CATEGORY 400
STRUCTURES

SECTION 401 – MAINTAINING EXISTING BRIDGE DECK DURING LIFE OF CONTRACT

401.01 DESCRIPTION. This work shall consist of patching the existing bridge deck as specified in the Contract Documents or as directed by the Engineer.

401.02 MATERIALS.

Rapid Hardening Cementitious Materials For Concrete Pavement Repairs	902.14

The Contractor shall submit the patching material to the Engineer for approval.

401.03 CONSTRUCTION. The Engineer and Contractor shall periodically review the existing deck and determine if any patching is necessary. All holes over 1 in. deep having an area greater than 2 square feet shall be patched.

Before patching begins, the Contractor's Traffic Manager shall confer with the Engineer to decide on a plan for diverting or detouring traffic during patching operations. All items relating to traffic safety and traffic control requirements shall conform to the Contract Documents.

The areas requiring repairs shall be clean and free of loose material and shall conform to the manufacturer's recommendations for surface preparation.

When working on a full depth repair area, the Contractor shall protect waterways and roadways under the structure from falling debris. No removed material shall be disposed of in any waterway.

The patching material shall be placed full depth to the top of the existing bridge deck surfaces.

New reinforcement shall be required only when directed by the Engineer.

If a patch has been made and it has not yet reached sufficient strength to support traffic when this section of the structure is opened to traffic, it shall be covered with a steel plate as specified in Sections 522.03.13 and 300.03.05. All areas around the plate shall be built up with asphalt material.

401.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

401.04.01 ***Patching For Maintaining Existing Bridge Deck*** will be measured and paid for at the Contract unit price per square foot. The payment will also be full compensation for the removal and disposal of material required to prepare the patch area, including chipping and hand cleaning, as well as furnishing and placing reinforcement steel, forming, providing protective structures, floodlighting, and furnishing, placing and removing any steel plates. Patches performed day or night will be paid for at the Contract unit price.

401.04.02 All work, materials, sequence of operations, equipment, protection vehicle and channelization devices required to maintain traffic during each occurrence of patching including removal after patching is complete, will be measured and paid for at the Contract unit price per each for the pertinent ***Maintenance of Traffic for Bridge Patching Operation*** item. When more than one patch is made under one movement of traffic for patching, the item will be paid for only once, regardless of the number of patches made or the length of time traffic is rerouted. If traffic is maintained more than once for a particular patching operation, the work will be measured and paid for only once.

SECTION 402 – REMOVAL OF EXISTING STRUCTURES

402.01 DESCRIPTION. This work shall consist of the removal and disposal or salvage, wholly or in part, of existing structures as specified in the Contract Documents or as directed by the Engineer.

The Contractor is advised that prints of plans of the pertinent existing structure(s) may be available from the County. The County assumes no responsibility for the accuracy or completeness of existing plans. Dimensions, details, etc. as shown thereon may not be as built.

402.02 MATERIALS. Not applicable.

402.03 CONSTRUCTION. Before removal operations begin, the Contractor shall submit to the Engineer for approval a list of the equipment to be used and the removal method. Approval does not relieve the Contractor of responsibility for preserving those portions of the structure designated to remain and be incorporated into the rehabilitated structure, or to be used to maintain traffic.

Sheeting and shoring required for the removal of existing structures or portions thereof shall meet the requirements specified in Section 404.03.03.

Unless otherwise specified in the Contract Documents, the limits of removal for existing structures shall be 18 inches below the proposed ground-line or to the limits necessary to avoid conflict with the proposed construction. The material obtained from the removal of the existing structures shall become the property of the Contractor who shall be responsible for removing and disposing of the material on approved spoil areas.

When remaining portions of an existing structure will be exposed to view in the final structure, make a neat 1 in. deep saw cut to separate the removal operations from the remaining concrete. Protect existing reinforcing steel as specified in Section 416.03.07.

Regardless of whether or not a hot mix asphalt (HMA) overlay is depicted in the Contract Documents, or if it is depicted but the actual thickness varies from what is shown, no additional compensation or credit will be made. The provisions of Section GP-4.05 will not apply.

Immediately halt removal operations if any of these existing elements that are to remain permanently or temporarily are damaged by the Contractor's operation. Submit the material and work methods proposed for use to repair or replace the damaged elements to the Engineer for approval. Perform the approved method of repair or replacement of the damaged elements to the full satisfaction of the Engineer and BCBEC-Structures at no additional cost to the County. Any delays due to the required repair or replacement shall not be a clause for any claim.

Materials to be salvaged shall be removed in such a manner as not to damage the material. Salvaged material shall be loaded, hauled, unloaded and stacked at a site specified in the Contract Documents or as directed by the Engineer. The Contractor shall notify the County a minimum of 48 hours prior to the delivery of the salvaged materials. The Contractor shall arrange for provisions to store the material off the ground and for unloading and neatly packing the material at the County's designated storage site. The Contractor shall provide the labor, equipment, etc. needed to unload the salvaged materials at the County sites.

During construction only approved equipment and material (for maximum weight, size and location) required for a particular operation will be allowed on the existing or newly constructed portion of new bridge. Refer to Sections 402.03.05 and 420.03.05 for additional requirements.

When a structure contains existing protective shields (sheeting or planking) that have been previously placed to contain debris from a deteriorating deck, the Contractor shall remove and dispose of the debris and shields at no additional cost to the County.

402.03.01 Removal of Bridge Deck Slabs and Parapets. The Contractor shall protect the public against injury and damage from demolition operations when removing portions of existing bridge deck slabs. When deck removal is performed over or near roadways, railroads or waterways, the Contractor shall furnish and erect temporary protective shields to prevent any material or debris from entering these areas.

Protective shield working drawings per Section TC-4.01 shall be submitted to the Engineer for review and approval. Flooring and siding shall have no cracks or openings through which material particles may pass. The shields shall be able to support over their entire area 150 lb/sq.ft. in addition to their own dead weight.

A minimum underclearance of 14.5 ft shall be maintained over the roadway pavement and shoulders. No portion of the shield including connection devices shall encroach on this underclearance. If less than 16.0 ft underclearance is provided, the Contractor shall furnish and erect signs indicating the exact minimum underclearance. The Engineer shall approve signs in accordance with Section 813 and the location of those signs. They shall be removed when the original underclearance is restored and shall become the property of the Contractor.

After the Engineer determines that the protective shields have served their purpose, they shall be removed and become the property of the Contractor.

402.03.02 Bridge Deck Slabs to be Replaced. On structures where the existing structural steel will be used in the finished structure and the Contractor elects to support the protective shields from the steel, all connections thereto shall be made by means of clamps or other approved devices. The drilling of holes in the existing steel work, or welding to the steel work for this purpose is prohibited.

Before removal operations begin, the outlines of the top flanges or cover plates of all stringers and floor beams shall be drawn on the bridge deck and 1 in. diameter pilot holes made outside these lines to confirm the location of the steel.

Prior to removing the existing slabs, the Contractor shall take elevations at locations along the bottom of the bottom flange or top of the top flange by removing small sections of slabs over stringers using pilot holes at the center and quarter points of all stringers, and at other points if necessary, to provide a maximum spacing of 10 ft between elevations. After removing the deck, the Contractor shall take a new set of elevations at the same points and ascertain the rebound. These rebounds shall be used in lieu of dead load deflections to establish grade controls and to produce finished tops of concrete bridge decks that will be true to planned line and grade. For bridge decks constructed with a longitudinal construction joint between stringers, diaphragms between these stringers shall not be disconnected unless specified in the Contract Documents.

On continuous bridges, the Contractor's proposed sequence of deck removal shall address uplift at the ends of continuous spans.

If damage results from the Contractor's operations, the removal operation shall be modified and the damaged items shall be repaired or replaced by the Contractor in a manner acceptable to the Engineer at the Contractor's expense.

402.03.03 Removal of Existing Bridge. Existing bridges, including piles, shall be removed as specified in Section 207.03.01 and from any area that will interfere with proposed construction.

402.03.04 Removal and Salvage of Existing Bridge Railings. All existing posts, rails, nuts, washers, etc. shall be carefully removed from the bridge. The salvaged materials shall be loaded, hauled, unloaded and stacked as specified in this Section. All nuts and washers shall be separated and placed in strong wooden kegs. Each keg shall be securely sealed and clearly marked with size, amount and type of material contained within. Posts and rails shall be carefully loaded on trucks with layers of railing components securely tied down and separated by blocking to prevent scratching, marring and denting of the material.

402.03.05 Storing Materials and Equipment On/Against Structures Restrictions. Materials and equipment shall not be stored on or against any structure unless written permission is obtained from the Engineer and BCBEC-Structures for each type of material or equipment to be stored. Submittals to the Engineer shall include the type of material or equipment; the proposed storage location; the area at the base of the material or pallet and its total weight; height of stockpiles; number of axles, load per axle, and axle spacing; vehicle gross weight; and any other information necessary to calculate the stresses applied to the structure. Stockpiles shall not be placed against piers, parapets, or any other structure that could be possibly overstressed.

