that the materials used and fabrication procedure employed conform to the requirements of section 576. The Engineer may reject any scupper, drainage trough or downspout system which, in his opinion, exhibits poor quality or workmanship.

576-3.02 Erection of Downspout Systems

A. General

1. Pipe Installation. The pipe shall be laid true to line and grade as shown on the plans or as directed by the Engineer, with joints close and even, so that a true and even surface of invert will be made over the joints throughout its entire length. Horizontal pipe shall be installed so that the minimum slope shall not be less than 1:50. Pipe shall be placed in accordance with the requirements of this specification unless special methods are called for on the plans or in the itemized proposal.

2. Field Testing. Prior to the acceptance of the structure by the Department, the downspout system should be flushed out and tested to insure that it is flowing at full capacity. Any obstruction in the downspout system preventing the free flow of drainage or its operation at full capacity shall be removed to the complete satisfaction of the Engineer.

B. Ductile Iron Downspouts
1. **Pipe Supports.** Supports for horizontal piping shall be spaced 5 feet maximum. Supports for vertical piping shall be spaced 6 feet maximum.

2. **Pipe Joints.** All joints in pipe, except when encased in concrete, shall be made with groove type couplings. Pipes encased in concrete shall have joints formed in accordance with the pipe manufacturer's recommendations.

3. **Painting.** All metal embedded in concrete shall not be painted. All other metallic portions of the downspout system shall be painted in the field in accordance with the requirements of the contract documents. Color shall be as shown on the plans.

**C. PVC Downspouts and Protective Insulator**

1. **Pipe Joints.** PVC pipe joints shall be sealed in the following manner: All necessary cuts shall be square and clean from burrs. Mating surfaces of pipe and fittings shall be cleaned with methyl ethyl ketone or acetone prior to solvent cement application. The solvent cement shall be applied as recommended by the manufacturer. The pipe and fitting should be joined with a twisting motion to distribute cement uniformly. The solvent cement manufacturer's recommendations for cure time shall be followed.

2. **Protective Insulator.** The protective insulator shall be attached to the pipe in such a manner so as to prevent its dislodgement as the concrete is placed. Suitable methods would include taping the joints with a weather resistant tape or bonding with a non-metallic substance.

3. **Form Wire.** The PVC pipe and its protective insulator shall be held in place by form wire in such a manner as to provide sufficient lateral support to prevent movement as the concrete is placed.

4. **Vibrator.** Particular caution shall be taken to prevent the vibrator from striking the pipe and its protective insulator during the placing of concrete.

**576-4 METHOD OF MEASUREMENT**

**576-4.01 Scuppers.** Payment will be made at the unit price bid for each type of scupper furnished and placed as shown on the plans and in accordance with the specifications.

**576-4.02 Drainage Troughs.** The trough shall be measured as the number of feet measured along the center line of each polyvinyl chloride section, furnished and placed as shown on the plans and in accordance with the specifications.

**576-4.03 Downspout System.** The downspouts will be measured as the number of feet measured along the center line of pipe between the extreme outer limits of downspouts, including hoppers, furnished and placed as shown on the plans and in accordance with the specifications.

**576-5 BASIS OF PAYMENT**

**576-5.01 Scuppers.** The unit price bid for each type of scupper shall include the cost of furnishing all labor, equipment and materials necessary to set the scupper to its proper line and grade. No additional payment will be made for furnishing and placing the grating for the Type B1 or B2 scupper.
576-5.02 Drainage Troughs. The unit price bid per foot shall include the cost of furnishing all labor, materials and equipment necessary to erect the trough and its threaded rod supports as indicated on the plans.

576-5.03 Downspout System

A. General. The unit price bid per foot shall include the cost of furnishing all labor, materials and equipment necessary to erect the pipe and pipe fittings, pipe supports, hoppers, nuts, bolts, washers, to provide cleanouts if indicated on the plans, straps to cap and plug the pipe if necessary, and to replace cracked or otherwise defective material necessary to complete the work.

B. Ductile Iron Downspouts. The unit price bid per foot shall also include the cost of furnishing and placing pipe hangers and brackets, grooved type couplings and paint.

C. PVC Downspouts and Protective Insulator. The unit price bid per foot shall also include the cost of furnishing and placing the protective insulator and all adaptor fittings required at the juncture of PVC Pipe and Ductile Iron Pipe.

D. Excavation. All required excavation will be paid for under pay item 206.02 Trench and Culvert Excavation and 206.04 Trench and Culvert Excavation - O.G.

Payment will be made under:

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<tr>
<th>Item No.</th>
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<tr>
<td>576.02</td>
<td>Scuppers (Type B)</td>
<td>Each</td>
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<tr>
<td>576.10</td>
<td>Drainage Trough</td>
<td>Foot</td>
</tr>
<tr>
<td>576.2001</td>
<td>Downspout System (Ductile Iron)</td>
<td>Foot</td>
</tr>
<tr>
<td>576.21</td>
<td>Downspout System (PVC)</td>
<td>Foot</td>
</tr>
<tr>
<td>576.2201</td>
<td>Downspout System (Ductile Iron and PVC)</td>
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</tbody>
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SECTION 577 (VACANT)

SECTION 578 - BONDED CONCRETE OVERLAY FOR STRUCTURAL SLABS

578-1 DESCRIPTION. Prepare the surfaces that will be in contact with slab reconstruction concrete and place slab reconstruction concrete. Prepare the structural slab surface and place a Class E, bonded concrete overlay.

578-1.01 Scope. Concrete removal work will be paid for under the appropriate item(s). Minimum thickness of the overlay concrete is 3 inches. Include the cost of any grade changes necessitated by this requirement in the unit bid price for overlay concrete.

578-1.02 Definitions

A. Overlay Concrete. Class E Concrete placed over existing and slab reconstruction concrete.

B. Slab. Reconstruction Concrete. Concrete placed completely around the exposed top mat of bar reinforcement. Slab reconstruction concrete will be Class D for Method 1 and Class E for Method 2, as described in §578-1.03 Placement Methods.

578-1.03 Placement Methods.
A. Method 1 - Separate Placement. Place Class D slab reconstruction concrete and Class E overlay concrete separately.

B. Method 2 - Integral Placement (Optional). When 100% of the top mat of bar reinforcement is exposed or when all of the following conditions are satisfied, Class E overlay concrete and Class E slab reconstruction concrete may be placed in a single lift.

1. The area of the exposed top mat of bar reinforcement is 5% or less of the placement area, per span.
2. No individual area of the exposed top mat of bar reinforcement exceeds 25 sf.
3. No dimension of any area of the exposed top mat of bar reinforcement exceeds 6 feet.

578-2 MATERIALS. All material listed under §557-2.

578-3 CONSTRUCTION DETAILS.

578-3.01 Blast Cleaning. §584-3.02

578-3.02 Preplacement Wetting. §584-3.03

578-3.03 (Vacant)

578-3.04 Handling and Placing Concrete. §584-3.05

578-3.05 Construction Joints. §584-3.07

578-3.06 Finishing and Curing Slab Reconstruction Concrete - Separate Placement. §584-3.09

578-3.07 Finishing Bonded Concrete Overlay. §557-3.07

578-3.08 Curing Bonded Concrete Overlay. §557-3.11 with the following: Cure concrete with wet burlap for 7 days. Provide uniform continuous wetting until concrete curing is complete. The wet burlap and curing cover option is not allowed.

578-3.09 Opening to Traffic. Traffic is allowed only after completion of the required curing period.

578-3.10 Defective or Damaged Concrete. §584-3.08

578-4 METHOD OF MEASUREMENT. For placements with 100% exposure of the top mat of bar reinforcement, the number of square feet of slab reconstruction concrete will be equal to the number of square feet of overlay concrete.

For placements with less than 100% exposure of the top mat of bar reinforcement, measure slab reconstruction concrete prior to overlay concrete placement.

A. Method 1- Separate Placement. Measure slab reconstruction concrete as the number of square feet of Class D slab reconstruction concrete placed. Measure overlay concrete as the number of square feet of plan area of Class E overlay concrete placed.

B. Method 2- Integral Placement (Optional). Measure slab reconstruction concrete as the number of square feet of Class E slab reconstruction concrete placed. Measure overlay concrete as the number of square feet of plan area of Class E overlay concrete placed.
578-5 BASIS OF PAYMENT. Include the cost of all labor, materials and equipment necessary to complete the work in the unit bid price.

Payment will be made under:

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<td>Overlay Concrete, Class E – Type 2 Friction</td>
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<td>578.1203nn</td>
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<td>578.1209nn</td>
<td>Overlay Concrete, Class E – Type 9 Friction</td>
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</tr>
<tr>
<td>578.1300nn</td>
<td>Slab Reconstruction Concrete, Class D or E</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

NOTE: nn denotes a serialized pay item.

SECTION 579 - STRUCTURAL SLAB RECONSTRUCTION PREPARATION

579-1 DESCRIPTION. The work shall consist of initially preparing an existing structural slab for reconstruction. Generally, this work shall entail the removal of concrete to the depths, and at the locations, required by the contract documents.

579-1.01 Structural Slab Scarification

A. This work shall consist of removing the top surface of structural slab concrete. Removal shall be done by scarification to the following limits, unless a greater depth is indicated on the plans:

- Minimum of 1/4 inch
- Maximum of 1/2 inch

B. After scarification, if a structural slab survey is required, the surface to be surveyed shall be cleaned sufficiently to allow the survey to be taken. The Engineer will determine if the surface is cleaned sufficiently to allow performance of the necessary delamination and potential survey tests.

C. All removed materials shall be transported from the work site and disposed of or disposed of in an area on the job site approved by the Engineer.

579-1.02 Exposure of Reinforcing Bars

A. Definitions

1. Bar Mat. That combination of transverse and longitudinal reinforcing steel placed with the structural slab to absorb stresses. Structural slabs generally contain two bar mats; an upper mat and a lower mat.

2. Upper Mat. That bar mat closest to the existing top surface of the structural slab. Only the upper mat is relevant to this work, except in localized areas.

3. Localized Area. An area where full depth removal and subsequent patching will be done as part of this work. For the work of this section a localized area shall not exceed 25 sf. The sum of the localized areas shall comprise no more than five percent (5%) of the structural slab area to be prepared.

B. The work shall consist of structural concrete removal from the periphery of the upper mat reinforcing bars to provide a minimum clearance of 1 inch between the reinforcing bar surface and
the remaining concrete surface. In addition, the Engineer may order the removal of other concrete. (Refer to 579-3, Construction Details).

C. All work performed under the requirements of this subsection shall not extend beyond a plane which is 5 inches below the original top of slab, except for localized areas.

D. Removed materials shall be disposed of in accordance with 579-1.01B.

579-2 MATERIALS

<table>
<thead>
<tr>
<th>Class A Concrete¹</th>
<th>501²</th>
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<tbody>
<tr>
<td>Quilted Covers (for curing concrete)</td>
<td>711-02</td>
</tr>
<tr>
<td>Plastic-Coated Fiber Blankets (for curing)</td>
<td>711-03</td>
</tr>
</tbody>
</table>

NOTES:
1. 501, Class D Concrete, may be substituted at no extra cost.
2. For quantities of 5 cy of total project placement, or less, automatic batching equipment will not be required.

579-2.01 Equipment

A. Power Operated Scarifier. The specific equipment the Contractor proposes to use shall be approved by the Engineer prior to use. Power bush hammers, or other impact type devices which indent or pulverize the surface shall not be allowed under any circumstances.

B. Pneumatic Hammers and other equipment. These shall be subject to the Engineer's approval prior to use. Pneumatic hammers shall meet the requirements of §580-3.02

C. Other Equipment. All other equipment proposed for use shall be approved by the Engineer prior to actual employment in the work.

579-3 CONSTRUCTION DETAILS. The Contractor shall exercise care during the execution of the work to avoid damaging or loosening material that is to remain. All damage caused by the Contractor's operations to material that is to remain shall be repaired, or the material replaced as determined by the Engineer. All repair and replacement work shall be done in a manner satisfactory to the Engineer.

579-3.01 Structural Slab Scarification. Scarification of designated areas shall be accomplished with a power operated scarifier. Inaccessible areas will be scarified with pneumatic hammers.

579-3.02 Reinforcing Bar Exposure

A. Concrete shall be removed from the uppermost reinforcing bars of the structural slab to the limits designated by §579-1.02B. The Contractor may remove concrete, to the designated minimums, from around both sets of bars in the upper mat.

B. If concrete is removed only from the periphery of the uppermost bar, removal shall be done in accordance with those details indicated on the plans.

C. If the Contractor chooses to remove concrete from the periphery of both bars of the upper mat, or if the Engineer determines that:
   • The lower bar is corroded; OR
   • The concrete around the lower bar is deteriorated; OR
   • Delamination extends to the level of, or below, the lower bar; OR
   • The lower bar is debonded;
then the concrete shall be removed from the periphery of the lower bar in accordance with the details indicated on the plans.

D. At locations where deteriorated concrete extends beyond the minimum removal limits, the Engineer will order its removal. The Engineer will be the sole determiner of what constitutes deteriorated concrete. This ordered removal shall be part of this work, except that removal of deteriorated concrete below the limit established by §579-1.02C, shall be part of this work only within the limits of localized areas.

Locations where concrete is removed beyond minimum limits, lacking specific orders from the Engineer directing such removal, will be designated as damage locations. All damage locations shall be repaired in a manner satisfactory to the Engineer, at no additional cost to the State.

E. At localized areas, the Engineer may order concrete removal below the plane established by §579-1.02C. When such removal reaches the uppermost bar of the lower reinforcing bar mat, removal shall be continued until full depth removal is achieved.

F. Care shall be exercised when removing concrete to avoid damaging reinforcement, or other materials, which are to remain in place. Reinforcing steel damaged by the Contractor's operations shall be replaced with new reinforcing steel of the same size, appropriately spliced. Reinforcing steel splices shall be made in accordance with the details shown on the plans. Other materials designated to remain in place, which are damaged by the Contractor's operations, shall also be replaced.

579-3.03 Full Depth Patches. Refer to the details indicated on the plans.

A. Immediately prior to placing new concrete, the reinforcing bars and the edges of the existing structural slab, which will be in contact with new concrete, shall be blast cleaned. Forms shall be drawn tightly. Preparation and formwork shall be approved by the Engineer prior to any concrete placement. “After blast cleaning has been accepted, thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing water with oil-free compressed air, and protect the surface from drying, so the concrete remains in a saturated surface dry condition when placing bonding grout.

B. Concrete shall be placed and consolidated in accordance with the requirements of §555-3.04. The uppermost surface of the concrete patch shall be level with the highest of the surrounding prepared surfaces. The uppermost surface shall be intentionally roughened. The Engineer may require that a coarse textured drag be used on the plastic concrete surface.