For structures under construction or rehabilitation, the Contractor shall also submit information pertaining to the phase of construction, which members have been modified or separated from the remainder of the structure, or have been newly constructed.

Any materials or equipment that would have a detrimental affect to the structure such as aluminum products placed against concrete surfaces shall be adequately protected to prohibit them from coming in contact with each other. Any discoloration or damage to the structure as a result of material or equipment being stored on/against the structure shall be removed or repaired.

402.04 MEASUREMENT AND PAYMENT. Removal of existing bridges and structures or any portion thereof will be measured and paid for as specified. The payment will be full compensation for all excavation, backfill, saw cuts, professional engineering services, removal of existing shields and debris, temporary protective shields, temporary sheeting and shoring, hauling, disposal, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. On deck replacement projects, payment also includes obtaining all deck elevations specified to determine rebound, computations necessary to place new deck at required elevation, and submitting all data for review.

Construction fence used to restrict access under demolition areas will not be measured but the cost will be incidental to the pertinent Removal of Existing Structure item. When an item for construction fence is included in the Contract Documents, that portion of the construction fence used to protect demolition areas will be excluded from the measurement and payment for that item.

402.04.01 The items

Remove Existing Structure,
Remove Existing Bridge,
Remove Existing Bridge Substructure,
Remove Existing Bridge Superstructure,
Remove and Dispose of Existing Structural Steel,
Remove Portions of Existing Bridge Superstructure,
Remove Portions of Existing Bridge Substructure, and
Remove Portions of Existing Structure

will not be measured but will be paid for at the pertinent Contract lump sum price.

402.04.02 Removal of existing traffic barriers (parapets, railings, etc.) from bridges, including end posts, wing walls, and retaining walls will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Remove Existing Traffic Barrier*** item.

402.04.03 Removal of existing structures for which no specific pay item is included in the Contract Documents will not be measured but the cost will be incidental to other pertinent items specified.

402.04.04 Salvaged materials will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Remove and Salvage Existing Structural Steel*** bid item or for ***Remove and Salvage Traffic Barrier on Bridge***. The cost shall include protecting the material from damage, storing, shipping, stacking, loading, unloading, equipment labor and all incidentals necessary to complete the work. Materials damaged due to the Contractor's negligence shall be replaced at no additional cost to the County, or, at the direction of the Engineer, the Contractor shall reimburse the County for the replacement value. See also Section GP-6.06.

SECTION 403 – DRILLED HOLES IN EXISTING MASONRY

403.01 DESCRIPTION. This work shall consist of drilling holes in existing masonry for grouting of bars, bolts or anchorages, as specified in the Contract Documents or as directed by the Engineer.

403.02 MATERIALS.

Grout	902.11(c)

403.03 CONSTRUCTION. Holes shall be drilled only in the solid portion of the masonry. No holes will be permitted at points where cracks exist. The holes shall be drilled at least 1/2 in. larger than the outside diameter of the insert to be grouted and at least 6 inches from the face of any masonry surface. Dowel bars shall have a minimum diameter equivalent to a No.

6 reinforcing bar. Holes shall be cleaned and then filled two thirds full of grout. The insert shall be placed and allowed to set for 24 hours or the holes shall be filled with the cement mortar of the concrete mix placed around the inserts and placed simultaneously with the placing of the concrete.

403.04 MEASUREMENT AND PAYMENT. ***Drilled Holes in Existing Masonry*** will be measured and paid for at the Contract unit price per linear feet of drilled holes. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Inserts and grout required for insertion in these holes will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

Drilled holes for which no specific pay item is included in the Contract Documents will not be measured but the cost will be incidental to the other pertinent items specified in the Contract Documents.

SECTION 404 – STRUCTURE EXCAVATION (Class 3 and Class 4)

404.01 DESCRIPTION. This work shall consist of excavation and backfill for bridges, box culverts and other major structures as specified in the Contract Documents or as directed by the Engineer. Classes of structure excavation are:

> Class 3 Excavation — Excavation above the water surface specified in the Contract Documents.
>
> Class 4 Excavation — Excavation below the water surface specified in the Contract Documents.
>
> If Class 4 Excavation is not specified in the Contract Documents, all excavation shall be considered Class 3 Excavation regardless of the location of the water surface.

404.02 MATERIALS.

Crusher Run Aggregate CR-6	901, Table 901 A
No. 57 Stone	901, Table 901 A
Subfoundation Concrete	Table 902 A Mix #1 in Soil Mix #4 in Rock

404.03 CONSTRUCTION. All excavation contiguous to existing pavements and structures shall be sheeted, shored, braced, and supported in a substantial manner to prevent settlement, movement, or damage to the pavement or structure. Excavated material shall not be placed in any manner that may endanger any structure and shall be kept out of waterways.

404.03.01 Backfill and Embankment Material. All suitable material removed from the excavation shall be placed in backfill or stored for future use. Excavated material shall not be wasted without permission of the Engineer. Boulders, logs or other unforeseen obstacles encountered shall be removed. Unsuitable material shall be disposed of in an approved disposal area.

404.03.02 Footing Elevations. The elevation for the bottom of the footing specified in the Contract Documents shall be considered as approximate only, and the Engineer may, during the period of construction, order changes in dimensions or elevations of footings to secure a satisfactory foundation.

404.03.03 Footing Foundations. Footings for structures shall be on suitable foundations. The Engineer shall approve the foundations prior to placement of concrete and/or prior to driving foundation piles.

All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface, either level or stepped as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. When concrete is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Final removal of the foundation material to grade shall not be made until just before concrete is placed. If the Contract Documents include an item for Sub-foundation Investigation (Section 406) the item shall be used to verify the character of the foundation if directed by the Engineer.

Faces of footings shall be placed plumb against undisturbed material, rock, sheeting, shoring, or forms. Vertical faces of footings in rock shall bear against a minimum 1 ft depth of rock. If the excavation will not stand plumb, the Contractor shall furnish and install sheeting, shoring, or forms as required. When specified in the Contract Documents, sheeting used to construct spread footings shall be left in place and cut off 18 inches below finished grade. When not specified, or when sheeting is used to construct pile-supported foundations, the sheeting may be removed.

The design of sheeting and shoring shall be the responsibility of the Contractor. When the material retained by the sheeting and shoring is greater than 6 ft high, the detail, procedure, and computations shall be submitted the same as specified for falsework details in Section TC-4.01 and Section 499 and the Contract Documents. The experience specified in Section TC-4.01 will be waived.

Forms used for footings shall be removed and the void between the footing and the embankment shall be backfilled with sub-foundation concrete or tamped fill utilizing crusher run aggregate CR-6. The material shall be compacted to not less than 92 percent of maximum

density when tested in conformance with T 180, Method C. Sub-foundation concrete shall be used for this backfill when footings are submerged. Working drawings for forms used for footings are not required to be submitted for approval unless directed by the Engineer or the footing thickness exceeds 6 ft. However, working drawings for forms are required for footings of any thickness in submerged areas, cofferdams and adjacent to railroad tracks.

Where foundation piles are used, the excavation of each pit shall be completed to the as planned bottom of footing elevation before the piles are driven. After the driving is completed, all loose and displaced material shall be removed, without damaging the placed piling, leaving a suitable bed to receive the footing concrete. A 4 inch to 12 inch bed of No. 57 stone shall be placed on the bottom of the excavation prior to placing the footing concrete. The as planned bottom of footing elevation shall be maintained. For tremie seal, the displaced material may remain in place provided the minimum thickness of footing concrete, pile embedment and the required sealing of the foundation seal are maintained.

Where foundation piles are not used to support bridge piers or abutments, retaining walls, or wing walls of box culverts or rigid frames, and excavation to suitable bearing must be made below the as planned bottom of the foundation, the additional excavated spaces under these substructure units shall be backfilled with subfoundation concrete or the footing elevation shall be lowered, or the footing deepened as specified in the Contract Documents or as directed by the Engineer. Rock foundations that are to receive footing concrete shall have a rough finish and shall be excavated to provide level bearing areas and vertical steps. Where excavation to suitable bearing for box culverts must be made below the as planned bottom of the foundation, additional excavated spaces under the barrels shall be backfilled with No. 57 stone. The spaces under the wing wall footing shall be backfilled with sub-foundation concrete or the footing elevation lowered or footing depth deepened.

404.03.04 Cofferdams and Foundation Seals. When cofferdams are required, the Contractor shall submit for review, drawings and a complete description of the process for construction of the cofferdam. Timber or bracing left in the cofferdams or cribs shall not extend into the substructure concrete. Cofferdams shall be constructed to protect the concrete against damage.

(a) Foundation Seal. When the foundation cannot be dewatered, the Engineer may require the construction of a concrete foundation seal. The Contractor shall submit for review drawings and description of the process before placing of the seal. If a mud wave is created during the placement of the tremie seal, the displaced material shall be removed in order to preserve the full foundation cross section specified in the Contract Documents. The foundation shall then be pumped out and the footing placed in the dry. When weighted cribs are employed and the crib weight is utilized to overcome a part of the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal. When a foundation seal is placed under water, the cofferdam shall be vented or ported at low water level as directed.

(b) Pumping. Pumping will not be permitted during the placing of concrete. Pumping to dewater a sealed cofferdam shall not begin until the seal has set sufficiently to withstand the hydrostatic pressure.

(c) Removal of Cofferdams or Cribs. Cofferdams or cribs shall be removed by the Contractor after the completion of, and without damage to, the substructure.

(d) Stability of Foundation. The Contractor shall be responsible for stabilizing the foundation area so that the concrete footing can be constructed in the dry and in its proper place.

404.03.05 Backfilling. Backfill all excavated spaces resulting from structure excavation not occupied by the portions of the permanent work with suitable material approved by the Engineer. The backfilling shall be carried to the surface of the surrounding ground or grade as specified in the Contract Documents. Borrow shall not be used until the available project excavation is exhausted. The top surface of the backfilled areas shall be neatly graded. Backfill compaction shall conform to Section 204.03.04.

Backfilling Against Structures. Backfilling against various structures shall be done as follows:

(a) Brick Masonry. Backfilling is not permitted until seven days after completion of the section.

(b) Concrete Structures. Backfilling is not permitted until curing is completed and the concrete has achieved 80 percent of the specified compressive strength.

(c) Footings, Culverts and Piers. Fill placed around footings, culverts and piers shall be deposited on both sides to approximately the same elevation at the same time.

(d) Abutments, Retaining Walls, Culverts or Other Structures. The bed for the backfill shall be built up in horizontal layers so that at all times there is a horizontal berm of uniformly compacted material behind the structure for a distance at least equal to the height of the abutment or wall remaining to be backfilled, except insofar as undisturbed material protrudes into this area. Compaction of the berm shall conform to Section 204.03.04. Jetting of fills or other hydraulic methods involving liquid or semi-liquid pressure within the berm area is prohibited.

404.04 MEASUREMENT AND PAYMENT. ***Class 3 Excavation*** and ***Class 4 Excavation*** will be measured and paid for at the Contract unit price per cubic yard for the volume of material actually removed from within the limits specified.

No measurement or payment will be made for removing any water or liquids.

Class 3 Excavation and ***Class 4 Excavation*** will extend a maximum of 18 in. to vertical planes outside of the structure. Where blasting is required, a maximum of 6 in. will be allowed below the planned elevation.

Class 3 Excavation and ***Class 4 Excavation*** will include excavation for bridges, box culverts, and other structures as specified in the Contract Documents.

The upper limits for ***Class 3 Excavation*** on existing ground or embankments will be the existing ground line or the lower limit of roadway excavation. The lower limit of the two will control.

The upper limits for ***Class 3 Excavation*** on preliminary embankments will be the bottom of the proposed footing elevation. For stepped footings the upper limits will be the bottom of the proposed footing elevation of the highest portion of the footing. If the preliminary embankment has a surcharge, the upper limits will be the lower limit of roadway excavation.

The upper limits for ***Class 4 Excavation*** will be the bottom of the streambed or at the top of the waterline shown on the Contract Documents. The lower limit of the two will control.

The payment per cubic yard for ***Class 3 Excavation*** and ***Class 4 Excavation*** specified in the Contract Documents will be full compensation for all excavation, backfill, filling void around footings due to removing forms, blasting, grout, dewatering, removal and disposal of excess or unsuitable material, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. When an item for ***Class 3 Excavation*** and ***Class 4 Excavation*** is not included in the Contract Documents, the excavation will not be measured but the cost will be incidental to other items.

Excavation for Culverts and Culvert Endwalls is not included in the ***Class 3 Excavation*** or ***Class 4 Excavation***.

404.04.01 Additional excavation required below the elevation specified in the Contract Documents and necessitated by the lowering or deepening of footings, or the placing of sub-foundations or underpinning, will be measured and paid for at the Contract unit price per cubic yard for either ***Class 3 Excavation*** or ***Class 4 Excavation*** as directed by the Engineer.

404.04.02 Sheeting, bracing, and shoring either removed or left in place, will not be measured but the cost will be incidental to other pertinent items unless otherwise specified in the Contract Documents.

404.04.03 Excavation necessary to expose or remove piles, grillages, sheeting, cribbing, masonry, or other obstructions will not be measured nor paid for if the excavation occurs outside the limits of excavation. The removal and disposal of obstructions within the limits of excavation will not be measured but the cost will be incidental to the Contract unit price per cubic yard for either ***Class 3 Excavation*** or ***Class 4 Excavation***.

SECTION 405 – POROUS BACKFILL

405.01 DESCRIPTION. This work shall consist of furnishing and placing of porous backfill material, reinforced concrete base and pipe drains at the rear of abutments, wing walls and retaining walls and other locations as specified in the Contract Documents or as directed by the Engineer.

405.02 MATERIALS.

Porous Backfill, No. 57, Aggregate	901
Concrete Mix No. 1	902.10.03
Pipe Drains	905
Reinforcement Steel	908
Geotextile	921.09

405.03 CONSTRUCTION. Porous backfill material shall be placed in layers in conjunction with the adjacent fill. Any fill material removed for placing the porous backfill material shall be at the expense of the Contractor. When a form is used between the porous backfill material and the earth backfill, the form shall be completely removed from the completed fill.

Concrete base shall be sloped to drain to points of discharge.

405.04 MEASUREMENT AND PAYMENT. ***Porous Backfill*** will not be measured for payment but will be paid for at the Contract lump sum price for the pertinent ***Porous Backfill*** item. If no item for ***Porous Backfill*** appears in the Contract Documents, the work will not be measured but the cost will be incidental to other items specified in the Contract Documents.

The payment will be full compensation for all excavation, concrete, reinforcement, drains, geotextile, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 406 – SUB-FOUNDATION INVESTIGATION

406.01 DESCRIPTION. This work shall consist of drilling or augering test holes in rock or other foundation material as a means of verifying the character and suitability of material for foundation purposes.

406.02 MATERIALS. Not applicable.

406.03 CONSTRUCTION. Drill test holes in accordance with T206 and T225 as a first order of work or a minimum of 10 working days prior to excavation and/or pile driving in the area of the proposed test hole. The Engineer shall be notified a minimum of 10 days prior to the drilling. Test holes shall be located and bored to depths as specified in the Contract Documents. The Contractor shall submit to the Engineer for approval the name of the geotechnical engineer that will be responsible for supervising the test hole drilling and the preparation of the subsequent report. The geotechnical engineer shall be a Registered Professional Engineer in the State of Maryland.

The Contractor shall submit the drilling report to the Engineer within two working days unless directed otherwise by the Engineer. The Contractor shall schedule the borings such that a minimum of 10 working days will be available for the Engineer to review the test hole data and revise the proposed foundation if necessary. No excavation, pile driving, etc. shall occur unless directed by the Engineer. All reports, data, test results, etc. obtained from the test holes shall become the property of Baltimore County.

406.04 MEASUREMENT AND PAYMENT. ***Sub-foundation Investigation*** will be measured and paid for at the Contract unit price per linear foot for the actual total length of holes drilled or augered as directed by the Engineer. The payment will be full compensation for all geotechnical engineering services, material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 407 – PILING

407.01 DESCRIPTION. This work shall consist of furnishing and installing piling as specified in the Contract Documents or as directed by the Engineer. See Special Provisions when drilled shafts (caissons, concrete-encased H-piles, etc.) or micropiles are specified. When required, dynamic pile monitoring shall be performed as specified elsewhere in the Contract Documents.

407.02 MATERIALS.

Sand	901, Table 901 A
Concrete for Steel Piles	902.10.03 Mix No.3 Slump 4 to 6 in.
Concrete Grout	902.11(a)
Epoxy Grout	902.11(d)
Timber Piles	907.01
Timber Sheet Piles	907.01
Resin and Fiberglass Caps	907.01.01
Casings for Cast-In-Place Concrete Piles	907.02
Steel Bearing Piles, including H Piles	907.03

Steel Sheet Piles	907.04
Reinforcement for Cast-In-Place Piles	908.01
Hardware	909.09
Water	921.01
Timber Preservatives	921.06
Steel Pipe Piles	907.06

407.03 CONSTRUCTION. The Contractor shall be responsible for ordering and delivering piling of the proper type and length to the structure site.

407.03.01 Storage and Handling. Piling shall be stored and handled to avoid damage. Damaged piling shall be repaired or replaced as directed by the Engineer.

407.03.02 Preparation for Driving. Piling shall not be driven until embankments and excavation have been completed as specified in the Contract Documents or as directed by the Engineer.

The Contractor shall provide templates or other approved means to assure that the piles are properly aligned and positioned.

The heads of all piling shall be equipped with a cap or cushion so that the energy imparted by the hammer can be transmitted to the pile evenly without injury to the top or butt. The top of the pile, irrespective of its type, shall be normal to the axis of the moving parts of the hammer.