C. Concrete shall be cured, in a manner approved by the Engineer, for a minimum of 72 curing hours prior to any other concrete placement work in contact with the curing concrete. A curing hour is defined as any hour, starting from the hour of placement, during which the ambient air temperature at the concrete surface remains at, or above 45°F as measured by a recording thermometer. Curing shall be done by means of quilted covers (§711-02), or plastic coated fiber blankets (§711-03). Quilted covers, if used, shall be kept wet during the entire curing period. The use of curing compounds shall not be allowed.

579-3.04 Hydrodemolition Equipment. Hydrodemolition equipment, if approved by the Engineer, shall be subject to the following:

A. Water Filtration and Disposal. At least two weeks prior to the employment of any hydrodemolition equipment, the Contractor shall submit to the Engineer, for approval, a comprehensive plan for the filtration and disposal of hydrodemolition water.

This plan shall ensure, to the extent practical, that all debris particles will be removed from hydrodemolition water, prior to its being introduced into any lake, river, stream, or any drainage system which empties into a lake, river or stream.

The Contractor is specifically notified that use of the existing bridge drainage system for hydrodemolition water disposal will not be permitted.
**B. Water Retention.** Hydrodemolition water shall be prevented from running onto, or over all portions of the project site not immediately subject to hydrodemolition work. In addition, the Contractor shall provide shielding, acceptable to the Engineer, that protects traffic and prevents all debris from escaping the immediate work location. A comprehensive plan for accomplishing these requirements shall be submitted to the Engineer, for approval, at least two weeks prior to the beginning of any hydrodemolition work.

The Contractor is specifically notified that use of the existing bridge drainage system, for this purpose, will not be permitted.

The plan for this work may be submitted as part of the requirements of §579-3.04A.

**C. Adherence.** Once approved, the water filtration and disposal, as well as the water retention plans shall be strictly adhered to by the Contractor. Should the Engineer determine that these plans are not being followed as approved, the Contractor will be required to immediately cease work until the conditions are rectified in a manner satisfactory to the Engineer.

Should the Contractor fail to rectify the situations to the Engineer's satisfaction, the Engineer may, with the concurrence of the D.C.E.C., require the Contractor to use equipment other than hydrodemolition equipment.

No extension of time will be granted, nor will any additional compensation be granted, for either the ceasing of work, or the substitution of equipment, if either one is required as a result of the Contractor's failure to follow the approved plans.

**D. Debris Removal.** All debris shall be removed quickly enough to prevent rebonding of the debris to the concrete surface. All debris which rebonds shall be removed in a manner satisfactory to the Engineer at no cost to the State.

Material designated to be left in place, which is damaged by rebonded debris removal work, shall be repaired in a manner satisfactory to the Engineer at no cost to the State.

579-4 METHOD OF MEASUREMENT

**579-4.01 Structural Slab Scarification.** The work will be measured as the number of square feet stated in the Estimate of Quantities shown on the plans. Except to allow for progress payments, no field measurements will be taken. Field measurements for progress payments shall not exceed the Estimate of Quantities figure.

**579-4.02 Reinforcing Bar Exposure.** The work will be measured as the number of square feet of concrete removed. Quantities will be determined from field measurements.

**579-5 BASIS OF PAYMENT.** The unit price bid per square foot shall include the cost of all labor, materials and equipment necessary to complete the work. No additional payment will be made for removals, repairs or replacements made necessary due to the Contractor's operations.

**579-5.01 Reinforcing Bar Exposure.** The unit price bid per square foot shall include the cost of all labor, material and equipment necessary to perform full depth patching in localized areas. Full depth concrete removal, and full depth patching, in excess of the limits established for localized areas will be paid for as extra work.

*Payment will be made under:*

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<tr>
<td>579.02</td>
<td>Reinforcing Bar Exposure</td>
<td>Square Foot</td>
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SECTION 580 - REMOVAL OF STRUCTURAL CONCRETE
(Last Revised September, 2016)

580-1 DESCRIPTION. This work shall consist of removal and disposal of structural concrete from structural concrete elements, concrete approach slabs, concrete bridge pylons, concrete from structural steel members, and other concrete removal and disposal in accordance with the contract documents and as directed by the Engineer.

580-2 MATERIALS. Not Specified.

580-3 CONSTRUCTION DETAILS

580-3.01 General. The Contractor shall remove structural concrete in accordance with the contract documents, so as not to damage material designated to remain in place. Reinforcement designated to remain in place shall be cleaned.

The Contractor shall only remove structural concrete from elements to remain to the limits shown in the contract documents, in order to preserve structural adequacy and stability. Replacement concrete shall be placed and allowed to reach its initial set prior to any additional removals. A minimum of 7 calendar days prior to beginning removal of structural concrete, the Contractor shall provide a Structural Concrete Removal Plan for acceptance by the Engineer. The Structural Concrete Removal Plan shall identify the equipment to be used, the sequence of operations, provisions for protection of structural steel, provisions for removal and disposal of material, and any additional work zone traffic control or worker safety provisions.

580-3.02 Removal of Structural Concrete. The Contractor shall remove concrete to a sound surface in accordance with the contract documents. The removal operation shall be angled inward creating a key. Small angle corners shall be minimized per contract documents to prevent voids. Reinforcing bars and miscellaneous material shall be removed or shall be retained, as shown in the contract documents. After removal of concrete has been performed, surfaces designated to come in contact with new concrete placements shall be cleaned in order to ensure proper bonding with the new concrete. Concrete surfaces to be cleaned shall be thoroughly blast cleaned or abraded by other mechanical means to remove remaining loose material. After blast cleaning or abrading, vertical or overhead surfaces shall be air-blown, or rinsed with water to remove dust. Other surfaces shall be vacuum cleaned.

Demolition or chipping hammers shall weigh no more than 45 lbs excluding the weight of the bit and muffler. The hammers shall deliver no more than 1600 blows per minute. The Contractor shall provide the Engineer information from the hammer manufacturer to assure that these requirements are not exceeded. The air pressure used to power the hammer shall not exceed 110 psi, measured at the air compressor, as shown by an air pressure gauge in proper working condition provided by the Contractor. Only sharp chisel point bits, a minimum of 2 inches wide, shall be used.

If the Contractor's operations result in damage to concrete that is to remain, the Contractor shall make immediate corrections to prevent damage. Exceptions to the hammer limitations shall be approved by the Deputy Chief Engineer (Structures) prior to use.

580-3.03 Removal of Concrete Approach Slabs. The Contractor shall remove concrete approach slabs in accordance with the contract documents. Sawcutting of the concrete approach slab in order to separate it from existing abutment will be shown in the contract documents and paid for separately.

580-4 METHOD OF MEASUREMENT

580-4.01 General. Vacant.
580-4.02 Removal of Structural Concrete. The quantity to be measured for payment will be in cubic yards measured to the nearest 0.1 cubic yards of concrete removed.

580-4.03 Removal of Concrete Approach Slabs. The quantity to be measured for payment will be in square feet of concrete approach slab removed, measured to the nearest whole square foot.

580-5 BASIS OF PAYMENT

580-5.01 General. Vacant.

580-5.02 Removal of Structural Concrete. The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, and all costs of disposal.

580-5.03 Removal of Concrete Approach Slabs. The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including any sawcutting other than separating the approach slab from the existing abutment, and all costs of disposal.

Payment will be made under:

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<td>580.01</td>
<td>Removal of Structural Concrete</td>
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<tr>
<td>580.04</td>
<td>Removal of Concrete Approach Slab</td>
<td>Square Foot</td>
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</table>

SECTION 581 - REMOVAL OF BRIDGE OVERLAYS

581-1 DESCRIPTION. The work shall consist of the removal and disposal of bridge overlays, reinforcement, if present, and any miscellaneous materials encountered, as shown on the contract plans.

581-2 MATERIALS. Not specified.

581-3 CONSTRUCTION DETAILS. Not specified.

581-4 METHOD OF MEASUREMENT. The work shall be measured by the area of bridge overlay, removed and disposed of. The quantities will be determined from field measurements.

581-5 BASIS OF PAYMENT. The unit price bid per square foot shall include the cost of furnishing all labor and equipment to complete the work.

Payment will be made under:

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<td>581.02</td>
<td>Removal of Cement Concrete Overlay</td>
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</tbody>
</table>

SECTION 582 - REMOVAL AND REPLACEMENT OF STRUCTURAL CONCRETE

582-1 DESCRIPTION. The work shall consist of the removal and disposal of unsound structural concrete from an existing structure and its replacement with new structural concrete, or an approved patching material, as indicated on the contract plans, or as ordered by the Engineer. All work shall be done at the locations indicated on the contract plans, or where ordered by the Engineer.

All miscellaneous materials, not including bar reinforcement, encountered during the removal of unsound structural concrete, shall be removed and disposed of unless otherwise indicated on the contract plans, or ordered by the Engineer.
582-2 MATERIALS. Materials used in this work shall conform to the following requirements:

Vertical and Overhead Patching Material 701-08
Water 712-01
Quilted Covers (for curing) 711-02
Plastic Coated Fiber Blankets (for curing) 711-03
Membrane Curing Compound 711-05
Admixtures 711-08

582-2.01 Replacement Concrete. Concrete shall be Class A or Class D concrete for structures. It shall conform to the requirements of Section 501 - Portland Cement Concrete - General.

582-2.02 Vertical and Overhead Patching Material. The patching material used shall be a brand that appears on the Department's Approved List.

582-3 CONSTRUCTION DETAILS

582-3.01 Repair Determinations. The choice of replacement material will be indicated on the plans, determined by the Engineer, or determined by the contractor. The Contractor's determinations shall be made in accordance with the criteria of this subsection, and only in the absence of directions from the plans, or the Engineer. The Contractor's determinations shall be approved by the Engineer prior to the actual performance of the work.

A. Horizontal or Essentially Horizontal Locations. Class A, Class D or Class DP concrete shall be used. Class A concrete shall be placed only at locations where removal depths average greater than 5 inches. Class D concrete shall be placed only at locations where removal depths average between 1 ½ and 5 inches. Class D or DP may be used for pedestal repairs when access is limited and where placement dimensions are greater than 1½ inches but do not exceed 12 inches. Average depth shall be determined by a measurement procedure acceptable to the Engineer.

B. Vertical or Essentially Vertical Locations. Class A concrete, Class D concrete, or approved patching material shall be used. Concrete classes shall be restricted to the depth limitations noted for horizontal locations. Patching material shall be placed at locations where removal depths average between 1/2 and 1 1/2 inches. Average depths shall be determined by a measurement procedure acceptable to the Engineer.

C. Overhead. Class A, Class D or approved patching material shall be used when formwork is provided. Concrete classes shall be restricted to the depth limitations noted for horizontal locations. Approved patching material may be used without formwork provided lift thicknesses do not exceed 1 inch. Anchoring devices shall be used when patching material is used for repair depths of 1½ inches or greater.

D. Pockets. Locations, within locations of 1 1/2 inches in average depth or less, which exceed this average depth, shall be filled with Class A, or Class D, concrete in accordance with the limitations outlined under horizontal locations.

582-3.02 Removal of Unsound Concrete. All unsound concrete shall be removed to a sound surface as determined by the Engineer. If called for on the plans, the existing concrete shall be saw-cut to obtain a straight joint between the existing concrete and the new material. Care shall be exercised while removing the unsound concrete so as not to damage materials which are to remain in place. Exposed reinforcement
remaining in place shall be cleaned in accordance with the requirements of §584-3.02A. Chipping hammers shall meet the requirements of §580-3.02.

**A. Removal for Concrete Replacement.** The minimum depth of removal shall be the greater of the following:

- A depth no less than 1 1/2 inches from the rear most point of reinforcement to sound concrete.
- The depth necessary to reach sound concrete.

Should the removal depth exceed 6 inches, the Engineer may order supplementary anchoring as part of the replacement procedure. The sides of the cavity shall be made at a slight angle, so that the width of the base of the cavity is greater than the opening at the surface, thereby providing a key.

**B. Removal for Patching material Replacement.** Feather edges shall not be permitted. The minimum patch depth shall be 1/2 inch as measured from the theoretical plane of the original concrete surface.

**582-3.03 Preparation of Surface**

A. All surfaces receiving new material shall be blast cleaned in accordance with the requirements of §584-3.02.
B. Bar reinforcement shall be placed at the location indicated on the plans, and at all additional locations determined by the Engineer.
C. Existing reinforcement, which, in the Engineer's opinion, has lost significant section, shall be repaired in a manner satisfactory to the Engineer.
D. Bar placement, and bar repair work directed by the Engineer will be paid for separately.

**582-3.04 Placement.** Air clean the surface with oil-free compressed air. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface, and all porous surfaces to be in contact with new concrete, for 12 hours. This may be accomplished by continuous wetting with soaker hoses or the use of burlap/burlene/et etc. where moisture can be maintained. If, in the opinion of the Engineer, conditions or the situation prohibits this, then the surfaces should be wetted for as long as possible. Surfaces must be wetted by a means acceptable to the Engineer using potable water.

The Contractor shall remove any puddles of free standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete. No material shall be placed if the ambient air, or concrete surface temperature is at, or below 45°F.

**A. Concrete Placement.** All concrete placements shall be in accordance with the applicable requirements of the following subsections:

- 555-3.02, 555-3.03A, 555-3.04, 555-3.06, 555-3.07, 555-3.08.

If formwork configuration, or clearances between formwork, steel and existing concrete are such that Class A, or D, concrete cannot be placed without voids, or honeycombing, the Contractor may, with the Engineer's permission, use an approved high range water reducer to increase the concrete's workability. Approved high range water reducers appear on the Department's Approved List.

The high range water reducer shall be added at the work site only and shall be dispersed uniformly throughout the plastic concrete. The Engineer shall approve the Contractor's dispersal methods and devices prior to their actual use.

The high range water reducer shall be added only after the concrete has reached the proper slump and contains the required quantity of air. No more than two additions of the admixture shall be made.
and the manufacturer's maximum dosage rate shall not be exceeded. After the admixture has been added, the concrete shall be mixed an additional 30 revolutions. The second admixture addition shall be made only after the 30 revolutions required for the first addition have been completed. It is the responsibility of the Contractor to ensure that concrete slump does not exceed 9 inches, and air content remains within specification requirements. Plastic concrete mixes failing to meet the foregoing requirements will be subject to rejection. Replacement will be done at the Contractor's expense.

The Engineer may allow high range water reducer to be added at the concrete batching facilities. Consideration for this procedure will be undertaken only after the Contractor has clearly demonstrated the capability of providing concrete which meets the requirements of this subsection.

B. Vertical and Overhead Patching Material Placement. Patching material shall be prepared in accordance with the directions provided by the manufacturer. The Engineer shall be given two copies of the manufacturer's printed instruction at least two weeks prior to the start of all patching work. This shall include the mixing proportions and the mixing method. The manufacturer's literature shall be consulted for surface preparation and priming instructions. The material shall be troweled on in layers, the thickness of which depends on the material consistency and the location and profile of the surface to which it is applied. However, lift thickness in excess of 1 inch will not be permitted without the use of anchoring devices or formwork at overhead locations. Special curing procedures are generally not required, except under conditions of high heat, low humidity, or strong winds, as defined by the manufacturer. The manufacturer should be consulted for specific curing procedures under these adverse conditions.

582-3.05 Form Removal. Form removal shall be in accordance with §555-3.09 with the following exception:

Forms shall be removed from thin concrete placements 24 curing hours after placement has been completed unless the Engineer determines the concrete is not strong enough to withstand damage. For purposes of this subsection, a thin concrete placement begins at the outermost surface of the new concrete and generally terminates at, or before, the midpoint of the main reinforcing steel. Concrete may be removed and replaced completely around one or two main reinforcing steel members to a depth no greater than 1 inch from the innermost surface of those members and still be considered a thin concrete placement. Main reinforcing steel members include reinforcing bars, but not spiral reinforcement or stirrups. Curing procedures shall be implemented immediately upon form removal.

582-3.06 Curing. Curing shall be performed according to the following:

A. Concrete. This shall be done in accordance with §555-3.08.

B. Vertical and Overhead Patching Material Curing. Manufacturer's recommendations for curing shall be followed for the patching material applications.

582-4 METHOD OF MEASUREMENT

582-4.01 Removal of Structural Concrete - Replacement with Class A Concrete. Measurement shall be made as the number of cubic yards of concrete placed where indicated on the contract plans, or where ordered or approved by the Engineer.

582-4.02 Removal of Structural Concrete - Replacement with Class D Concrete. Measurement shall be made as the number of square feet repaired as indicated on the contract plans, or where ordered or approved by the Engineer.
582-4.03 Removal of Structural Concrete - Replacement with Vertical and Overhead Patching Material. Measurement shall be made as the number of square feet of the plane projection of the repaired area as indicated on the contract plans, or where ordered or approved by the Engineer. Measurement shall be made prior to the placement of patching material.

582-5 BASIS OF PAYMENT

582-5.01 Removal of Structural Concrete - Replacement with Class A Concrete. The unit price bid per cubic yard shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that bar reinforcement removal and replacement shall be paid for separately. Progress payments will be made in accordance with §582-5.04.

582-5.02 Removal of Structural Concrete - Replacement with Class D Concrete. The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that bar reinforcement removal and replacement shall be paid for separately. Progress payments will be made in accordance with §582-5.04.

582-5.03 Removal of Structural Concrete - Replacement with Vertical and Overhead Patching Material. The unit price bid per square foot shall include all labor, materials and equipment necessary to complete the work. Progress payments will be made in accordance with §582-5.04.

582-5.04 Progress Payments. Progress payments will be made when the concrete removal is completed. Payment will be made at the unit price bid for 50% of the quantity removed. The balance of the quantity will be paid upon completion of the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>582.05</td>
<td>Removal of Structural Concrete - Replacement with Class A Concrete</td>
<td>Cubic Yard</td>
</tr>
<tr>
<td>582.06</td>
<td>Removal of Structural Concrete - Replacement with Class D Concrete</td>
<td>Square Foot</td>
</tr>
<tr>
<td>582.07</td>
<td>Removal of Structural Concrete - Replacement with Vertical and Overhead Patching Material</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

SECTION 583 - SHOTCRETE

583-1 DESCRIPTION

583-1.01 Work. The work shall consist of removal and disposal of unsound structural concrete and replacement with shotcrete where indicated in the contract documents and where ordered by the Engineer. The Contractor has the option of using either the Dry Mix Process or the Wet Mix Process.

583-1.02 Definitions

A Shotcrete. This is mortar conveyed through a hose and pneumatically projected at high velocity onto a surface.

B. Dry Mix Process. This is a process in which the dry cement-sand mixture is carried by compressed air to the nozzle where water is injected and the resulting mixture is jetted from the nozzle at high velocity onto the surface to be shotcreted.

C. Wet Mix Process. This is a process in which all the ingredients including water are thoroughly mixed and then jetted from the nozzle at high velocity onto the surface to be shotcreted.
D. Delivery System. This consists of the nozzle, water ring or air ring, and any necessary valves, connected to the delivery hose.

583-2 MATERIALS. Materials used in this work shall conform to the following requirements:

Portland Cement, Types 1 or 2  
Concrete Sand  
Water  
Wire Fabric For Concrete Reinforcing  
Expansion Bolt Anchors  
Hook Bolts Inserted in Expansion Bolt Anchors

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>Description</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quilted Covers (for curing)</td>
<td>711-02</td>
<td>Membrane Curing Compound</td>
<td>711-05</td>
<td></td>
</tr>
<tr>
<td>Plastic Coated Fiber Blankets</td>
<td>711-03</td>
<td>GSA FF-S-325,Group III,Type 1 or Group VIII,Type 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Membrane Curing Compound</td>
<td>711-05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE. The wire fabric shall be galvanized in accordance with ASTM A641M regular coatings. The wire fabric shall be fabricated from No. 12 wire spaced 2 inches (nominal) in each direction or No. 10 wire spaced 3 inches (nominal) in each direction. Wire used shall have a minimum yield strength of 35 ksi.

583-2.01 Equipment

A. Batching and Mixing Equipment. The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity.

B. Air Supply. The compressor shall be of adequate capacity to maintain a sufficient, constant nozzle velocity for all parts of the work while simultaneously operating a blow pipe for cleaning away rebound. The air hose shall be equipped with a filter to prevent any oil or grease from contaminating the shotcrete.

C. Delivery Equipment

1. Dry Mix Process. The delivery equipment shall be capable of delivering a continuous, smooth, uniformly mixed material to the nozzle. The nozzle shall be equipped with a water ring and valve to permit adjustment of the water. The water added to the dry mix material at the nozzle shall be maintained at a pressure at least 16 psi greater than the air pressure. The nozzle shall be capable of delivering a conical discharge stream.

2. Wet Mix Process. Only pneumatic-feed type of delivery equipment will be allowed. Positive displacement type of equipment will be allowed pending a qualification test prior to the beginning of the work, which will also be the qualification test for the operator. The nozzle shall be equipped with an air ring for injecting compressed air into the material flow.

583-2.02 Qualification Test. If encasement of reinforcing bars is required, this test shall be performed to qualify the shotcrete operator and the equipment, prior to beginning work. Each shotcrete operator shall be qualified by constructing a 2 x 2 foot test panel fabricated to duplicate the project shotcreting. Reinforcement shall be placed in the panel to provide a minimum 1 inch (front and rear) embedment and be of the same size and spacing encountered in the structure. Panels shall be shot in the vertical, horizontal, and overhead positions as expected to be encountered. After setting, the test panel shall be broken open in a manner approved by and in the presence of the Engineer, to verify the reinforcement embedment. If voids are discovered, the work shall not proceed; additional panels shall be constructed until results acceptable to the Engineer are achieved. Small non-interconnected voids, as determined by the Engineer, shall not constitute failure.
Additional qualification panels will be required whenever, in the opinion of the Engineer, the shotcrete operation significantly changes.

583-3 CONSTRUCTION DETAILS

583-3.01 Preparation of Surfaces. All unsound concrete shall be removed until there are no offsets in the cavity which would cause an abrupt change in thickness, except for a transition from above to below reinforcement. Minimum 1/2 inch square shoulders shall be left at the perimeter of the cavity. The final cut surface shall be sound and properly shaped. The sound surface shall be blast cleaned. Abrasive material used for blast cleaning shall contain no more than one percent free silica by weight. Air clean the surface with oil-free compressed air. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface and all porous surfaces to be in contact with new concrete for 12 hours. This may be accomplished by continuous wetting with soaker hoses or the use of burlap/burlene/etc. where moisture can be maintained. If in the opinion of the Engineer conditions or the situation prohibits this then the surfaces should be wetted for as long as possible. Surfaces must be wetted by a means acceptable to the Engineer using potable water. The Contractor shall remove any puddles of free standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete.

![TABLE 583-1 SIZE AND SPACING OF HOOK-TYPE BOLTS (inches)]

<table>
<thead>
<tr>
<th>Thickness of Placement</th>
<th>Underside &amp; Vertical Surfaces Nominal Size and Spacing&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Topside Nominal Size and Spacing&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1/4 dia. @ 18 ctrs.</td>
<td>1/4 dia. @ ctrs. 24</td>
</tr>
<tr>
<td>4</td>
<td>3/8 dia. @ 24 ctrs.</td>
<td>3/8 dia. @ ctrs. 36</td>
</tr>
<tr>
<td>5</td>
<td>3/8 dia. @ 21 ctrs.</td>
<td>3/8 dia. @ ctrs. 36</td>
</tr>
<tr>
<td>6</td>
<td>3/8 dia. @ 20 ctrs.</td>
<td>3/8 dia. @ ctrs. 36</td>
</tr>
<tr>
<td>7</td>
<td>3/8 dia. @ 18 ctrs.</td>
<td>3/8 dia. @ ctrs. 36</td>
</tr>
<tr>
<td>8</td>
<td>1/2 dia. @ 23 ctrs.</td>
<td>1/2 dia. @ ctrs. 36</td>
</tr>
<tr>
<td>9</td>
<td>1/2 dia. @ 22 ctrs.</td>
<td>1/2 dia. @ ctrs. 36</td>
</tr>
<tr>
<td>10</td>
<td>1/2 dia. @ 21 ctrs.</td>
<td>3/4 dia. @ ctrs. 24</td>
</tr>
<tr>
<td>11</td>
<td>1/2 dia. @ 20 ctrs.</td>
<td>3/4 dia. @ ctrs. 24</td>
</tr>
<tr>
<td>12</td>
<td>1/2 dia. @ 18 ctrs.</td>
<td>3/4 dia. @ ctrs. 24</td>
</tr>
</tbody>
</table>

NOTE: 1. Bolt diameters may be increased but not decreased. Spacing may be decreased but not increased.

No material shall be placed if the ambient air, or concrete surface temperature is at, or below 45°F. Reinforcement may consist of either existing reinforcing bars or welded galvanized wire fabric, depending on the conditions and shall be clean and free from loose mill scale, loose rust, oil or other coatings that interfere with bonding.

Chipping hammers shall meet the requirements of §580-3.02.

Sufficient clearance shall be provided around the reinforcement to permit complete encasement with sound shotcrete. The minimum clearance between the reinforcement and the form or other backup material shall be 1 inch.

Where the chipped area is equal to or less than 2 inches in depth, the use of wire fabric or mechanical concrete anchors will not be required except for overhead surfaces. Where the chipped areas are overhead, and are 1 inch in depth or greater, galvanized wire fabric and mechanical concrete anchors shall be used. Mechanical concrete anchors shall be placed as required by Table 583-1.

Where the chipped area is over 2 inches in depth and existing bar reinforcement is available, galvanized wire fabric shall be attached to the bars with tie wires. If existing bar reinforcement is not
available, wire fabric shall be installed by means of mechanical concrete anchors in accordance with the requirements of Table 583-1.

Wire fabric shall be cut in sheets of the proper size and shall be carefully bent in such a manner as to follow closely the contours of the areas to be repaired. The wire fabric shall be securely tied to the hook-type bolts or the reinforcing bars.

Where sheets meet, they shall be lapped a minimum of 4 inches and shall be securely fastened together.

Expansion bolt anchors shall be placed in holes drilled in the existing concrete surface to the diameter and depth recommended by the manufacturer of the expansion bolt anchors. Hook-type bolts of the proper length shall be inserted and securely attached to the expansion bolt anchors so as to provide a positive connection to sound concrete.

Where the chipped area is 6 inches or greater in depth, the Contractor shall place galvanized wire fabric in layers 4 inches apart.

Where it is necessary to place more than one layer of galvanized wire fabric in an area to be repaired, the innermost layer shall be covered by a shotcreting prior to the installation of the next outermost layer. Existing reinforcement which has lost significant section shall be repaired in a manner satisfactory to the Engineer as extra work.

583-3.02 Preparation of Materials

A. General. The sand shall be measured either by volume or weight, by means of batch boxes approved by the Engineer, or in a proportioning plant approved in accordance with section 501, Portland Cement Concrete - General. Wheelbarrows or shovels will not be permitted for measuring. The same source of sand shall be used throughout each structure.

B. Dry Mix Process. Dry mix shotcrete shall be composed of one part of cement to three to four and one-half parts of sand.

Prior to mixing, the moisture content of the sand shall be between 3 and 6%. The sand shall be dampened or dried as required to bring the moisture within these limits.

A wetting agent approved by the Engineer may be used at the Contractor's option in the dry mix process.

Sand-cement mixtures shall be applied within 75 minutes of the time the sand initially contacts the cement. Sand-cement mixtures which exceed the 75 minute limit shall not be incorporated in the work. They shall be disposed of in a manner acceptable to the engineer.

C. Wet Mix Process. Wet mix shotcrete shall be composed of one part of cement to three parts of sand. The cement, sand and water shall be premixed to a desired consistency and in accordance with §501-3.03, Handling, Measuring and Batching Materials, and §501-3.04, Concrete Mixing, Transporting and Discharges - General Requirements.

583-3.03 Placement

A. Weather. Shotcrete shall not be applied during any precipitation which is of sufficient intensity to cause the placed shotcrete to run. Shotcrete shall not be placed during a wind that disrupts the nozzle spray.

Shotcrete shall not be applied when the ambient air temperature is below 45°F unless it is placed in accordance with §555-3.08C.2., Provision of External Heat. Receiving surfaces shall be heated to, and maintained at, approximately 45°F by a method approved by the Engineer before shotcreting operations begin. Under no conditions shall shotcrete be applied against surfaces upon which any frost adheres.
B. Application. Before starting to shoot, precautions shall be taken to protect property in the area. Adjacent construction, openings, shrubbery, and all areas that might be discolored or damaged by rebound, cement, water or dust must be covered with tarpaulins or plastic sheets to protect them from damage.

When projecting the shotcrete, the stream of flowing materials shall be directed from the nozzle as nearly at a right angle as possible to the surface being treated, and shall be held uniformly at the same distance, less than 5 feet away from the surface at all times. Manufacturer's recommendations shall be followed. The size of the nozzle shall be consistent with the manufacturer's recommendation for the maximum size of the sand used. The use of rebound material shall not be permitted.

Shotcrete on vertical and overhead surfaces shall be built up in 3/4 inch maximum layers to prevent sloughing in heavy applications. Succeeding layers shall be applied just prior to the initial set to maintain a good bond.