407.03.03 Tapered Shells. Reserved.

407.03.04 Pile Tips.

(a) Timber piles shall be pointed where driving conditions require. The point shall be symmetrical and not less than a 4 in. diameter. Timber piles shall have their tips or bottoms shod with a metal shoe or point when specified in the Contract Documents or as directed by the Engineer.

(b) Timber sheet piling shall be drift sharpened or beveled at the bottom so as to wedge contiguous piles in tighter contact.

(c) Steel H piles shall be driven without any special tip reinforcement unless otherwise specified in the Contract Documents.

(d) Steel pipe piles shall be driven open-ended unless otherwise specified in the Contract Documents.

407.03.05 Splicing. Splicing of timber piles is prohibited. In the event of an isolated timber pile penetrating below planned tip elevation resulting in the top being below planned

elevation, the Engineer will determine if it must be replaced, supplemented by an additional pile or if the structure can be changed without detriment.

If splicing of steel H piles and steel pipes is necessary, they shall be spliced as specified in the Contract Documents by electric arc welding conforming to AWS Structural Welding Code for the full periphery. The number of splices permitted shall be compatible with driving conditions at the site and the standard lengths of piling produced by manufacturers; however, only one section of each pile shall be less than 20 feet.

When welding is required above a specified maximum elevation, weld as specified in Section 408.03 Metal Structures – Construction, excluding the submerged arc-welding requirement. Welders shall provide proof of certification in accordance with the AASHTO/AWS Bridge Welding Code D1.5 to the Engineer for approval.

All welding above the specified maximum elevation shall receive 100 percent Magnetic Particle Inspection (MT) on the root pass and completed weld, and 100 percent Radiographic Inspection (RT) in accordance with AWS D1.5. Inspectors shall be approved by the Engineer as specified for certification in accordance with AWS D1.5. Inspectors certified by an accredited Certified American Society for Non-Destructive Testing (ASNT) Level III in the inspection discipline, may submit certifications to the Engineer for approval.

Where a manufactured pile type is designed to be spliced by screwing two pieces together or by the use of couplings or collars, and the details for the splice are not specified in the Contract Documents, the device shall be submitted to and approved by the Engineer before use.

It is intended insofar as practical that piles be driven in a continuous operation, and that splicing be performed prior to approaching the estimated tip elevation.

407.03.06 Test Piling. Furnish for each test pile, a Wave Equation Analysis (WEAP) of pile driveability, sealed and signed by a Professional Engineer, registered in the State of Maryland, experienced in such work. The analysis shall demonstrate that the pile hammer proposed by the Contractor has sufficient power to drive the piles to the Driving Load and Estimated Minimum Penetration shown on the plans without overstressing or damaging the piles. The analysis shall, at a minimum, include the following:

(a) Analysis methodology.

(1) The ultimate soil resistance used in the analysis shall be not less than 225 percent of the required design capacity of the driven pile. The proportioning of the tip resistance and the distribution of the side resistance shall be based on the soil boring data using either static analysis or other strength correlations.

(2) For hammers with an adjustable energy range, analysis shall demonstrate that minimum energy used within the range can mobilize the ultimate soil resistance, and that the maximum energy used within the range will not overstress the pile during

driving operations based on allowable stresses in the AASHTO LRFD Bridge Design Specifications (current edition and all interims).

(3) The analysis shall demonstrate that with the hammer used, the required ultimate soil resistance shall be attained using hammer blows in the range of 2 to 10 blows per in.

(b) Interpretation of Soil Boring Data necessary to determine the resistance the pile will develop during driving to the estimated pile tip elevation.

(c) Computer input and output sheets and graphs showing soil resistance versus blow counts, and maximum tensile and compressive stresses in the pile versus blow counts.

(d) Provide for each hammer, at each test pile, charts of LRFD Driving Load (Pu) versus Energy (blow/minute) and Pile Set (blow/in.) using the formula shown on the plans for the End of Driving (EOD) condition.

(e) Test pile driving operations shall not commence until approval for the WEAP has been received.

(f) Drive test piles to determine the depth of penetration and the length of piling for structures.

Acceptance of the pile hammer and driving equipment will not relieve the Contractor's responsibility for properly driving piles, in satisfactory condition, to the driving resistance and tip elevations indicated or directed.

Drive test piles in permanent vertical position. Test piles found to be satisfactory shall be utilized as permanent piles.

407.03.07 Pile Driving. At least one month prior to the start of pile driving operations submit to the Engineer the hammer name, model, and manufacturer’s data for each pile hammer proposed to be used for pile driving, including Manufacturer’s Catalog Information and a completed Pile and Driving Equipment Data Form.

The hammer to be used for driving permanent piles shall be the same hammer that was used to drive the test piles. If the Contractor changes hammers, the Contractor shall drive additional test piles at his expense before driving the permanent piles, even if the energy ratings of the hammers are identical.

Hammers shall be operated at speeds recommended by the manufacturer for the bearing value specified. The manufacturer’s manual for the hammer employed shall be available to the Engineer at the project site.

Use pile-driving equipment of an acceptable type, mass (weight), and capacity. Use air compressors of sufficient capacity to provide 25 percent more air than shown in the manufacturer's specifications for air-driven hammers. Do not use capblocks or cushions containing asbestos.

Use drop-steam, air, diesel, or hydraulic actuated pile-driving hammers. Hammers shall be capable of developing at least the energy shown on the plans.

Equip hammers with a suitable drive head that accurately and securely holds the top of the pile in correct position, with reference to the hammer, and that distributes the blows from the ram over the entire top area of the pile or mandrel.

Within reasonable limits, use the optimum type and size of hammer for the indicated pile and subsurface conditions at the structure site. Use a hammer of a type and size that enables piles to be driven to any driving resistance without pile damage due to driving stresses, as indicated by the Wave Equation Analysis. Acceptance of a hammer relative to driving stress damage will not relieve the Contractor's responsibility for piles damaged because of misalignment of the leads, failure of capblock or cushion material, failure of splices, malfunctioning of the hammer, or other improper construction methods.

Construct pile driver leads to allow free movement of the hammer. Hold the leads in true vertical or inclined positions, as required, by guys or stiff braces to ensure support of the pile during driving. Provide leads of sufficient length so a follower will not be necessary under normal conditions.

No driving shall be done with the hammer out of the leads.

On all special, marine or water projects and pile bents, the leads shall be of sufficient length so that the use of a follower will not be necessary. Long piles and batter piles may require guides at intervals and additional support to prevent excessive bending or buckling under the hammer blow. Piles shall be held in place and alignment by templates or other means approved by the Engineer.

Water jets shall not be used unless specified in the Contract Documents or as directed by the Engineer. If it becomes necessary to remove material from within a pipe pile to advance the pile tip or merely to obtain room for concreting, leave a 10 foot soil plug undisturbed at the tip of the pile. Install turbidity curtains around piles being cleaned when appropriate.

Where piling must perforate strata resistant to driving, the Contractor shall auger or drill holes through the strata. The size of the auger or drill to be used shall not be larger than the nominal diameter of a round pile or the minimum diameter of a circle in which an H pile will fit and shall meet with the approval of the Engineer before use. After the hole is completed, the pile shall be inserted and dry sand shall be used to completely fill any voids between the pile and the walls of the hole. Driving shall then be completed, after which any remaining voids shall be completely filled with dry sand.

407.03.08 Pile Driving Tolerances.

(a) General. Foundation piles shall not be used out of the position specified in the Contract Documents by more than 6 in. in any direction after driving regardless of the

length of piles. Variation from the vertical or from the batter shall not be more than 1/4 in./ft .

(b) H Piles. Rotation of the pile in excess of 25 degrees from the as planned axis will not be permitted.

(c) Bents. Piles shall be driven so that the cap may be placed in its proper location.

407.03.09 Unacceptable Piles. Any pile not in conformance with the Contract Documents shall be corrected at the Contractor's expense by one of the following methods or other methods approved by the Engineer.

(a) The pile shall be withdrawn and replaced by a new pile.

(b) A second pile shall be driven adjacent to the unacceptable pile.

(c) The pile shall be spliced or built up (except timber piles).

(d) A sufficient portion of the footing shall be extended to properly embed the pile.

407.03.10 Unanticipated Driving Conditions. Should unanticipated driving conditions occur where resistance on the pile results in hammer blows per inch in excess of 20 with the hammer operated at its maximum fuel or energy setting (or at a reduced fuel or energy setting recommended by the Engineer based on pile installation stress control) then the Contractor shall stop driving and contact the Engineer for further guidance.

407.03.11 Pile Cutoff. The tops of all piles and pile casings except timber piles which support timber caps shall be cut off at the elevations specified in the Contract Documents and on a true plane perpendicular to the axis of the pile unless otherwise specified. Timber piles that support timber caps shall be cut off to insure that the plane of the bottom of the cap will bear fully on the pile head. Shimming between the timber cap and pile head is prohibited.

Cut off piles used for sheeting and shoring at least 18 inches below existing grade, channel bottom, or mud line as applicable. When specified, these piles may be removed. Dispose of all removed material in an approved manner.