When encasing reinforcing steel, the stream from the nozzle shall be directed at an angle so as to fill the space behind the bars. An air jet shall be used to blow out any rebound ahead of the application of shotcrete. Should any such deposit of sand rebound be covered with shotcrete, it shall be cut out and removed by the Contractor without compensation.

Ground wires may be installed to establish the thickness and surface planes of the shotcrete build up. Both horizontal and vertical ground wires may be installed at corners and offsets not clearly established by exterior corners of walls, column or beam corners, and other locations. They may also be used as screed guides. Eighteen or 20 gage hard steel piano wire is recommended for this purpose. Ground wires shall be tight and true to line, and placed in such a manner that they may be further tightened.

C. Quality Control

1. Test Panels. This test shall be used to determine the physical quality of the shotcrete and shall be performed immediately before shotcreting operations begin, after each additional 100 sf, and immediately after operations are ended.

The test panels shall be 12 inches square, 3/4 inch thick plywood boards with galvanized mesh (1/2 inch square openings) strips projecting 4 inches attached around the perimeter of the board. The boards shall be erected horizontally, vertically, or overhead, depending on the anticipated shooting positions. The shotcrete operator shall completely fill the test panel, after which it shall be screeded or cut with a trowel such that it contains a 4 inches uniform depth of shotcrete. The test panels shall then be covered with wet quilted covers or wet polyethylene-coated blankets; put in a shaded, protected place; kept wet and cured for a minimum of seven days. The test panels shall be sent to the Department of Transportation's Materials Bureau for testing at fourteen days. Cores will be drilled from the panels and compressive strengths at fourteen days will be reported to the Engineer. Additional information on the conditions of the shotcrete such as sand pockets, voids, and laminations will also be reported with the strength results.

2. Coring. The Contractor shall take a core, at a location determined by the Engineer, from each structural element, such as pier, abutment, arch, etc., to verify acceptability of reinforcement encasement. Cores which do not contain reinforcing bars will not be used to determine encasement acceptability. If interconnected voids are found, the structural element represented by that core shall be rejected. All rejected shotcrete shall be repaired or replaced at the Contractor's expense. Repair methods shall be proposed by the Contractor for approval by the Engineer. The Contractor may take additional cores at locations approved by the Engineer to establish the limits of rejected work. The additional coring shall not jeopardize the design integrity of the structural element. If additional cores are not taken, all work on that structural
element shall remain rejected. Core holes shall be patched with an applicable concrete repair material from the Approved List.

D. Finishing. The natural gun finish will be sufficient unless the plans call for one of the following finishes:

1. Screed Finish. After the surface has taken its initial set, excess material outside the forms and ground wires shall be sliced off with a sharp-edged cutting screed. After screeding, the ground wires shall be removed.

2. Broom Finish. This type of finish may be applied after screeding.

3. Flash Coat Finish. This is a thin surface coating containing finer sand than normal, and the application nozzle is held well back from the work. This finish shall be applied to the surface as soon as possible after screeding.

Any of the remaining three types of finish may be applied following flash coat:

a. Wood Float Finish. This gives a granular finish.

b. Rubber Float Finish. This gives a coarse finish.

c. Steel Trowel Finish. This gives a very smooth finish.

E. Curing. Curing shall be in accordance with §555-3.08, Curing, and the following modifications:

- All curing covers shall be pre-wet and kept wet during the entire curing period in a manner satisfactory to the Engineer.
- Curing compounds shall be applied twice. The second application shall be done when the first application has become tacky. The second application shall be done at a right angle to the first application. The rate of each application shall be that given in §555-3.08A.

583-4 METHOD OF MEASUREMENT. The quantity to be paid for under this item will be the number of square feet of finished shotcrete installed. Measurement will be taken as the plane projection of the finished surface. Measurement shall be made prior to the placement of shotcrete.

583-5 BASIS OF PAYMENT. The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

583-5.01 Removal of Structural Concrete - Replacement with Shotcrete. No Reinforcement Bar Encasement. The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

583-5.02 Removal of Structural Concrete - Replacement with Shotcrete, Reinforcement Bar Encasement. The unit price bid per square foot shall include the cost of furnishing all labor, materials and equipment necessary to complete the work, except that replacement of deteriorated reinforcement shall be paid for separately. Payment shall not be made until cores verify acceptability.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>583.02</td>
<td>Removal of Structural Concrete - Replacement with Shotcrete, No Reinforcement Bar Encasement</td>
<td>Square Foot</td>
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<tr>
<td>583.03</td>
<td>Removal of Structural Concrete</td>
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</tbody>
</table>
SECTION 584 - SPECIALIZED OVERLAYS FOR STRUCTURAL SLABS

584-1 DESCRIPTION. Prepare the surfaces that will be in contact with slab reconstruction concrete and place slab reconstruction concrete. Prepare the structural slab surface and place a specialized concrete overlay.

584-1.01 Scope. Concrete removal work will be paid for under the appropriate item(s). Minimum thickness of overlay concrete is 1 1/2 inches. Include the cost of any grade changes necessitated by this requirement in the unit bid price for overlay concrete. Use only one type of overlay concrete on any one structure.

584-1.02 Definitions

A. Class DP Concrete. A homogeneous mixture of portland cement, fly ash, microsilica admixture, fine and coarse aggregates, air entraining agent, set retarding water reducing admixture and water.

B. Microsilica Concrete. A homogeneous mixture of portland cement, microsilica admixture, fine and coarse aggregates, air entraining agent, high range water reducing admixture and water.

C. Overlay Concrete. Concrete placed over existing and slab reconstruction concrete. Overlay concrete will be Microsilica concrete for Method 1 and Method 2, and Class DP concrete for Method 3, as described in 584-1.03 Placement Methods.

D. Slab Reconstruction Concrete. Concrete placed completely around the exposed top mat of bar reinforcement. Slab reconstruction concrete will be Class D or Class DP concrete for Method 1, Microsilica concrete for Method 2, and Class DP concrete for Method 3, as described in 584-1.03 Placement Methods.

E. Positive-tie-downs. Anchors drilled into the structural slab and connected to reinforcing steel.

584-1.03 Placement Methods.

A. Method 1 - Separate Placement. Place Class D or Class DP slab reconstruction concrete and Microsilica overlay concrete separately. Use only one type of slab reconstruction concrete on each placement.

B. Method 2 - Integral Placement of Microsilica Concrete (Optional). When all of the following conditions are satisfied, Microsilica overlay concrete and Microsilica slab reconstruction concrete may be placed in a single lift:

- The area of the exposed top mat of bar reinforcement is 5% or less of the placement area, per span.
- No individual area of the exposed top mat of bar reinforcement exceeds 25 sf.
- No dimension of any area of the exposed top mat of bar reinforcement exceeds 6 feet.

C. Method 3 - Integral Placement of Class DP Concrete (Optional). When 100% of the top mat of bar reinforcement is exposed, Class DP overlay concrete and Class DP slab reconstruction concrete may be placed in a single lift.
584-2 MATERIALS

584-2.01 General. All materials listed in §557-2 with the following:

A. Air Entraining Admixture. §711-08 with the following: For Microsilica concrete, use only a vinsol resin-based air entraining agent.

B. Microsilica Admixture

1. Follow the requirements of §501-2 and §501-3.01.
2. Samples will be taken in accordance with Materials Method 9.1M and Materials Procedure 90.1.
3. Blended Portland Cement, §701-03 (Type SF) may also be used for the Portland cement/microsilica portion of the Class DP and the Microsilica Concrete designed mix.

C. (Vacant)

584-2.02 Manufacture of Class DP Concrete

A. Proportioning. The initial ingredient proportions, except for admixtures, are given in TABLE 584-1.

B. Handling, Measuring and Batching. Follow the requirements of §501-3.02 and §501-3.03, except that water reduction must be accomplished using only a water-reducing and retarding admixture (§711-08, ASTM Type D). If a microsilica slurry is used, include the slurry water as mix water.

<table>
<thead>
<tr>
<th>TABLE 584-1 MIX CRITERIA - CLASS DP CONCRETE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Content (lb/cy)</td>
</tr>
<tr>
<td>Fly Ash Content (lb/cy)</td>
</tr>
<tr>
<td>Microsilica Content (lb/cy)</td>
</tr>
<tr>
<td>Sand Percent Total Aggregate (solid volume)</td>
</tr>
<tr>
<td>Designed Water/Total Cementitious Content</td>
</tr>
<tr>
<td>Desired Air Content (%)</td>
</tr>
<tr>
<td>Allowable Air Content (%)</td>
</tr>
<tr>
<td>Desired Slump (inches)</td>
</tr>
<tr>
<td>Allowable Slump (inches)</td>
</tr>
<tr>
<td>Type of Coarse Aggregate Gradation</td>
</tr>
</tbody>
</table>

NOTE: The criteria are given for design information and the data is based on a fine aggregate modulus of 2.80 and a CA1 coarse aggregate gradation. Adjust the mixture proportions using actual fineness modulus and bulk specific gravities (saturated surface dry for aggregates). Compute the adjustments according to Department instructions.

584-2.03 Manufacture of Microsilica Concrete

A. Proportioning. The initial ingredient proportions except for admixtures are in TABLE 584-2.

<table>
<thead>
<tr>
<th>TABLE 584-2 MIX CRITERIA - MICROSILICA CONCRETE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Content (lb/cy)</td>
</tr>
</tbody>
</table>

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
Sections 200 - 599 STANDARD SPECIFICATIONS (USC) May 1, 2020 Volume 2
### Microsilica Content (lb/cy)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsilica Content (lb/cy)</td>
<td>61</td>
</tr>
</tbody>
</table>

### Sand Percent Total Aggregate (solid volume)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand Percent Total Aggregate (solid volume)</td>
<td>53</td>
</tr>
</tbody>
</table>

### Designed Water/Total Cementitious Content

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designed Water/Total Cementitious Content</td>
<td>0.37</td>
</tr>
</tbody>
</table>

### Desired Air Content (%)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired Air Content (%)</td>
<td>6.5</td>
</tr>
</tbody>
</table>

### Allowable Air Content (%)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable Air Content (%)</td>
<td>5.0 - 8.0</td>
</tr>
</tbody>
</table>

### Desired Slump (inches)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired Slump (inches)</td>
<td>4</td>
</tr>
</tbody>
</table>

### Allowable Slump (inches)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable Slump (inches)</td>
<td>2 - 6</td>
</tr>
</tbody>
</table>

### Type of Coarse Aggregate Gradation

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Coarse Aggregate Gradation</td>
<td>CA 1</td>
</tr>
</tbody>
</table>

**NOTE:** The criteria are given for design information and the data is based on a fine aggregate modulus of 2.80 and a CA1 coarse aggregate gradation. Adjust the mixture proportions using actual fineness modulus and bulk specific gravities (saturated surface dry for aggregates). Compute the adjustments according to Department instructions.

### B. Handling, Measuring and Batching.

Follow the requirements of Subsection 501-3.02 and -3.03, except that water reduction must be accomplished using only a High-Range Water-Reducing Admixture ($\text{§711-08, ASTM Type F}$). Add the High-Range Water Reducer at the batching facility.

The Regional Materials Engineer may allow a maximum of two additions of water and/or admixture at the work site. Provide an additional 30 mixing revolutions for each addition of water and/or admixture. However, once the concrete has reached the desired slump, only the High-Range Water Reducer may be used to adjust the concrete slump. The maximum total mixing revolutions is 200. Observe the Manufacturer’s maximum dosage rate for the admixture, regardless of where the admixture is added. If a microsilica slurry is used, include the slurry water as mix water.

### 584-2.04 Equipment

**A. Microsilica Admixture.** Follow Subsection 584-2.01B.

**B. Finishing Machine.** A finishing machine capable of self propulsion in forward and reverse, raising the screeds above the screeded surface when traveling in reverse, and meeting one of the two sets of requirements below.

1. **Roller Screed.** Must be equipped with a power driven strike-off auger, power driven finishing roller, vibrating pan or roller producing 3000 to 7000 vpm, and pan float.

2. **Dual Oscillating Screed.** Must be equipped with at least 2 oscillating screeds producing between 3000 and 7000 vpm, strike-off auger, and control of each screed's vertical position and tilt angle.

   The specific method and equipment used for finishing will be approved by the Regional Construction Engineer before use. Provide access to the machine at the work site for one working day, for inspection by the Engineer. Have a qualified Finishing Machine Operator present at the time of inspection. Two weeks prior to the inspection date, provide the Engineer with a copy of the operating manual for their exclusive use.

   Use supporting rails with no bends or kinks. Support the rails with fully adjustable supports (no shims), spaced a maximum of 12 inches on center. When placing concrete adjacent to a completed placement, set the supporting rails for one side of the finishing machine on the completed placement.

**C. Recording Thermometer.** A continuous recording thermometer capable of measuring temperatures in the range of 30°F to 100°F for a minimum of 24 hours. Include the cost of calibration in the unit price bid.
D. (Vacant)

584-3 CONSTRUCTION DETAILS

584-3.01 Limitation of Operations

A. No structural concrete removal work is permitted in areas adjoining new concrete during the new concrete’s specified curing period.
B. No loads, other than construction loads which are less than 2 tons and approved by the Engineer, are permitted on areas of the structural slab where concrete has been removed.
C. No loads are permitted on concrete until completion of the specified curing period.

584-3.02 Blast Cleaning

A. Blast clean all surfaces to be in contact with new concrete. Remove all grease and dirt. Remove all rust and mortar which is not firmly bonded to the surface being cleaned. Rust and concrete deposits which are firmly bonded and cannot be removed by blast cleaning may remain. A light coating of orange rust, that forms on steel surfaces after blast cleaning, is not considered detrimental to bond and may remain. Remove all debris created by blast cleaning.
B. Place reinforcing steel supports and positive-tie-downs at a maximum spacing of 4 feet.
C. Repeat blast cleaning if more than 48 hours pass before concrete placement begins.

584-3.03 Preplacement Wetting. After blast cleaning has been accepted, thoroughly wet the structural slab surface and all porous surfaces to be in contact with new concrete for at least 12 hours immediately prior to placement. Remove all standing water with oil-free compressed air, and protect the deck from drying, so the concrete remains in a saturated surface dry condition.

584-3.04 (Vacant)

584-3.05 Handling and Placing Concrete. §557-3.05 and §557-3.12 with the following:

A. Place concrete only when the ambient air temperature and deck surface temperature (after wetting) will be below 85°F during the entire placement.
B. Place overlay concrete only if preplacement wetting has been completed on an area large enough to require one working day for placement, at least one span length.
C. When using concrete transporting devices on a prepared surface, protect exposed reinforcing steel from deformation and prevent contamination of the surface.
D. If operations are delayed for more than 30 minutes, install a construction dam or bulkhead. If placement operations are delayed for more than 60 minutes or if the concrete attains initial set, discontinue placement for at least 48 hours. This restriction does not prohibit continuation of the placement provided a gap is left in the placement. This gap is to be sufficient in length to allow the finishing machine to clear the previously placed concrete. Prepare the gap area for concrete placement in accordance with this specification, after the previously placed concrete, on both sides of the gap, has cured for 48 hours.

584-3.06 Finishing and Curing

A. Slab Reconstruction Concrete - Separate Placement. §557-3.09 and §557-3.11 with the following:
1. For areas less than 25 sf, hand finishing of slab reconstruction concrete is acceptable. For areas greater than 25 sf, use either a manually driven vibrator equipped power screed from the Department’s Approved List or the same machine to be used to finish the overlay.
2. Screed to the level of the surrounding concrete. When 100% of the reinforcing steel is exposed, screed to a minimum 3/8 inch above the reinforcing steel. Roughen the screeded surface with a tining rake or similar device.
3. Cure concrete with wet burlap for 3 days. Provide uniform continuous wetting until concrete curing is complete. The wet burlap and curing cover option is not allowed.
4. Blastclean the surface, according to §584-3.02, after the curing period is over, but prior to wetting. Expose approximately 50% of the surface coarse aggregate, and leave an irregular texture.

**B. Overlay Concrete.** §557-3.08, §557-3.11, and §557-3.12 with the following:

1. Finish overlay concrete to a minimum depth of 1 1/2 inches and a minimum total cover over top mat of bar reinforcement of 2 3/8 inches. Use a finishing machine meeting the requirements of this specification.
2. Machine finish the concrete within 10 minutes of its deposition onto the deck. If the machine cannot finish the concrete within the 10 minute time limit, stop all further placement, immediately cover the fresh concrete with plastic curing covers, and keep the unfinished concrete covered until it is machine finished. Once concrete being placed can be machine finished within the 10 minute time limit, resume placing concrete.
3. Apply curing within 10 minutes after machine finishing. Provide uniform continuous wetting until concrete curing is complete. Cure Microsilica concrete with wet burlap for 4 days. Cure Class DP concrete with wet burlap for 7 days. The wet burlap and curing cover option is not allowed.

**584-3.07 Construction Joints.** For the purpose of this specification, construction joints provide for interruptions in overlay concrete placement.

At transverse and longitudinal construction joints, place the overlay concrete a distance at least equal to the depth of the overlay, beyond the intended joint location. After the overlay concrete has cured for 48 hours, sawcut along the joint to a depth of 3/4 1/8 inch. Chip the extra overlay concrete to the level of the original prepared surface at a 45° angle. Do not undercut existing concrete.

**584-3.08 Defective or Damaged Concrete.** §557-3.16 with the following:

A. Defects and damage, for the purposes of this specification, are imperfections caused by the Contractor's operations, including, but not limited to: cracking, tearing, and open areas. Repair all defective or damaged concrete at no cost to the Department, using the same class of concrete originally placed.
B. Make all repairs rectangular in plan shape and as close to square as possible. Sawcut the perimeter of the repair to a depth of 3/4 1/8 inch. Chip out the damaged or defective concrete to the level of the original prepared surface. Angle the walls of the repair cavity at 45° toward the center of the repair. Do not undercut existing concrete. Prepare the surfaces of the repair cavity and place new concrete in accordance with this specification.

**584-4 METHOD OF MEASUREMENT.** For placements with 100% exposure of the top mat of bar reinforcement, the number of square yards of slab reconstruction concrete will be equal to the number of square yards of overlay concrete.

For placements with less than 100% exposure of the top mat of bar reinforcement, measure slab reconstruction concrete prior to overlay concrete placement.
**A. Method 1 - Separate Placement.** Measure slab reconstruction concrete as the number of square yards of Class D or Class DP slab reconstruction concrete placed. Measure overlay concrete as the number of square yards of plan area of Microsilica overlay concrete placed.

**B. Method 2 - Integral Placement of Microsilica Concrete (Optional).** Measure slab reconstruction concrete as the number of square yards of Microsilica slab reconstruction concrete placed. Measure overlay concrete as the number of square yards of plan area of Microsilica overlay concrete placed.

**C. Method 3 - Integral Placement of Class DP Concrete (Optional).** Measure slab reconstruction concrete as the number of square yards of Class DP slab reconstruction concrete placed. Measure overlay concrete as the number of square yards of plan area of Class DP overlay concrete placed.

**584-5 BASIS OF PAYMENT.** Include the cost of all labor, materials and equipment necessary to complete the work in the unit bid price.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>584.3001nn</td>
<td>Overlay Concrete, Microsilica Concrete – Type 1 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3002nn</td>
<td>Overlay Concrete, Microsilica Concrete – Type 2 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3003nn</td>
<td>Overlay Concrete, Microsilica Concrete – Type 3 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3009nn</td>
<td>Overlay Concrete, Microsilica Concrete – Type 9 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3101nn</td>
<td>Overlay Concrete, Class DP – Type 1 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3102nn</td>
<td>Overlay Concrete, Class DP – Type 2 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3103nn</td>
<td>Overlay Concrete, Class DP – Type 3 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3109nn</td>
<td>Overlay Concrete, Class DP – Type 9 Friction</td>
<td>Square Yard</td>
</tr>
<tr>
<td>584.3200nn</td>
<td>Slab Reconstruction Concrete, Class D, DP or Microsilica Concrete</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>

**NOTE:** nn denotes a serialized pay item.

**SECTION 585 - STRUCTURAL LIFTING OPERATIONS**  
*(Last Revised May, 2019)*

**585-1 DESCRIPTION.** This work shall consist of raising, supporting, and lowering each designated bearing point to perform the tasks specified in the contract documents. This work shall also include the temporary shoring of a bearing point where a shim tight installation is designated on the plans. Examples of work specifying a shim tight installation include, but are not limited to:

- Temporary shoring of capbeams during staged construction.
- Temporary shoring of girders during substructure rehabilitation.
- Temporary shoring of a bridge construction stage to decrease or eliminate live load deflection.

**585-1.01 Bearing Point.** The term bearing point is defined as a point on the structure which is designated on the plans to be raised or shored to perform other work.

**585-1.02 Lift Point.** The term lift point is defined as a point on the structure where the lifting force is applied.

**585-1.03 Type.** The type designation is used to distinguish between different methods of accomplishing the
work, and/or significantly different lifting loads. Such situations will be noted on the contract plans. They will be defined by a type designation. The type designation will be reflected in the pay item title (e.g., 585.01 Structural Lifting Operations - Type A, etc.).

585-2 MATERIALS

585-2.01 Used Materials. Used materials will be allowed. Those materials that are permanently attached to the structure shall be new, and meet the requirement of the New York State Steel Construction Manual and the following requirements:

Structural Steel 715-01
High Strength Bolts, Nuts and Washers 715-14
Pins and Rollers 715-15

585-2.02 Lifting Equipment. Unless otherwise specified in the contract documents or plans, the choice of structural lifting system and/or temporary shoring shall be at the Contractor's option, subject to the following provisions:

Jacks used for lifting operations shall have the rated capacity clearly shown on the manufacturer's name plate attached to each jack. Jacks shall have a rated capacity of a least one and a half times the calculated lifting force. Lifting equipment deemed to be inadequate or faulty shall be removed from the site.

Jacks shall be equipped with pressure gauges or other load measuring devices that will enable the applied lifting force to be monitored. Jacks and associated lifting equipment shall be calibrated as per manufacturer’s instructions.

585-3 CONSTRUCTION DETAILS

585-3.01 General. Unless a specific distance is shown on the plans, each designated bearing point shall be raised the minimum distance that will allow the work to be completed.

The Contractor shall engage the services of a Professional Engineer to design and detail the structural lifting system and/or temporary shoring. The Professional Engineer shall be available for consultation in interpreting their plans and in the resolution of problems which may arise during the performance of the work. The Contractor and the Professional Engineer shall be intimately familiar with the current condition of the existing superstructure with respect to the structural capacity of the members.

All field welding and slip critical connections shall be performed in accordance with the New York State Steel Construction Manual. For slip-critical connections, the class of slip resistance shall be specified on the working drawings.

The Contractor shall furnish lift plans and calculations for the installation of the structural lifting system and/or temporary shoring structural elements as per the requirements in §107-05 P.2 Lift Plans. If drilling and grouting into existing concrete is included as part of the structural lifting system, the DCES will determine the need for pull-out testing based on The New York State Bridge Manual. A non-destructive investigation shall be performed by the Contractor to determine the location of existing reinforcing steel prior to drilling. If reinforcing steel conflicts with, or is encountered during the drilling operation, the DCES shall be notified by the Contractor to determine the appropriate course of action. At no time shall reinforcement be cut without the approval of the DCES. All drilling and grouting operations shall comply with Section 586 Miscellaneous Structural Reconstruction. Spalled concrete in areas to be drilled and grouted shall be repaired prior to the installation of the lifting equipment.

If drilling and grouting into repaired spalled concrete, the embedment depth, subject to the contractor’s engineer’s approval, may only include the depth of repair behind the reinforcement. If the drilling and grouting is into unreinforced concrete, the embedment depth shall be measured into existing sound concrete only, and shall not include the depth of the repair.
585-3.02 Loads. The contract documents designate, by type, the bearing points to be raised or shored to perform the contract work. The unfactored loads at each bearing point are shown in the contract documents. The Contractor and the Professional Engineer shall determine the appropriate lateral and longitudinal loads in the design of the structural lifting system and/or temporary shoring. The Contractor shall select the location of the lift points, subject to the approval of the DCES, and calculate the required lifting force at that location.

All design and details shall be in conformance with the current AASHTO Guide Design Specifications for Bridge Temporary Works, with the following revisions:

- Loads and load combinations shall be from either the current AASHTO Standard Specifications for Highway Bridges or the AASHTO LRFD Bridge Design Specifications.
- There shall be no required minimum vertical design load.
- The minimum slenderness ratio for steel structural lifting compression members shall be 120.
- The presumptive soil bearing values shown in Table 2.5.2-1 shall not apply for footings located on slopes exceeding a 1 vertical on 6 horizontal. In these cases, designs should be based on either the current AASHTO Standard Specifications for Highway Bridges or the AASHTO LRFD Bridge Design Specifications.

Structural lifting system and/or temporary shoring submittals shall be designed to Inventory Level. Operating Level designs will not be allowed. The design of the structural lifting system shall include a narrative of how lateral and longitudinal stability of the structure is maintained while in a supported position.

585-3.03 Working Drawings. The Contractor shall furnish legible working drawings, prepared, sealed and signed by a Professional Engineer, for the system proposed to raise, support, and lower, or temporarily shore each designated bearing point. The working drawings shall not alter the number or location of designated bearing points shown on the contract documents.

The working drawings shall include, but are not limited to the following:

- Lift point locations
- Unfactored calculated lifting forces and equivalent pressures for the following two conditions:
  - Anticipated structure liftoff
  - Maximum capacity of the entire lifting system
- Details for all lifting equipment and temporary shoring systems
- Sequence of lifting operations
- Type and grade of all materials
- Distance that each bearing point is to be raised
- Schematic hydraulic layout
- All disconnections, reconnections or adjustments that are necessary to properly complete the lifting operations. This includes, but is not limited to, railings, joints, power lines, gas lines, water lines, etc.
- Scour protection of supports for lifting and/or shoring in, or adjacent to, waterways. Scour protection shall be, at minimum, medium stone fill.
- Positive connection to the existing structure

Working drawings and design computations shall be submitted electronically to the DCES, with a copy to the Engineer, for approval. The DCES shall be allowed the longest of the following time durations to examine design computations and working drawings:

- Fifteen work days.
- Two work days for each drawing of a set of working drawings.
• One work day for every four (4) design computation sheets. Any design computation sheet written on both sides will be considered as two design computation sheets.

Time for review will begin upon receipt of all pertinent information by the DCES.

The DCES comments will be indicated on the returned copies. Should the proposed system not be approved, the reasons will be indicated with the return of the material. The Contractor shall submit revised drawings and design computations for approval, subject to the same terms as the first submission. Resubmission will not be considered a reason to request an extension of time. The review of the design calculations and working drawings by the Department shall not relieve the Contractor of any responsibility for safely and adequately designing and installing the lifting system and/or temporary shoring.

All work shall be done in accordance with the approved working drawings. The Contractor must have approved working drawings prior to the start of any structural lifting operations. The Contractor shall bear all costs and damages which may result from the ordering of any materials, equipment; or the use of any preparatory labor prior to the approval of the working drawings.

585-3.04 Lifting Operations. The Contractor shall raise each designated bearing point by applying the necessary lifting force at each lift point. If the anticipated structure liftoff pressure is reached prior to the structure lifting, the structural lifting operation shall stop. The Contractor and its Professional Engineer shall investigate the causes of why the structure failed to lift. Concurrence from the Engineer must be obtained prior to restarting the lifting operation. The Contractor shall not apply a lifting pressure in excess of the calculated maximum allowable lifting pressure stated on the working drawings.

During all phases of the operation, the differential lift between any two adjacent bearings on a common centerline of bearing shall not exceed 3/8 inch unless approved by the DCES.

The Contractor shall, at the earliest possible moment during or after each lift, safely secure the structure with shims, cribbing, bolsters, or other suitable supports. After the structure has been raised the structural lifting system shall be positively connected to the existing structure.

The lifting operation shall be conducted such that the distance between the structure and the shims, cribbing, bolsters, or other suitable supports shall not exceed 3/8 inch at any time.

Any replacement, repair, or adjustments to the superstructure steel due to the structural lifting operations shall be performed in accordance with the current New York State Steel Construction Manual.

All materials required for temporary support of the structure shall remain the property of the Contractor and shall be removed from the site after the work is completed.

585-3.05 Inspection. Structural lifting systems, and temporary structural supports, that are to remain in place for a period exceeding one year shall be inspected by a Professional Engineer hired by the Contractor. The Professional Engineer shall certify in writing to the Engineer that the structural system can continue to function as originally designed.

585-4 METHOD OF MEASUREMENT. The quantity to be measured for payment will be the number of bearing points raised.

585-5 BASIS OF PAYMENT. The unit price bid per bearing point shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work. Payment will be made only once for each bearing point regardless of the number of times the bearing point is raised.

Progress payments will be made after all temporary supports have been installed and any required lifting has been performed. Payment will be made for 70 percent of the quantity. The remaining 30 percent will be paid for after the bearing points have been lowered to their final permanent position and the lifting equipment and temporary supports have been removed.

Payment will be made under:
SECTION 586 - MISCELLANEOUS STRUCTURAL RECONSTRUCTION
(Last Revised September, 2019)

586-1 DESCRIPTION
586-1.01 Drilling and Grouting Anchors. This work shall consist of drilling and grouting anchors. For the purposes of this specification, the term ‘anchors’ refers either to bolts or to reinforcing bars, as appropriate. When the item number indicates Pull-Out Testing is required, all anchors shall be paid for under that item number regardless of whether they are selected to be tested.