407.03.12 Steel Pipe Piles. After driving, remove soil plugs to the specified elevation. Prior to placing filling (when specified) or reinforcement, use a suitable light to inspect the interior for the entire unplugged length. Do not fill or place reinforcement until the pile is approved.

Provide all required equipment for inspection including oxygen, light, boatswain's chair, and lift. Comply with Federal, State and local safety regulations.

407.03.13 Concreting Steel Pipe Piles. Perform concreting as specified in Section 414. Perform reinforcement work as specified in Section 416. Securely fasten the reinforcement together to form a cage, positioned and held at a uniform distance from the shell.

Except as specified herein, use tie wire to secure tie bars and bands of cage reinforcement. For foundation (footing) piles, tack welding may be used if a welder that has been certified in accordance with AASHTO/AWS Bridge Welding Code D1.5 performs the work.

For bents and column piles, tie bars, bands, and spacer lugs shall not be welded to the main reinforcing bars, except that a band may be placed at the top and bottom of the pile cage and all main bars welded to the band. Use tie wires to fasten the remainder of the intersections of ties and main bars.

Clean the areas in the top portion of the pile that are to be filled with reinforced concrete and tremie concrete. Place and cure tremie concrete prior to dewatering the top of the pile shell. Place the reinforcing unit in the top portion of the pile prior to filling with Mix No. 3 concrete.

Do not place concrete in any pile until completing driving within a radius of 15 ft or until all the piles for any unit of the structure (pier, bent, or abutment) have been driven to their final penetration and accepted. If this procedure is not feasible, discontinue driving within the above limits until the concrete in the last pile placed has set at least 72 hours.

Immediately prior to concreting, remove water and other foreign substances. Deposit the concrete in one continuous operation.

The restriction in Section 414.03.04 for dropping concrete more than 5 ft does not apply.

Set and fasten reinforcing steel cages in proper position in the pile before filling with concrete, except when the reinforcing steel cage extends 6 ft or less below the top of the pile, the concrete filling may be placed before installing the reinforcement. Thoroughly consolidate using mechanical vibrators from the bottom of the reinforcing steel cages to the pile top.

Do not disturb or apply loads to concreted piles until all concrete has been in place and cured at least 72 hours.

407.03.14 Treatment for Timber Pile Heads. Timber pile heads that are not to be imbedded in concrete shall be painted with an approved asphalt treatment. After the asphalt has sufficiently cured, it shall be covered with a glass resin composite shield. The first coat of resin shall be applied to the top and down the side a minimum of 1 in. beyond the limits of the woven glass. Precut woven glass cloth shall be applied using a 3 in. grooved aluminum roller to achieve “wet out.” Woven glass cloth shall be neatly wrapped over the top of the pile, draped down the side a minimum of 2 in. and nailed with copper nails. When the first coat of resin has taken a tack free set, a second coat of resin shall be applied to seal the entire application.

407.04 MEASUREMENT AND PAYMENT. The payment for the items specified in the Contract Documents will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work.

407.04.01 Piling (permanent and test) will be measured and paid for at the Contract unit price per linear foot for the pertinent ***Pile*** item. The measured length of all piling will be taken from its tip up to final cutoff unless otherwise specified in the Contract Documents. For test piles not utilized as permanent piles, the measurement for cutoff will be at the same elevation as the nearest proposed permanent pile or to actual top of test pile, whichever is lower. Where piling designated as test piles is accepted for use in the permanent structure, measurement will be made as test piles and no additional allowance will be made in other piling items.

407.04.02 Furnishing and setup of pile driving equipment required for driving permanent and test piles will be measured and paid for at the Contract unit price per each for the pertinent ***Setup for Driving Pile*** item. The unit price per each for the setup required for driving each pile for the proposed structure will be used regardless of the distance that the equipment must be moved for each pile setup. A maximum of one setup will be paid for any setup required for re-driving or any additional driving of any pile, no matter what reason the particular pile may require re-driving or additional driving.

407.04.03 Pile Points for Steel H Piles will be measured and paid for at the Contract unit price per each for the pertinent ***Pile Point for Steel H Bearing Pile*** item.

407.04.04 RESERVED.

407.04.05 ***Timber Sheet Piling*** will be measured and paid for at the Contract unit price per 1000 board feet (MBM) for the pertinent ***Timber Sheet Piling*** item. Computation of quantities will be based on nominal thickness of lumber, the length of the sheet piling, and the average depth of the sheet piling from cutoff at the top to the tip of the sheet piling in the completed structure. No allowance will be made for waste.

407.04.06 ***Steel Sheet Piling*** will be measured and paid for at the Contract unit price per square foot as measured along the plane of surface for the pertinent ***Steel Sheet Piling*** item.

407.04.07 The following will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents:

(a) Tips for pile shells or casings.

(b) Test pieces of sheet piling (timber or steel).

(c) Reinforcement and concrete used in cast-in-place piles.

(d) Pile splices.

(e) Augering.

(f) Cleaning, painting, or coating of piling.

(g) Piling or sheet piling for temporary structures, piles or sheet piling driven for the Contractor's convenience, or for any piles or sheet piling not specified in the Contract Documents.

(h) Piling not approved by the Engineer, such as piles not properly driven, piles with questionable safe bearing values, piles damaged during driving, or piles driven below planned cutoff or the removal of any pile rejected by the Engineer as unsatisfactory.

(i) Delays that are a result of changing cast-in-place concrete pile shell thickness resulting from driving test piles or for delays incurred by performing load tests not specifically called for in the Contract Documents.

(j) WEAP analysis will not be measured, but the cost will be incidental to the Contract unit price for the pertinent Pile item.

SECTION 408 – METAL STRUCTURES

408.01 DESCRIPTION. This work shall consist of furnishing, fabricating, transporting and erecting of steel beams, plate girders, trusses, grillages, columns and bents, shoes, pedestals, castings, miscellaneous steel and all incidental structural steel as specified in the Contract Documents or as directed by the Engineer.

408.02 MATERIALS.

Grout	902.11(c),(d),(e)
Metals	909
Bolts	A 325 Type 1 unless Type 3 is specified
Nuts	A 563 Grade C, D & EH
Washers	F 436
Bearing Pads	910.02
Epoxy Adhesive	921.04

Nuts, bolts and washers shall be coated to be compatible with the metal being fastened.

408.03 CONSTRUCTION. Unless otherwise specified, all welding and dimensional tolerances shall conform to AWS D1.5.

408.03.01 Working Drawings. The Contractor shall provide working drawings as specified in Section TC-4.01. The Contractor is responsible for the erection of curved girders and if lateral bracing is required for shipping or erection, the details shall be specified on the working drawings.

408.03.02 Work Scheduling. The Contractor shall give a minimum of two weeks notice to the Engineer when and where shop work shall begin. No materials shall be fabricated until directed by the Engineer.

408.03.03 Facilities for Shop Inspection. The Contractor shall furnish all facilities for the inspection of material and workmanship in the shop. The Inspector shall be allowed free access to the required areas of the premises and shall be provided with an approved office area.

408.03.04 Material Identification. The Contractor shall identify main member material by heat number.

408.03.05 Mill Orders. The Contractor shall furnish the Engineer with copies of mill orders and test reports.

408.03.06 Testing. The Contractor shall furnish, without charge, sample specimens as directed by the Engineer.

408.03.07 Defective Material and Workmanship. The acceptance of any material and workmanship by the Inspector will not deter subsequent rejection. Rejected material and workmanship shall be replaced or repaired as directed by the Engineer.

408.03.08 Marking and Shipping. Each member shall be painted or marked with an erection mark for identification. An erection diagram shall be furnished with erection marks clearly delineating the orientation of diaphragms.

Erection marks for the field identification of members and weight marks for members over 6000 lb in weight shall be painted upon surface areas previously painted with the shop coat. Material shall not be loaded for shipment until the shop coat is thoroughly dry and in any case not less than 24 hours after the paint has been applied.

Where unpainted steel is specified for a finished structure, the Contractor shall not place the Contractor's or any other company's name on any of the structural steel. Mark numbers and inspection stamps shall appear only on the top surface of the top flange of all girders, beams, and diaphragms unless otherwise directed.

No painting shall be done after loading of materials for transport.

The Contractor shall furnish the Engineer copies of material orders, shipping statements, and erection diagrams. The weights of the individual members shall be shown on the shipping statements. The loading, transportation, unloading and storing of structural material shall be

conducted so that the metal shall be kept clean and shall not be excessively stressed, deformed or otherwise damaged.

When handling long steel members, handling devices shall be placed at approximately the quarter points. When storing and shipping members, blocking shall be placed at intervals that prevent sag and distortion. All beams and girders shall be stored, shipped and handled in an upright position. Members other than beams and girders shall be handled, hauled and stored with the stronger axis vertical to resist gravity.

All girders having stiffeners the full height of the web on both sides of the web shall be adequately blocked before shipment. This blocking shall be located at the quarter points and midpoint of the girder and at additional locations to assure that the maximum interval between blocking does not exceed 25 ft.