586-1.02 Removal of Rivets-Replacement with High Strength Bolts. This work shall consist of removal of rivets and replacement with high strength bolts.

586-1.03 Field Drill Holes in Existing Structural Steel. This work shall consist of field drilling holes in existing structural steel that is in service prior to the beginning of construction.

586-2 MATERIALS

586-2.01 Drilling and Grouting Anchors. Grout Material used in Permanent applications where a sustained tensile load will exist, shall conform to §701-05 Concrete Grouting Material. Grout used in other applications shall conform to either §701-07 Anchoring Materials - Chemically Curing or §701-05 Concrete Grouting Material. Chemically curing anchoring materials or adhesives are referred to herein as grout.

Permanent and temporary installations using Anchoring Materials – Chemically Curing shall be designed using the current edition of ACI 318 for the given loading conditions.

Anchoring Materials – Chemically Curing shall not be used in permanent applications where sustained tensile loads will exist, including but not limited to all horizontal or overhead applications, as well as all angles in between. Installation of anchors for Bridge railing, decorative railing, pedestrian fence and screening are not typically subject to sustained tensile loads. Some cantilever applications can produce sustained tensile loads, and chemically curing anchors shall not be used in these applications.

When such work is required, alternative anchoring methods or materials such as mechanical anchors or cementitious grouting operations shall be used in these locations. Use of alternate materials or methods not previously approved shall require approval of the Deputy Chief Engineer Structures (DCES).

Anchoring Materials – Chemically Curing may be used for temporary applications, as a part of a design sealed and signed by a Professional Engineer.

586-2.02 Removal of Rivets - Replacement with High Strength Bolts. High strength bolts, nuts and washers shall meet the requirements of §715-14 High Strength Bolts, Nuts and Washers. If paint color is not specified, the color selected shall match the existing paint. Paint shall meet the requirements of §708-02, Structural Steel Paint - Class 2.

586-2.03 Field Drill Holes in Existing Structural Steel. None Specified.

586-3 CONSTRUCTION DETAILS

586-3.01 Drilling and Grouting Anchors. All holes shall be drilled by means of a rotary impact drill. Except as indicated below, if reinforcing steel is encountered, the reinforcing steel shall be cut and removed by means of a core drill. The remainder of the drilling shall be done with the rotary impact drill.
Where plans indicate significant design reinforcement, a non-destructive investigation shall be done to determine the location of existing reinforcing steel prior to drilling. If after the non-destructive investigation, reinforcing steel is determined to be in conflict with, or encountered during the drilling operation, the DCES shall be notified to determine the appropriate course of action.

The Contractor shall not perform drilling with a lubricant, except in this case water is not considered a lubricant. Drilling methods shall not cause spalling, or other damage to concrete. Concrete spalled, or otherwise damaged by the Contractor's operations shall be repaired at no additional cost to the State.

Holes shall be surface dry and shall have had all foreign and loose material removed immediately prior to grout placement. Prior to anchor placement in the grouted hole, all material which might interfere with bond between the anchor and the grout shall have been removed. This includes, but is not limited to: moisture, grease, dirt, mill scale and rust. Rust which cannot be removed from the anchor even by vigorous scrubbing with a wire brush is considered firmly bonded and may remain, unless more specific instructions are provided in the manufacturer’s installation procedures. The depth of hole and hole diameter shall be in accordance with the grout manufacturer's recommendation, and shall consider: anchor diameter, strength of existing concrete, anchor spacing and edge distance. The distance from the bottom of the hole to the nearest free surface of a structural element, shall be at least 1 5/8 inches or as recommended by the manufacturer, whichever is greater. The length of any plastic sleeve used as an aid to grout placement shall not be included in the length of the hole. The Contractor may increase the embedment length beyond that required by the contract documents if approved by the Engineer, at no additional cost to the State.

Grout shall be stored, mixed, and placed in accordance with the manufacturer's instructions. No grout shall be placed at a temperature outside the range recommended by the grout manufacturer.

Anchors shall be inserted full depth into the grouted hole and shall be manipulated or rotated in accordance with the Manufacturer's recommendations to ensure complete coverage of the embedded anchor with grout. After insertion of the anchor, all excess grout shall be struck off flush with the concrete face. Care shall be taken to prevent grout from running out of the drilled hole. Should the grout fail to fill the hole after anchor insertion, additional grout shall be added immediately after insertion of the anchor to allow a flush strike-off.

If the anchor is inserted in a hole with an axis that is predominantly horizontal, care shall be taken to prevent grout from running down the face of the concrete.

All uses of Anchoring Materials - Chemically Curing, both permanent and temporary, shall be installed by a certified ACI/CRSI Adhesive Anchor Installer.

Temporary applications using §701-07 Anchoring Materials - Chemically Curing shall be inspected by the Contractor every 90 days at a minimum to ensure that the adhesive anchor is performing as intended. The Contractor shall check for such things as creep of anchor material, movement of the anchors, loose bolts, loose nuts, etc. Temporary items anchored using §701-07 Anchoring Materials – Chemically Curing shall be removed or abandoned, in such a way that the anchors are no longer subject to any load upon completion of their temporary use.

**A. Anchor Pull-Out Testing.** Table 586-1 *Number of Anchors to be Pull-Out Tested* gives the number of anchors (N1) to be tested for any lot size. The Engineer will randomly choose the anchors to be tested. Testing of anchors in a lot shall not begin until all the anchors in the lot are installed. If one (N1) anchors fails, N2 indicates the number of additional anchors that must be tested. If only one anchor fails (N1+N2), the lot will be accepted. If more than one anchor fails, all remaining anchors must be tested.

A lot size is determined by the Contractor, but must meet the following criteria:

1. A lot size shall not exceed 600 anchors.
2. All anchors in a lot must be installed within a two-month period.
3. Any anchors installed beyond the two-month period set forth in 2 above shall be part of another lot.
4. A lot shall only include anchors grouted with a single product
5. A lot shall only include anchors of the same type, diameter and embedment depth.
Table 586-1 NUMBER OF ANCHORS TO BE PULL-OUT TESTED

<table>
<thead>
<tr>
<th>LOT SIZE</th>
<th>N1</th>
<th>N2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-30</td>
<td>All the anchors in the lot</td>
<td>-</td>
</tr>
<tr>
<td>31-50</td>
<td>30</td>
<td>All remaining anchors</td>
</tr>
<tr>
<td>51-75</td>
<td>38</td>
<td>All remaining anchors</td>
</tr>
<tr>
<td>76-100</td>
<td>44</td>
<td>21</td>
</tr>
<tr>
<td>101-200</td>
<td>49</td>
<td>26</td>
</tr>
<tr>
<td>201-300</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>301-600</td>
<td>55</td>
<td>30</td>
</tr>
</tbody>
</table>

B. Test Equipment. The test equipment shall consist of a load cell, jacking system, a frame to distribute the jack load, couplers to connect the jack to the anchors, and appropriate safety devices. A calibrated pressure gauge with hydraulic ram is equivalent to a load cell. Prior to starting the testing, the Contractor shall supply the Engineer with a certificate of calibration for the load cell performed within the previous six months by an independent testing agency. Supports for the frame used to distribute the jack load shall be located outside a circle centered at the anchor. The circle shall have a diameter equal to 2 inches plus twice the anchor embedment length, but need not exceed 24 inches. The frame and jack shall be positioned so that the load is applied along the axis of the anchor. Chains or cables shall be used to connect the various pieces of the tensioning system so that free flying projectiles will not be created by the failure of an anchor coupling or other portion of the testing system.

C. Test Load. The test load for bolts shall be 90% of the ASTM proof load. When no proof load is given in the ASTM specifications for the bolt, the test load shall be the yield strength. The test load for reinforcing bar shall be 90% of the yield strength. Table 586-2, Anchor Pull-Out Test Loads lists the test loads for the most commonly used anchor bolts and rebar steels.

Table 586-2 ANCHOR PULL-OUT TEST LOADS

<table>
<thead>
<tr>
<th>Diameter (inches)</th>
<th>Test Load (kips)</th>
<th>Size</th>
<th>Test Load (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>11</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>5/8</td>
<td>17</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>3/4</td>
<td>26</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>7/8</td>
<td>35</td>
<td>7</td>
<td>32</td>
</tr>
<tr>
<td>1</td>
<td>46</td>
<td>8</td>
<td>43</td>
</tr>
<tr>
<td>1 1/8</td>
<td>51</td>
<td>9</td>
<td>54</td>
</tr>
<tr>
<td>1 1/4</td>
<td>65</td>
<td>10</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>11</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>14</td>
<td>122</td>
</tr>
</tbody>
</table>

Note: this load testing is designed to be non-destructive. Loading shall be stopped as soon as the test load is reached.

Anchors pass if the specified test load is attained without permanently displacing the anchors. Concrete spalled or otherwise damaged by the load testing shall be repaired at no additional cost to the State. All
anchors which fail a load test, or are otherwise damaged, shall be replaced at no additional cost to the State. All replaced anchors shall be successfully load tested.

586-3.02 Removal of Rivets-Replacement with High Strength Bolts. If the existing steel is painted, prior to the beginning of any other work operations, the paint shall be removed for a minimum distance of 4 inches on each side of the centerline of work location in accordance with the requirements of Section 574 Structural Steel Painting: Localized.

Rivets shall be removed by one of the following methods: Shear rivet head using a pneumatic rivet breaker (helldog), and drive out rivet shank with a pneumatic punch or flame cut rivet head above the base metal using a rivet scarfing tip without damaging the base metal, and drive out shank using a pneumatic punch. If punching will damage the base metal, the shank shall be removed by drilling. Any damage to the base metal shall be repaired at no additional cost to the State.

All high strength bolts shall be the same diameter as the rivets they replace. High strength bolts shall be installed after the nicks, burrs and foreign substances that might interfere with seating of the bolt head and nut washers are removed. Light grinding may be required. Installation and inspection of high strength bolts shall be performed in accordance with the Steel Construction Manual.

If it becomes necessary to disconnect, or adjust, steel remaining as part of the structure to complete the work, the Contractor shall obtain the Engineer's approval prior to performing disconnections or adjustments. If the bolt will not fit the rivet hole, the hole may be reamed sufficiently to accommodate the bolt.

If the contract does not include an item(s) for cleaning, priming and painting of structural steel, cleaning and painting of the bolt and immediate surrounding area shall be done as part of this work. Cleaning and painting shall be done in accordance with the requirements of Section 574 Structural Steel Painting: Localized. All steel exposed by the cleaning operations shall be painted, including at least 2 inches in every direction from the washer's edge.

586-3.03 Field Drill Holes in Existing Structural Steel. If the steel is painted, prior to the beginning of any other work operations, the paint shall be removed for a minimum distance of 4 inches on each side of the centerline of work location in accordance with the requirements of Section 574 Structural Steel Painting: Localized. Any required re-painting will be paid for separately.

The required hole diameter will be indicated on the contract documents. The Contractor shall not flame cut, or flame drill holes. All damage to existing steel caused by the contractor’s operation, shall be repaired by the Contractor at no additional cost to the State.

586-4 METHOD OF MEASUREMENT

586-4.01 Drilling and Grouting Anchors. The quantity to be measured for payment will be the number of holes into which grout and bolts have been inserted.

586-4.02 Removal of Rivets - Replacement with High Strength Bolts. The quantity to be measured for payment will be the number of high strength bolts installed.

586-4.03 Field Drill Holes in Existing Structural Steel. The quantity to be measured for payment will be each hole drilled.

586-5 BASIS OF PAYMENT

586-5.01 Drilling and Grouting Anchors. The unit price bid for drilling and grouting anchors shall include the cost of all labor, materials, and equipment necessary to satisfactorily complete the work. The cost of new bolts and/or reinforcing bars will be paid for separately.
586-5.02 Removal of Rivets - Replacement with High Strength Bolts. The unit price bid for removal of rivets and replacement with high strength bolts shall include the cost of all labor, material and equipment necessary to satisfactorily complete the work, including paint removal and painting. Payment will be made for each installed bolt regardless of whether a rivet was removed from the location.

586-5.03 Field Drill Holes in Existing Steel. The unit price bid for field drill holes in existing steel shall include the cost of all labor, equipment and materials necessary to satisfactorily complete the work, including paint removal when required. No additional payment will be made for holes drilled through different thicknesses, or through different numbers of plates.

*Payment will be made under:*

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>586.0201</td>
<td>Drilling and Grouting Bolts or Reinforcing Bars</td>
<td>Each</td>
</tr>
<tr>
<td>586.0202</td>
<td>Drilling and Grouting Bolts or Reinforcing Bars (with Non-Destructive Investigation)</td>
<td>Each</td>
</tr>
<tr>
<td>586.0301</td>
<td>Drilling and Grouting Bolts or Reinforcing Bars with Pullout Test</td>
<td>Each</td>
</tr>
<tr>
<td>586.0302</td>
<td>Drilling and Grouting Bolts or Reinforcing Bars with Pullout Test (with Non-Destructive Investigation)</td>
<td>Each</td>
</tr>
<tr>
<td>586.0401</td>
<td>Drilling and Grouting Bolts, Overhead or Sustained Tension, with Pullout Test</td>
<td>Each</td>
</tr>
<tr>
<td>586.0402</td>
<td>Drilling and Grouting Bolts, Overhead or Sustained Tension, with Pullout Test (with Non-Destructive Investigation)</td>
<td>Each</td>
</tr>
<tr>
<td>586.05</td>
<td>Removal of Rivets- Replacement with High Strength Bolts</td>
<td>Each</td>
</tr>
<tr>
<td>586.10</td>
<td>Field Drill Holes in Existing Structural Steel</td>
<td>Each</td>
</tr>
</tbody>
</table>

**SECTION 587 - BRIDGE RAILING RECONSTRUCTION**

587-1 DESCRIPTION. The work shall consist of the following:

- The removal and disposal of bridge railing.
- The removal and storage of bridge railing.
- The installation of stored bridge railing.
- The furnishing and installing of box beam bridge railing.
- The furnishing and installing of thrie beam bridge railing.

587-1.01 Bridge Railing Removed and Disposed; and Stored Bridge Railing Installed. Material removed for disposal and material not used for installation shall become the property of the Contractor and shall be removed from the work site.

587-1.02 Bridge Railing Removed and Stored. All bridge railing removed shall remain the property of the State and shall be transported to a location within the project site designated by the Engineer.

587-2 MATERIALS

587-2.01 New Material. Materials shall meet the requirements of §710-23, Steel Bridge Railing and the following:

<table>
<thead>
<tr>
<th>Component</th>
<th>ASTM Designation or Standard Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>S3 x 5.7 Post</td>
<td>A36</td>
</tr>
<tr>
<td>Post Plate</td>
<td>A36</td>
</tr>
<tr>
<td>Spacer Brackets</td>
<td>A36</td>
</tr>
</tbody>
</table>
Sections 200 - 599

STANDARD SPECIFICATIONS (USC) May 1, 2020

Rail Connection Angles A36
Rail Plates A36
“U” Bolts, Nuts and Washers A307
Anchor Bolts, Nuts and Washers A325
Thrie Beam 710-201
W6 x 25 Post A36
Anchor Bolts (Thrie Beam) A449
Carriage Bolts (Thrie Beam) A307
Nuts and Washers for Carriage Bolts A563 and F436
Attachment Plate A36
Concrete Grouting Material 701-05

NOTE: 1. Thrie Beam Bridge Railing shall be fabricated from 10 gage material.

587-2.02 Stored Material. The Contractor shall choose the best available material for installation, subject to the approval of the Engineer.

587-3 CONSTRUCTION DETAILS

587-3.01 Bridge Railing Removal. If so indicated on the plans, the existing anchorages shall be reused for anchoring new or stored railing. Should this be the case, the Contractor shall exercise care removing the railing so as not to damage the existing anchorages. The provisions of §589-3.01 shall apply for the removal of any painted bridge railing.

587-3.02 Bridge Railing Storage. The Contractor shall remove, transport, unload and store bridge railing. Care shall be taken not to damage the railing during the various operations. In the event railing is damaged it shall be repaired or replaced in kind as directed by the Engineer. Such repair or replacement shall be done at no expense to the State.

587-3.03 Stored Bridge Railing Installation. Installation of the railing shall be done in accordance with the following subsections of section 568, Bridge Railing:

- Inspection of Railing 568-3.01A
- Field Welding 568-3.01D
- Positioning Railing 568-3.01F
- Positioning Posts 568-3.01G
- Base Plates 568-3.01H
- Non-Metallic Pads 568-3.01I
- Anchor Studs 568-3.01L
- Inspection 568-3.01N

NOTE: 1. Bends or kinks in the railing which were present at the place of storage will not be cause for rejection.

587-3.04 Box Beam Bridge Railing Installation. Erection shall be in accordance with requirements of 568-3.01, Erection of Bridge Railing. The installation procedure shall be coordinated to provide the least disturbance of pedestrian and vehicular traffic, if such traffic is maintained during the course of the work.

587-3.05 Thrie Beam Installation

- A. Direct Attachment to Existing Railing. The railing shall be installed in accordance with the following:

- Inspection of Railing 568-3.01A
- Field Galvanizing for Repair 568-3.01C
- Inspection of Galvanizing 568-3.01B
- Inspection 568-3.01N
The railing shall be installed such that the bottom edge is parallel to the roadway profile.

**B. Separate Post Installation - Concrete Support Surface.** The posts and railing shall be installed in accordance with the following:

- Inspection of Railing 568.3.01A
- Positioning Posts 568-3.01G
- Inspection of Galvanizing 568-3.01B
- Base Plates 568-3.01H
- Field Galvanizing for Repair 568-3.01C
- Anchor Studs 568-3.01L
- Field Welding 568-3.01D
- Inspection 568-3.01N
- Erection 568-3.01E

Mortar leveling courses shall be made from Concrete Grouting Material (§701-05). Manufacturer's instruction shall be strictly followed.

Railing shall be installed such that the bottom edge is parallel to the roadway profile.

**C. Separate Post Installation - Steel Support Surface.** The posts and railing shall be installed in accordance with the following:

- Inspection of Railing 568-3.01A
- Positioning Posts 568-3.01G
- Inspection of Galvanizing 568-3.01B
- Base Plates 568-3.01H
- Field Galvanizing for Repair 568-3.01C
- Anchor Studs 568-3.01L
- Field Welding 568-3.01D
- Inspection 568-3.01N
- Erection 568-3.01E

Railing shall be installed such that the bottom edge is parallel to the roadway profile.

### 587-4 METHOD OF MEASUREMENT

**A. All Railing Removal and Installation Except Thrie Beam Railing Installation.** Measurement will be taken as the number of feet of railing removed, or installed. Measurement will be taken along the centerline of the top rail, end-to-end of railing between the limits indicated on the contract plans. No deduction will be made for open joints. If there is only one rail it will be considered the top rail.

**B. Thrie Beam Railing Installation.** Measurement will be taken as the number of feet of railing installed. Measurement will be taken along the top of the thrie beam, end-to-end of railing between the limits indicated on the contract plans. No additional measurement will be taken for overlapping sections of railing. If transition sections are installed, measurement will be taken to the end of the transition section indicated on the contract plans.

### 587-5 BASIS OF PAYMENT.

The unit price bid shall include the cost of all labor, materials and equipment necessary to complete the work. When required, mortar leveling courses, anchor bolts, nuts
and washers shall be included in the unit price bid. The drilling and grouting of anchor bolts, when required will be paid for under a separate item.

Painting of the railing, if required, shall be paid under a separate item.

**Payment will be made under:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>587.01</td>
<td>Bridge Railing Removal and Disposal</td>
<td>Foot</td>
</tr>
<tr>
<td>587.02</td>
<td>Bridge Railing Removal and Storage</td>
<td>Foot</td>
</tr>
<tr>
<td>587.03</td>
<td>Installation of Stored Bridge Railing</td>
<td>Foot</td>
</tr>
<tr>
<td>587.1001</td>
<td>Box Beam Bridge Rail, One Rail</td>
<td>Foot</td>
</tr>
<tr>
<td>587.1002</td>
<td>Box Beam Bridge Rail, Two Rail</td>
<td>Foot</td>
</tr>
<tr>
<td>587.20</td>
<td>Thrie Beam Bridge Rail - Attachment to Existing Bridge Rail</td>
<td>Foot</td>
</tr>
<tr>
<td>587.21</td>
<td>Thrie Beam Bridge Rail - New Post Installation Mounted on Concrete Surfaces</td>
<td>Foot</td>
</tr>
<tr>
<td>587.22</td>
<td>Thrie Beam Bridge Rail - New Post Installation Mounted on Steel Surfaces</td>
<td>Foot</td>
</tr>
</tbody>
</table>

**SECTION 588 - BRIDGE JOINT REHABILITATION**

**588-1 DESCRIPTION.** The work in this section shall include work required for bridge joint rehabilitation.

**588-2 MATERIALS.** Materials shall meet the requirements specified in the special specifications.

**588-3 CONSTRUCTION DETAILS.** The extent of work and construction requirements will be covered by special specifications in the contract documents.

**588-4 METHOD OF MEASUREMENT.** As specified in the special specifications.

**588-5 BASIS OF PAYMENT.** As specified in the special specifications.

**SECTION 589 - REMOVAL OF STRUCTURAL STEEL**

(Loast Revised September, 2016)

**589-1 DESCRIPTION.** The work shall consist of removal and disposal of existing structural steel as shown in the contract documents and as directed by the Engineer.

**589-2 MATERIALS.** Not Specified.

**589-3 CONSTRUCTION DETAILS**

**589-3.01 General.** A minimum of 14 days prior to the removal of existing structural steel, the Contractor shall submit a written Structural Steel Removal plan meeting the requirements of §202-3.01A. *Demolition Plan* to the Engineer for approval. The Structural Steel Removal plan shall set forth all expected supports, disconnections and adjustments to steel which is to remain. If, during the course of the work it becomes necessary to support, disconnect, or adjust steel not previously noted in the Structural Steel Removal plan, the Contractor shall submit a revised plan to the Engineer for approval.

All work performed on steel which is to remain shall be in accordance with the applicable requirements of the Steel Construction Manual (SCM). Materials removed as part of this work shall become the property of the Contractor, and shall be removed from the work site.

Cutting of steel to remain shall be performed in a manner to produce edges and surfaces suitable for welding, in accordance with the requirements of the SCM, Part 603 *Surfaces and Edges to be Welded.*
Thermal cutting of A709 steels shall be performed in accordance with the requirements of the SCM, Part 602 Thermal Cutting of A709 Steels. Replacement of steel removed will be paid for separately.

589-3.02 Steel Structures Coated with Paint. If the steel is coated with paint, prior to the start of steel removal operations, the paint shall be removed for a minimum distance of 4 inches on each side of the centerline of cut, bolt row, rivet row, or weld, as applicable. The paint removal work shall be performed in accordance with the requirements of §202-3.01D. Paint Removal.

589-3.03 Fastener Removals. If rivet shanks, or bolts, cannot be removed by punching without damaging the base metal, the rivet shank, or bolt, shall be removed by drilling.

A. Bolts. Nuts shall be removed with wrenches, wherever possible, and the bolts driven out with a hand held punch. Alternate removal procedures shall be set forth in the Removal Plan.

B. Rivets. Rivets shall be removed by either of the following methods:

- Shearing the rivet head, using a pneumatic rivet breaker (helldog), and driving out the rivet shank with a pneumatic punch
- Flame-cutting the rivet head 1/16 inch above the base metal, using a rivet scarfing tip, and driving out the shank using a pneumatic punch.

589-3.04 Welded Connection Disassembly. Welded connections shall be disassembled in accordance with the following:

A. Removal. The affected weld shall be removed by means of air carbon arc gouging equipment. To avoid damaging the base material, 1/8 inch of weld material should be left in place. If more removal is needed to break the weld, then the removal shall be done in the vicinity of the component which will not remain. Any damaged steel to remain shall be repaired or replaced in a manner to be approved by the DCES.

B. Grinding. The weld material on the existing steel to remain in place shall be ground flush with the base metal surface. No base metal shall be removed by grinding.

C. Inspection. The Engineer will perform a visual inspection of all weld removal locations. If the Engineer suspects that damage has occurred, the Contractor shall perform a dye penetrant inspection in accordance with the requirements of the SCM.

If the Contractor's operations damage existing steel which is to remain in place, the damaged steel shall be repaired, or replaced, as determined by the DCES at no additional cost to the State.

589-4 METHOD OF MEASUREMENT.

The quantity to be measured for payment for removal of existing steel with a pay unit of pounds will be in pounds of existing steel removed, measured to the nearest whole pound. The weight of existing steel removed will be computed from the nominal sizes indicated in the contract documents. If the nominal size is not indicated, field measurements shall be used to determine the weight, using 490 pcf as the density of steel. The weight of bolts, rivets and welds will be neglected, and no deductions will be made for any rivet or bolt holes in the existing steel or for any section loss due to corrosion.

The quantity to be measured for payment for removal of existing steel with an each pay unit will be in each unit of existing steel removed.

589-5 BASIS OF PAYMENT. The unit price bid shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work, including the removal of paint and fasteners, and disconnecting, supporting, or adjusting steel as necessary.
The treatment, handling and disposal of the paint removal waste will be paid separately.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>589.01nnn</td>
<td>Removal of Existing Steel</td>
<td>Pound</td>
</tr>
<tr>
<td>589.52nnn</td>
<td>Removal of Existing Steel</td>
<td>Each</td>
</tr>
</tbody>
</table>

NOTE: nnnn denotes a serialized pay item.

SECTION 590 - ADJUSTMENT OF BRIDGE APPURtenANCES

590-1 DESCRIPTION. This work shall consist of adjusting the elevation of bridge joints and drainage devices to meet the proposed finished elevations in the manner indicated on the Contract Plans.

In order to perform the work, it may be necessary to remove structural concrete. Structural concrete removal, if performed, shall be done under its respective item.

590-2 MATERIALS. Materials shall meet the following requirements:

- Structural Steel: ASTM A36, A242 or A588
- Nuts, Bolts, and Washers: ASTM A307 Grade A
- Galvanized Coatings and Repair Methods: 719-01
- Preformed Elastic Joint Sealer: 705-09

590-3 CONSTRUCTION DETAILS. All steel materials, including nuts, bolts, and washers, used as a part of this work, shall be galvanized in accordance with §719-01. Any galvanized surface, either existing or installed as a part of this work, which is damaged by welding or abrasion, shall be repaired in accordance with §719-01.

All welding shall be done in accordance with the applicable requirements of the New York State Steel Construction Manual.

The Contractor shall take suitable precautions to prevent damage to materials designated to remain-in-place. Damage to such material, due to the Contractor's operations, shall be repaired or the damaged material replaced, as determined by the Engineer.

Dimensions shown on the plans shall be verified by the Contractor and any necessary changes approved by the Engineer prior to construction of any needed fabrications.

Preformed elastic joint sealer, where required, shall be installed in accordance with the Contract Plans.

590-4 METHOD OF MEASUREMENT

590-4.01 Bridge Drainage Devices. The work will be measured as each bridge drainage device as defined by the Contract Plans which has had its elevation adjusted in accordance with the Contract Plans.

590-4.02 Bridge Joints. The work will be measured as the number of feet of joint system which has had its elevations adjusted in the manner indicated on the Contract Plans.

Measurement will be taken only between curb lines. No measurements will be taken across sidewalks, or raised medians. In the event that curbs are not present, measurement will be taken only to those points where the elevations have actually been adjusted.

590-5 BASIS OF PAYMENT

590-5.01 Bridge Drainage Devices. The unit price bid for each bridge drainage device adjusted shall include the cost of all labor, materials, and equipment necessary to complete the work.
No payment will be made for work done to repair damage due to the Contractor's operations, nor for any material supplied as replaced material made necessary due to damage attributable to the Contractor's operations.

**590-5.02 Bridge Joints.** The unit price bid per foot shall include the cost of all labor, materials and equipment necessary to complete the work.

No payment will be made for work done to repair damage due to the Contractor's operations, nor for any material supplied as replacement material made necessary due to damage attributable to the Contractor's operations.

Any concrete removal or replacement will be paid for under the appropriate items.

### Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>590.01</td>
<td>Vertical Adjustment of Bridge Drainage Devices - 1</td>
<td>Each</td>
</tr>
<tr>
<td>590.02</td>
<td>Vertical Adjustment of Bridge Drainage Devices - 2</td>
<td>Each</td>
</tr>
<tr>
<td>590.03</td>
<td>Vertical Adjustment of Bridge Drainage Devices - 3</td>
<td>Each</td>
</tr>
<tr>
<td>590.04</td>
<td>Vertical Adjustment of Bridge Drainage Devices - 4</td>
<td>Each</td>
</tr>
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<td>590.05</td>
<td>Vertical Adjustment of Bridge Drainage Devices - 5</td>
<td>Each</td>
</tr>
<tr>
<td>590.21</td>
<td>Vertical Adjustment of Joint System - 1</td>
<td>Foot</td>
</tr>
<tr>
<td>590.22</td>
<td>Vertical Adjustment of Joint System - 2</td>
<td>Foot</td>
</tr>
<tr>
<td>590.23</td>
<td>Vertical Adjustment of Joint System - 3</td>
<td>Foot</td>
</tr>
<tr>
<td>590.24</td>
<td>Vertical Adjustment of Joint System - 4</td>
<td>Foot</td>
</tr>
<tr>
<td>590.25</td>
<td>Vertical Adjustment of Joint System - 5</td>
<td>Foot</td>
</tr>
</tbody>
</table>

**SECTIONS 591 THRU 593 (VACANT)**

**SECTION 594 - TIMBER AND LUMBER**

**594-1 DESCRIPTION.** Under this work the Contractor shall furnish and place timber and lumber of various sizes and types as may be specified for sills or platforms beneath the road, for culverts, bridges reinforcing existing structures, and for other similar purposes as shown on the plans or specified by the Engineer.