Members too long to fit inside a truck or trailer shall not cantilever beyond the bed more than 1/4 of its length. Members too long to comply with this requirement shall be supported on dollies, additional vehicles, or other vehicles that fully support the long pieces as approved by the Engineer.

408.03.09 Storage of Material. Fabricated material shall be stored off the ground and protected as far as practicable from surface deterioration by exposure to conditions producing rust. These materials shall be kept free of dirt accumulation, oil or other deleterious matter.

408.03.10 Changes and Substitutions. No changes or substitutions shall be made in any approved drawing unless approved in writing by the Engineer.

408.03.11 Fabrication. Fabrication and construction shall be bolted or welded as specified in the Contract Documents or as directed by the Engineer.

When curved girder bridges are to be curved by the heat shrinkage method, the proposed method shall be submitted to the Engineer for approval.

408.03.12 Holes.

(a) Punched Holes. The diameter of the die shall not exceed the diameter of the punch by more than 1/16 in. Holes requiring enlargement shall be reamed. Holes shall be clean cut with no torn or ragged edges. Holes punched full size or sub-punched shall be punched so that after the steel is assembled and before any reaming is done, a cylindrical pin 1/8 in. smaller in diameter than the nominal size of the punched hole shall be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If this requirement is not met, the nonconforming punched pieces will be rejected. Holes not passing a pin 3/16 in. smaller in diameter than the nominal size of the punched hole will be rejected. Drifting done during assembling shall be only to bring the parts into position and not sufficient to enlarge the holes or distort the material. If the required accuracy cannot be obtained otherwise, holes for connections shall be sub-punched and reamed with the members assembled instead of being punched full size.

(b) Reamed or Drilled Holes. Holes shall be cylindrical, perpendicular to the member, and not more than 1/16 in. larger than the nominal diameter of the bolts. Where practical, reamers shall be directed by mechanical means. Burrs on the surface shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist drills. If required by the Engineer, assembled parts shall be taken apart for removal of burrs caused by drilling. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match marked before disassembling. When holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 in. between adjacent thicknesses of metal.

(c) Sub-punching and Reaming. Holes in all field connections and field splices of main truss or arch members, continuous beams, plate girders and rigid frames shall be sub-punched and reamed while assembled in the shop unless otherwise specified. The assembly, including camber, alignment, accuracy of holes and milled joints shall be acceptable to the Engineer before reaming is started.

All holes for floor beam and stringer field end connections shall be sub-punched and reamed utilizing a template or reamed while assembled.

If additional sub-punching and reaming is required, it will be specified in the Contract Documents. The accuracy of sub-punched holes shall be the same as required for punched holes.

408.03.13 Shop Assembly. Clean all surfaces of metal that will be in contact after assembling. The parts of a member shall be assembled, well-pinned and firmly drawn together with bolts before reaming or tightening of fasteners is started. The member shall be free from twists, bends and other deformations. Material that has been punched full size shall be reamed, if necessary, prior to tightening of fasteners. Refer to Section 408.03.12(c).

Parts not completely fastened in the shop shall be secured by bolts insofar as practicable to prevent damage in shipment and handling. Members assembled in the shop for reaming of field connections shall remain assembled until the Engineer's shop inspection.

408.03.14 Camber Diagram. A camber diagram shall be furnished to the Engineer showing the camber at each panel point for each truss, taken from actual measurements during truss assembly. A camber diagram shall be furnished to the Engineer showing the camber at all splice points, points of dead load inflection, and any other points designated by the Engineer for all beams and girders.

Stringers shall be cambered to the dimensions specified in the Contract Documents. The camber specified shall mean the camber as measured after all shop welding has been completed. The maximum tolerance for camber shall be zero (0) under to ½ in. over.

Full provisions shall be made for dead load deflections, fabricating tolerances, and irregularities at all points along all stringers so that the superstructure concrete may be placed to match the profile grade line.

408.03.15 Match Marking. Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be matched marked, and a diagram showing these marks shall be furnished to the Engineer.

408.03.16 Use of High Strength Bolts and Lock-Pin and Collar Fasteners. High strength bolts and lock-pin and collar fasteners shall be used unless otherwise specified in the Contract Documents. Unfinished bolts or machine bolts may be used for the temporary erection of structural steel and shall be replaced with high strength bolts, lock-pin and collar fasteners or welding for final erection. Turned bolts shall only be used when specified. The heads, nuts, and washers shall be drawn tightly against the work. Where bolts or lock-pin and collar fasteners are used in beveled surfaces, beveled washers shall be provided to give full bearing to the head, nut, or collar except as otherwise specified in Section 408.03.17. Where high strength bolt assemblies are used for joint connections, the Contractor shall also perform the additional testing specified in Section 408.03.17(e).

408.03.17 High Strength Bolt Joint Requirements.

(a) Only one grade of bolts, nuts and washers shall be used in a structure. Bolts may be supplied from various manufacturers provided that each bolt of a given length and diameter shall be made by the same manufacturer. Nuts and washers may be supplied from different manufacturers provided that the same manufacturers make all the respective nuts and washers to be used throughout the structure on all bolts having the same diameter. All bolts used with A 709, Grade 50W steel shall conform to A 325.

(b) The slope of surfaces of bolted parts in contact with the bolt head and nut shall not exceed 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for the lack of parallelism. When assembled, bolted parts shall fit solidly together and shall not be separated by gaskets or any other interposed compressible material. The holes shall be truly cylindrical and at right angles to the surface of the metal so that both head and nut will bear squarely against the metal. When assembled, all joint surfaces including those adjacent to the bolt heads, nuts or washers, shall be free of scale (except tight mill scale), dirt, burrs, and other deleterious material and defects that would prevent solid seating of the parts. Contact surfaces within joints shall be free of oil, lacquer, or rust inhibitor. For contact surfaces to be painted refer to Section 413A.03.06.

(c) When all bolts in the joint are tight, every bolt shall conform to the minimum bolt tension that is equal to the proof load specified in A 325. When field conditions prevent tightening at the nut, bolts may be tightened at the head, provided that the nut is prevented from turning. All bolts shall have a washer under the element (nut or bolt head) turned in tightening. Threaded bolt connections shall be tightened by the turn-

of-nut method. If impact wrenches are used, they shall be of adequate capacity and have a sufficient supply of air to perform the required tightening of each bolted connection.

(d) To provide the bolt tension specified in Section 408.03.17(c), there shall first be enough bolts brought to a "snug tight" condition to insure that the parts of the joint are brought into full contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be additionally tightened with tightening progressing systematically from the center of connection plates of the joints to the free edges. During this operation there shall be no rotation of the part not turned by the wrench.

After all bolts in the joint have a snug fit, the joint shall be additionally tightened by the applicable amount of nut rotation specified in the Nut Rotation From Snug Tight Condition table below. All bolt assemblies in the completed structure shall have full thread engagement that is accomplished when the end of the bolt is flush with or extends beyond the outer face of the nut.

NUT ROTATION FROM SNUG TIGHT CONDITION
DISPOSITION OF OUTER FACES OF BOLTED PARTS

Bolt length (as measured from underside of head to extreme end of bolt	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (beveled washer not used)	Both faces sloped not more than 1:20 from normal to bolt axis (beveled washer not used)
Up to and including 4 diameters	1/3-turn	1/2-turn	2/3-turn
Over 4 diameters but not exceeding 8 diameters	1/2-turn	2/3-turn	5/6-turn
Over 8 diameters but not exceeding 12 diameters	2/3-turn	5/6-turn	1-turn

NOTE 1: This table is for coarse thread, heavy hexagon structural bolts of all sizes and lengths and heavy hexagon semi-finished nuts.

NOTE 2: Nut rotation is rotation relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation: ±30 degrees for bolts installed by 1/2 turn or less, and ±45 degrees for bolts installed by 2/3 turn or more.

(e) Inspection. The Engineer will be present during the installation and tightening of bolts to determine that the tightening procedure is properly followed and all bolts are properly tightened.

The Contractor shall provide a sufficient number of safe working platforms at splices where high strength bolts will be checked for torque requirements. Platforms shall be maintained at splices until all checking is complete and the splice is acceptable to the Engineer.

The Contractor shall provide a calibrated torque wrench to be used as the inspection wrench and a calibrated bolt tension calibrator. Both have to be approved by the Engineer.

The Contractor shall conduct the following inspections unless otherwise specified in the Contract Documents. Bolts, nuts, and washers that were previously torqued to proof load shall not be reused in the structure.

(1) Three bolts of the same size, length, and condition as those under inspection shall be placed individually in the bolt tension calibration device. There shall be a washer under the part turned in tightening each bolt.

(2) Each of the three bolts shall be tightened in the calibration device by any convenient means to the proof load specified for its size. The inspecting wrench shall then be applied to the tightened bolt, and the torque necessary to turn the nut or head 5 degrees approximately 1 in. at 12 in. radius in the tightening direction shall be determined. The average torque measured in the tests of three bolts shall be taken as the job inspecting torque to be used in the manner specified in paragraph (3).