**594-2 MATERIALS.** Materials shall meet the following requirements:

- Wood Preservative - Creosote Oil, Type I: 708-30
- Wood Preservative - Water Borne: 708-31
- Wood Preservative - Oil Borne: 708-32
- Timber and Lumber: 712-13
- Stress Graded Timber and Lumber: 712-14
- Steel Plates as Specified: 715-01

**594-2.01 Fasteners.** Fasteners such as: spikes, nails, screws, timber connectors, bolts, nuts and washers shall meet the standard industrial fastener specifications for the intended application.

**594-2.02 Approval of Order.** Prior to ordering timber and lumber, the Contractor shall submit to the Engineer for approval, a detailed statement of his proposed order. No material shall be ordered until the statement is approved.

**594-2.03 Preservative Treatment.** The preservative treatment shall be applied to stress graded lumber and timber and shall conform to the requirements of the AWPA C2, C3, and C18.
594-2.04 Sampling and Inspection. Sampling and inspection will be done by an accredited representative of the Department. The Inspector shall have the power to take samples of the material for analysis and to reject those materials which do not fulfill the requirements of these specifications as to either quality or workmanship. The acceptance of any materials by the Inspector shall not be a bar to their subsequent rejection if found defective. The Contractor shall furnish all facilities and equipment for the inspection and testing of materials and workmanship and the Inspector shall be allowed free access to all premises where inspections can be made.

The Contractor shall give the Department and Department's Inspection Agents ample notice relative to the location of, and time when, treating operations will take place. Inspection of all timber and lumber will be made by the Department's Inspection Agents before, during, and after pressure treatment at the treating plant. No treated timber and lumber shall be shipped which does not bear, in legible form, the Inspector's stamp of approval.

594-3 CONSTRUCTION DETAILS

594-3.01 General. Timber and lumber shall be placed or erected as shown on the plans or specified by the Engineer.

Any surface breaks resulting from storage and handling which do not warrant rejection shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied.

Paint, where specified, shall be applied as required by the Contract Documents.

594-3.02 Treatment after Fabrication. All cutting, framing and boring of timber and lumber shall be done before treatment whenever practicable. Cutting and boring below high water shall be particularly avoided in material which is to be used in waters infested with marine borers.

All cut surfaces and all bolt holes bored subsequent to treatment shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied. Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

All cut surfaces and bolt holes below the high water line shall, in addition to the AWPA M4 preservative treatment, be coated with a thick application of a mixture of 30% creosote and 70% pitch.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation.

594-4 METHOD OF MEASUREMENT. The quantity to be paid for timber and lumber will be the number of cubic feet placed in the completed work. In measuring dressed timber and lumber, the cross-section of any piece will be taken as the minimum nominal commercial size of undressed material from which the piece could have been cut. When round timber is used, it shall be estimated as square timber of the smallest undressed commercial size from which the timber can be manufactured. The length of any piece will be taken as the actual length in the finished work, making no deductions for bevels, notches or splices. If the measured quantity is first computed in board feet, the conversion factor shall be 0.083334 cubic feet per board foot.

594-5 BASIS OF PAYMENT. The unit price bid per cubic foot shall include the cost of furnishing all spikes, nails, screws, timber connectors, bolts, nuts, washers, hardware, preservative treatment and other required materials together with labor and equipment necessary to complete the work.

Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>594.01</td>
<td>Timber and Lumber</td>
<td>Cubic Foot</td>
</tr>
</tbody>
</table>
SECTION 595 - WATERPROOFING SYSTEMS FOR STRUCTURES

595-1 DESCRIPTION. The work in this section shall include work required for waterproofing systems for structures.

595-2 MATERIALS. Materials shall be as specified in the special specifications.

595-3 CONSTRUCTION DETAILS. The extent of work and construction requirements will be covered by special specifications in the contract documents.

595-4 METHOD OF MEASUREMENT. As specified in the special specifications.

595-5 BASIS OF PAYMENT. As specified in the special specifications.

SECTION 596 - OPEN STEEL FLOOR

596-1 DESCRIPTION. The work shall consist of furnishing and placing open steel floor in structural slabs, at the locations indicated on the contract plans.

596-2 MATERIALS

596-2.01 Steel. All steel for the component parts shall conform to the requirements of ASTM A36 or A588. If steel conforming to ASTM A36 is used, it shall be furnished with a minimum copper content of 0.20 percent.

The Contractor shall furnish the Department with two certified copies of the record of physical tests and chemical analysis of the steel used.

596-2.02 Fabrication. All the requirements and provisions of the SCM shall apply.

596-2.03 Shop Painting. The open steel floor shall be painted in accordance with the contract documents. Surfaces which are to be welded shall not be painted until all welding is completed.

596-3 CONSTRUCTION DETAILS

596-3.01 Placement. Open steel floor shall be placed true to line and grade and shall make full and even bearing on the underlying surface.

596-3.02 Field Welding. All the requirements and provisions of the SCM shall apply.

596-3.03 Field Painting. The requirements of §596-2.03 shop painting, shall apply.

596-4 METHOD OF MEASUREMENT. The quantity to be measured will be the actual area, in square feet, of open steel floor furnished and installed, including any portions that are filled with concrete.

596-5 BASIS OF PAYMENT. The unit price bid per square foot shall include the costs of all labor, material (including fabrication) and equipment necessary to complete the work.
Payment will be made under:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>596.01</td>
<td>Open Steel Floor</td>
<td>Square Foot</td>
</tr>
</tbody>
</table>

SECTION 597 - TIMBER BRIDGE RAILING AND TRANSITIONS

597-1 DESCRIPTION. The work shall consist of furnishing and erecting timber bridge railing and transitions as shown on the contract plans and in accordance with the specifications. As soon as the Contract is awarded, the Contractor shall notify the DCES of the name and address of the fabricator of all timber bridge railing. This notification shall list the specific shop or shops in which the railing will be fabricated.

597-2 MATERIALS. Materials for this work shall meet the following requirements:

<table>
<thead>
<tr>
<th>Component</th>
<th>ASTM or SAE Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Steel Plates</td>
<td>A36 (A709, Grade 36)</td>
</tr>
<tr>
<td>Rail Splice Plate</td>
<td>A36 (A709, Grade 36)</td>
</tr>
<tr>
<td>Tension Rods and Connection Bolts</td>
<td>A325 or A449 Type 1</td>
</tr>
<tr>
<td>Round Head Square Neck Threaded Bolt</td>
<td>A307 Grade A</td>
</tr>
<tr>
<td>Nuts</td>
<td>A563 Class 10S, Type HH</td>
</tr>
<tr>
<td>Washers</td>
<td>F436, Type 1</td>
</tr>
<tr>
<td>Thrie Beam</td>
<td>A588 or A572 (A709, Grade 36 or 36W)</td>
</tr>
<tr>
<td>Thrie Beam to W-Beam Transition Piece</td>
<td>A588 or A572 (A709, Grade 36 or 36W)</td>
</tr>
<tr>
<td>Dome Head Drive Spike</td>
<td>Industry Standard</td>
</tr>
<tr>
<td>Split Rings</td>
<td>SAE 1010 Hot Rolled Carbon Steel</td>
</tr>
<tr>
<td>Shear Plates</td>
<td>ASTM A47/A47M, Grade 32510</td>
</tr>
</tbody>
</table>


Glued laminated timber shall comply with the requirements of the American Institute of Timber Construction (AITC). All wood products shall be pressure treated with wood preservative in accordance with §708-31 or §708-32 except that laminations for glue laminated timbers shall be treated prior to gluing with wood preservative designated as light pentain oil as in AWPA C28 and glued with wet-use adhesives conforming to Sections 4.5.1.2 of ANSI/AITC A190.1-1983.

The bridge rail shall be horizontally laminated glued laminated timber, visually graded Western species combination No. 2 or visually graded Southern Pine Combination No. 48. Other species and grades of glued laminated timber may be substituted provided that the minimum values tabulated in the latest edition of the National Design Specification for Wood Construction (ANSI/NFoPA NDS) are not less than the following:

\[ F_{b,y} = 1800 \text{ psi} \]
\[ E = 1800 \text{ ksi} \]

Posts, curbs, scuppers, and spacing blocks may be sawn lumber or glued laminated timber. When sawn lumber is used, material shall be visually graded No. 1 Southern Pine or visually graded No. 1 Douglas Fir-Larch. Other species and grades of lumber may be substituted provided that the minimum values tabulated in the latest edition of the National Design Specification for Wood Construction (ANSI/NFoPA NDS) or obtained through a Machine Stress Rated (MSR) procedure approved by the American Lumber Service (ALS) are not less than the following:

\[ F_b = 1350 \text{ psi} \]
E = 1500 ksi

597-3 CONSTRUCTION DETAILS

597-3.01 Fabrication. Timber bridge railing shall be fabricated to the dimensions shown on the Contract plans and in compliance with the specifications.

A. Shop Drawings. Shop drawings shall be provided in accordance with the Steel Construction Manual (S.C.M.) except as follows:

- The drawings shall be submitted to the Engineer for review and approval; and
- The computed weights need not be shown.

B. Galvanizing. Galvanizing shall conform to the requirements of §719-01, Galvanized Coatings and Repair Methods, Type I. All steel components of the railing, including the round head square necked threaded bolts, shall be galvanized. Galvanizing of high-strength steel tension rods shall follow the recommendations of the tension rod manufacturer so as not to adversely affect the mechanical properties of the steel. All steel components shall be galvanized after welding and other fabrication.

Shop galvanizing repair of uncoated areas will be permitted on localized areas. Repair of localized areas is limited to a total of 2 square inches on any one component. Any component requiring more than 2 square inches of galvanizing repair shall be stripped and regalvanized.

Shop repair shall be in accordance with the methods given in §719-01.

The following areas shall not require galvanizing repair: One 1/8 inch maximum dimension spot of tight flux remaining in the fusion line of any 7 inch length of weld after blast cleaning, pickling and galvanizing.

C. Shop Wood Repair. All cutting, framing and boring of timber shall be done before treatment whenever practicable.

All cut surfaces shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied.

All bolt holes bored subsequent to treatment shall be treated with preservative by means of an approved pressure bolt hole treater. Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

597-3.02 Erection of Timber Bridge Railing and Transitions

A. Inspection of Railing. Prior to installation, all timber and lumber shall be examined for shakes, holes, knots, checks, splits, and decay. The Materials Requirements under "Defects" of §712-17 shall apply. Any piece of timber or lumber exhibiting any one of the aforementioned defects shall be subject to rejection as determined by the Engineer.

B. Inspection of Galvanizing. Immediately prior to erection, the railing shall be inspected for damage. Damage to the galvanizing of steel railing components shall constitute sufficient cause for rejection except for the following conditions:

1. If a damaged area is not required to be repaired under the provisions of §710-23, Steel Bridge Railing.
2. If the total damaged area of a single piece is 6 square inches or less. Total damaged area is exclusive of the damaged area described under §597-3.02B1.
C. Field Wood Repair. All cut surfaces shall be treated in accordance with AWPA M4 with the addition that at least three coats of preservative shall be applied.

All bolt holes bored subsequent to treatment shall be treated with preservative by means of an approved pressure bolt hole treater. Any unfilled holes, after being treated with preservative shall be plugged with preservative treated plugs.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation.

D. Field Galvanizing Repair. Field galvanizing repair shall be allowed to be performed upon damaged areas meeting the requirements of §597-3.02B2.

Field galvanizing repair shall be made by painting zinc repair material onto the damaged area in accordance with the requirements of §719-01, Galvanized Coatings and Repair Methods.

All finished surfaces of welds and adjacent surfaces where galvanizing has been removed, due to any field welding operation, shall be field galvanized.

E. Holes in Metal Plates. Prior to galvanizing, any necessary holes in the metal plates shall be made in the shop in accordance with the requirements of the S.C.M.

F. Installation. The installation work shall be done by bolting methods alone. The requirements of the S.C.M. shall apply.

G. Posts. Bridge railing posts shall be installed as truly vertical as possible within the following tolerance limit: 5/16 inch in any direction as measured from the top of the deck to the top of the post.

Bridge railing transition posts shall be installed at the location and in the manner indicated on the Contract plans. The Contractor shall carefully excavate for all post holes. Post holes and post foundation structures shall be backfilled and compacted in accordance with Section 203, Select Structure Fill. Prior to acceptance, all posts shall be plumb to a tolerance of +/- 5/16 inch.

The tops of all posts and the top of the rail splice plate kerf shall be sealed with roofing cement or otherwise protected from direct exposure to weather.

H. Rails. The rails of timber railings shall span a minimum of four (4) posts. Bolts on traffic face of rail shall be round head square neck threaded bolt. Railing splices shall be installed in the manner indicated on the Contract plans.

I. Washers. Unless otherwise noted, malleable iron washers shall be provided under bolt heads and under nuts that are in contact with wood. Washers may be omitted under heads of dome-head timber bolts when the size and strength of the head is sufficient to develop connection strength without wood crushing.

J. Erection Inspection. All erection shall be subject to the inspection of the Engineer who shall be given all facilities required for a visual inspection of workmanship and materials.

597-4 METHOD OF MEASUREMENT

597-4.01 Timber Bridge Railing. The quantity to be paid for timber bridge railing shall be the number of feet measured along the centerline of railing between the extreme outer limits indicated on the Contract plans.

597-4.02 Timber Bridge Railing Transition. The quantity to be paid for timber bridge railing transition shall be the number of transitions required.
597-5 BASIS OF PAYMENT. The unit price bid per linear foot of the timber railing shall include the cost of all labor, material and equipment necessary to do the work. The price bid per timber bridge railing transition shall include the cost of all labor, material and equipment necessary to do the work. All drilling and grouting work, if permitted, will be done at the contractor’s expense.

Payment will be made under:

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<thead>
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<th>Item No.</th>
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<tbody>
<tr>
<td>597.10</td>
<td>Timber Railing</td>
<td>Foot</td>
</tr>
<tr>
<td>597.20</td>
<td>Timber Railing Transition</td>
<td>Each</td>
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</tbody>
</table>

598 AND 599 (VACANT)