(3) Bolts represented in the sample above which have been tightened in the structure shall be inspected by applying, in the tightening direction, the inspecting wrench and its job inspecting torque to 10 percent of the bolts but not less than two bolts selected at random in each connection. If no nut or bolt head is turned by this application of the job inspecting torque, the connection will be accepted as properly tightened. If any nut or bolt head is turned by the application of the job inspecting torque, this torque shall be applied to all bolts in the connection; and all bolts whose nut or head is turned by the job inspecting torque shall be tightened and re-inspected. Alternatively, the fabricator or erector may opt to retighten all of the bolts in the connection and then resubmit the connection for the specified inspection.

408.03.18 Lock-Pin and Collar Fastener Requirements.

(a) Lock-pin and collar fasteners shall conform to Section 408.03.17 for one manufacturer, weathering characteristics, sloped surfaces and applicable inspection.

(b) A representative sample of not less than three sets of lockpin and collar fasteners of each diameter, length and grade shall be checked at the job site in a device capable of indicating bolt tension. The test assembly shall include flat hardened washers, if required in the actual connection, arranged as in the actual connections to be tensioned. The calibration test shall demonstrate that each assembly develops a tension not less than 5 percent greater than the tension required for the comparable A 325 or A 490 bolt. Manufacturer's installation procedure shall be followed for installation of bolts in the calibration device and in all connections. Periodic retesting shall be performed when required by the Engineer.

(c) Fasteners shall be installed in all holes of the connection and initially tightened sufficiently to bring all plies of the joint into firm contact but without yielding or fracturing the control or indicator element of the fasteners. All fasteners shall then be further tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic partial tightening prior to final twist off of the control or indicator element of individual fasteners.

408.03.19 Welding. Welding of structures shall conform to the Contract Documents and AASHTO/AWS Bridge Welding Code D1.5 unless otherwise specified. The provisions contained herein shall apply to both shop and field welding.

The Engineer shall approve all welders, welding machine operators and tackers employed to work on structures for the County.

(a) Qualification Testing. Welders will be approved based on Qualification Testing conforming to AASHTO/AWS Bridge Welding Code D1.5. Qualification testing will be conducted by an AISC-certified facility.

(b) Qualifications from Outside Sources. Welders having certifications from outside sources in conformance with the AASHTO/AWS Bridge Welding Code D1.5 may submit that certification for approval to the Engineer.

All field welders approved by the Engineer shall have certification of qualification testing acceptable to the Engineer in accordance with (a) or (b) available at all times for inspection by the Engineer.

Unless otherwise specified by the Engineer in writing, only submerged arc welding will be permitted on members carrying primary stress. Members carrying primary stress include but are not limited to the following: rolled beams, cover plates on rolled beams, welded splices, girders and connection material of the members and other parts as specified in the Contract Documents.

After fabrication, no welding will be permitted on tension flanges for attachments such as metal forms and tie screws, except for steel stud shear developers specified in the Contract Documents.

Welding transversely across the tension flanges of beams or girders is prohibited and is cause for rejection unless otherwise specified in the Contract Documents.

408.03.20 Inspection of Fabricated Metal Structures. Fabricated metal structures shall conform to AASHTO/AWS Bridge Welding Code D1.5. Quality control inspection shall be the responsibility of the Contractor.

The Contractor shall have on file with the Engineer a current approved quality control plan prior to receiving source approval. This plan shall specify the frequency, method of inspection and provide for documentation. The inspection frequency shall be at least the minimum specified in AASHTO/AWS D1.5. The County requires 30 days to review quality control plans not previously on file.

The Contractor shall also keep complete and current records that shall be available to the County's representatives at all times.

When work is completed, the documentation for all quality control tests and inspections shall become the property of the County.

408.03.21 Planing. The top and bottom surfaces of steel slabs, base plates, and cap plates of columns and pedestals shall be planed or the plates or slabs shall be hot straightened. Parts of members in contact with them shall be faced. In planing the flat surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.

408.03.22 Abutting Joints. Abutting joints in compression members and in tension members where specified in the Contract Documents shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 1/8 in.

408.03.23 End Connection Angles. Floor beams, stringers, and girders having end connection angles shall be built to exact length back-to-back of connection angles. If end connections are faced, the finished thickness of the angles shall not be less than specified in the Contract Documents.

408.03.24 Main Members. Principal portions of main members carrying primary stress (refer to Section 909.01) shall be fabricated so that the direction of stress and rolling are the same.

408.03.25 Web Plates. At web splices, the clearance between the ends of the web plates shall not exceed 3/8 in. The clearance at the top and bottom ends of the web splice plates shall not exceed 1/4 in.

408.03.26 Bent Plates. Unwelded, cold bent, load carrying, rolled steel plates shall be taken from the stock plates so that the bend line will be at right angles to the direction of rolling, except that cold bent ribs for orthotropic deck bridges may be bent in the direction of rolling if permitted by the Engineer and shall conform to the following:

(a) Bending shall be so that no cracking of the plate occurs. Minimum bend radii, measured to the concave face of the metal shall conform to the following:

MINIMUM COLD-BENDING RADII				
A 709 Grades	Thickness, in. (t)			
	Up to 3/4	Over 3/4 to 1, incl.	Over 1 to 2, incl.	Over 2
36	1.5t	1.5t	1.5t	2.0t
50	1.5t	1.5t	2.0t	2.5t
50W	1.5t	1.5t	2.0t	2.5t
HPS70W	1.5t	1.5t	2.5t	3.0t
100	1.75t	2.25t	4.5t	5.5t
100W	1.75t	2.25t	4.5t	5.5t

(b) For brake press forming, the lower die span should be at least 16 times the plate thickness. Multiple hits are advisable.

(c) If a shorter radius is essential, the plates shall be bent at a temperature not greater than 1200 F. Hot bent plates shall be taken from stock so that the bend line will be at right angles to the direction of rolling.

(d) Before bending, the corners of the plate shall be rounded to a radius of 1/16 in. throughout the portion of the plate where the bending is to occur.

408.03.27 Erection Plan. The Contractor shall submit for approval, an erection diagram plan outlining erection procedure of the main members. The plan shall conform to Section TC-4.01 and shall be submitted for approval to the Engineer a minimum of 30 days prior to beginning erection. This plan shall include the numbers and types of equipment to be used including crane capacity, location of crane for lifting, falsework when required, and main member erection sequence and weight.

All wheels and outriggers of a crane or wheels of a structural steel delivery truck shall be at a minimum distance from the rear face of an abutment equal to the vertical distance from the top of a spread footing or to the original groundline if the footing is on piles. No other heavy construction equipment shall be operated within this minimum distance from the rear face of abutments.

The Contractor shall erect bridges with continuous main members in a manner providing the proper reactions, and avoiding overstressing main members.

The Contractor when preparing erection plans and procedures shall take into account the restrictions imposed by the Water Resources Administration relative to pollution or disturbance of existing waterways.

408.03.28 Falsework. The Contractor shall comply with the provisions specified in Section TC-4.01. The falsework shall be built and maintained in conformance with the approved falsework plans. Any changes subsequent to initial approval shall be proposed through the Contractor's Professional Engineer and be approved by the Engineer.

Before permitting any loads to be placed on falsework, the Engineer shall receive written certification by the Contractor's Professional Engineer that the falsework system has been assembled in conformance with the approved falsework drawings. A Certificate of Compliance stating that all manufactured materials and assemblies fully comply with the falsework design and plans shall accompany this certification. The Engineer may either accept the certificate or invoke any provision of Section GP-5.08. All tests required shall be made by and at the expense of the Contractor.

In addition to protective measures shown on the falsework plans, the Engineer may direct the Contractor to provide further protection of falsework against accidental collision by highway or construction traffic and equipment, traffic vibration, flood waters or high winds, etc., that are necessary for public safety and protection of the work.

408.03.29 Damaged or Defective Material. The correction of damaged or defective material shall not begin until a written procedure prepared by the Contractor is approved by the Engineer. Correction of damaged or defective material shall be by methods that do not produce fracture or injury. All damaged or defective material will be inspected by the Engineer before and after correction. Corrections shall be conducted in the presence of the Engineer.

408.03.30 Assembling Steel. Material shall be carefully handled and no parts shall be bent, broken, or otherwise damaged. Bearing surfaces and those to be in permanent contact shall be cleaned before the members are assembled. Before beginning the field bolting and welding, the structure shall be adjusted to correct grade and alignment and the elevations of panel points (ends of floor beams) properly regulated. Splices and field connections shall have one half the holes filled using bolts and cylindrical erection pins (40 percent bolts and 10 percent pins) before torquing high strength bolts. Splices and connections in members carrying traffic during erection shall have three fourths of the holes filled before torquing. Cylindrical erection pins shall be 1/32 in. larger than the diameter of the fasteners.

408.03.31 Anchor Bolts. Per Section 909.06. Do not cast anchor bolts in the concrete. Create a template to locate the anchor bolt holes and use it to shift the reinforcement prior to placing the concrete to eliminate conflicts between the reinforcement and the anchor bolt holes.

Set anchor bolts in round holes drilled or cast in the concrete. Accurately position bolts by using templates set to correct location and alignment to ensure proper span lengths, and carefully set tops of bolts to proper elevation. Unless otherwise noted, install bolts plumb or normal to the finished bearing surface of the masonry.

Bolts shall have the portion below the bridge seat swedged. Drill or cast holes to a diameter at least 1 in. larger than the bolt diameter.

Do not paint anchor bolts, nuts, and washers.

After anchor bolts are finally and correctly positioned, completely fill the holes with grout; however, do not grout until all structural steel is set in its final position. After the masonry plates or shoes are set, use the same grout to fill the space between the bolts and the round holes of fixed plates and shoes. Do not fill slotted holes in expansion devices unless specified.

Maintain an air temperature of at least 40 F around the mortar surface for a period of three days unless otherwise recommended by the manufacturer.

When mortar filling is used, first check the depth of the hole by inserting and withdrawing the bolt. Partially fill the hole with mortar, and immediately insert the bolt by forcing with uniform pressure or light blows from a hammer (flogging and running is prohibited) so that excess mortar is pushed out at the top of the hole. Remove excess mortar.

Set the bolt to project approximately 1/2 in. above the nut and ensure that it is threaded to approximately 1/2 in. below the nut in their final position.

Set rockers or expansion plates with slotted holes with the proper tilt or offset as determined by the temperature prevailing at the time and so that they will be in their midway position at 68 F or as specified.

408.03.32 Maintenance of Concrete. The Contractor is responsible for keeping all exposed concrete surfaces free from stains and discoloration. The Contractor shall prevent staining of the finished concrete surfaces where unpainted structural steel is specified. Any stains shall be removed and the concrete restored to its original color.

408.03.33 Safety Hazards. The Contractor shall be responsible for gas detection in and ventilation of confined spaces.

408.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. Measurement and Payment shall be in accordance with one of the following as specified in the Contract Documents:

408.04.01 ***Fabricated Structural Steel*** will not be measured for payment but will be paid for at the Contract lump sum price.

408.04.02 ***Fabricated Structural Steel*** will be measured and paid for at the Contract unit price per pound computed on the theoretical weight.

Where measurement and payment of ***Fabricated Structural Steel*** is based on weight, the weight will be computed on the basis of the net finished dimensions of the parts as shown on the approved working drawings, deducting for copes, cuts, clips, and all open holes.
Computations will be made on the basis of the following:

Material	Pounds /Cu Ft
Aluminum, cast or wrought	173.0
Bronze, cast	536.0
Copper alloy	536.0
Copper, sheet	558.0
Iron, cast	445.0
Iron, malleable	470.0
Lead, sheet	707.0
Steel, rolled, cast, copper bearing, silicone, nickel and stainless	490.0
Zinc	450.0

The weights of rolled shapes will be computed on the basis of their nominal weight per foot as specified in the Contract Documents or listed in the handbooks.

The weights of rolled shapes will be computed on the basis of their nominal weight for their width and thickness as specified in the Contract Documents, plus an estimated overrun computed as one half the permissible variation in thickness and weight as tabulated in A 6.

The weight of all shop weld metal (not included in weighed unit) and field weld metal will be computed on the basis of the theoretical volume from dimensions of the welds.

The weight of temporary erection bolts, shop and field paint, boxes, crates and other containers used for shipping, and materials used for supporting members during transportation and erection will not be included in the payment weight.

Structural members, materials that fail to meet the requirements of tests, and all materials rejected as a result of these tests will not be measured nor paid for under any method of payment.

408.04.03 When a pay item for ***Fabricated Structural Steel*** is not specified in the Contract Documents, the Fabricated Structural Steel will not be measured but the cost will be incidental to other pertinent items.

408.04.04 Rotational capacity testing for high strength bolt assemblies will not be measured but the cost will be incidental to the Contract price for the ***Fabricated Structural Steel*** item or other pertinent items specified in the Contract Documents.

SECTION 409 – STEEL STUD SHEAR DEVELOPERS

409.01 DESCRIPTION. This work shall consist of furnishing, fabricating and installing, complete in place, steel stud shear developers as specified in the Contract Documents or as directed by the Engineer.

409.02 MATERIALS.

Steel Stud Shear Developers	909.05

409.03 CONSTRUCTION. All structural steel in a particular span of a bridge shall be erected and have forming and decking complete in place in that particular span before shear developers are attached to the structural steel. Shear developers shall be installed as specified in AWS D1.5. After welding is completed, an inspection of all studs will be made by the Engineer prior to placing of concrete. All defects shall be corrected at the Contractor's expense.

409.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. Measurement and Payment shall be in accordance with one of the following as specified in the Contract Documents:

409.04.01 ***Steel Stud Shear Developers*** will not be measured but will be paid for at the Contract lump sum price.

409.04.02 ***Steel Stud Shear Developers*** will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

409.04.03 ***Steel Stud Shear Developers*** will be measured and paid for at the Contract unit price per each.

SECTION 410 – EXPANSION JOINTS IN STRUCTURES

410.01 DESCRIPTION. Furnish, fabricate, and install preformed joint fillers, preformed elastomeric joint seals, troughs, structural steel, and metal plates to be utilized in providing expansion and contraction capabilities in structures.

410.02 MATERIALS.

Hardware for Drainage Troughs	909.06
Preformed Joint Fillers	911.02

Preformed Polychloroprene Elastomeric Compression Joint Seals	911.04
Lubricant Adhesive	911.04.03
Troughs	911.11
Structural Steel	A 709, Grade 36

All structural steel for drainage troughs shall be hot dip galvanized to meet A 123 and A 153.

Ensure that troughs meet the thickness requirements for the type of material supplied. Place joints and splices for drainage troughs only where specified.

410.02.01 Paint. Refer to Section 413.

410.03 CONSTRUCTION. Store expansion joint material delivered to the bridge site under cover on platforms at least 4 in. above all types of surfaces and vegetation. Protect it at all times from damage and when placed ensure that it is free from dirt, oil, grease, or other foreign substances. All welding shall meet AWS D1.1 unless otherwise specified. All material and installation methods shall be approved prior to installation of any expansion joint material.

Provide the longest possible lengths of the preformed material with a minimum of joints. Lengths less than 4 ft shall be one piece. Cut material to a clean, true edge. Ensure straight lines at the joint.

When installing the seal, do not use any type of equipment that will damage the seal. Remove and replace damaged seals.

Drainage Troughs. Refer to MdSHA Office of Structures Standard Plate No. BR-SS(7.17)-95-313 Sheets 1 through 5 (*Drainage Trough Catch Basin – General Notes, Location Details, Type A, Type B and Type C Details*) and Standard Plate No. BR-SS(7.02)-79-64, Sheets 1 and 2 (*Compression Seal Roadway Joints at Abutments* and *Neoprene Trough Details for Compression Seal Roadway Joints at Abutments*).

Cleaning And Painting. Refer to Section 413.

Joint Replacement and Modification. Where the Contract Documents specify replacement or modification to existing expansion joints on bridges on which traffic will be maintained, have available a supply of steel plates at least 4 x 8 ft and 1 in. thick. Place these plates over the joints if traffic has to be restored before the concrete has cured and at any time the unfinished work will interfere with traffic.

Where the Contract Documents specify modification to existing expansion joints, remove the concrete as specified in Section 402.03.

Where the Contract Documents only specify replacement of existing roadway joint seal, the work shall include cleaning and painting the joint.

Thoroughly clean existing drainage troughs to remain of all debris. Clean and paint all exposed metal where noted on the Plans or as directed.

All angles shall be cut with a saw. All holes and slots shall be drilled. Do not cut with a torch.

Power tool clean to bare metal and paint any areas where the existing steel coating is damaged due to the installation of new troughs.

After the joints are complete in place and just prior to placing the compression seal, remove the masking tape and residue, and install the seal. Then apply the finish coat to the exposed portion of the angles above the seal.

Joint Seals in Bridge Decks. Place transverse compression seals in one piece for the entire length of the roadway joint. Shop and field splices are prohibited. Use the longest compression seal pieces as practicable for longitudinal bridge joints.

Apply the lubricant adhesive according to the manufacturer's recommendations. If the seal is stretched in excess of 5 percent, remove and reinstall the seal as directed.

410.03.01 In-Place Testing. Subject the completed joint to a water test to detect any leakage. Conduct the test at least five days after completing the joint. Provide all facilities required for the Engineer's inspections of the underdeck areas. Cover the roadway section of the joint from curb to curb, or parapet to parapet, with at least 1 in. of water. If this is not possible, perform the water test in part section along the joint. When testing subsequent part sections, overlap at least 1 ft of the joint previously tested.

Maintain the ponding for a period of five hours for the entire roadway or each section of joint being tested. During and at the conclusion of the test, examine the underside of the joint for leakage. The expansion joint seal will be considered watertight if no obvious wetness is visible. If the joint system exhibits evidence of water leakage at any point, locate and repair all leaks.

When repairs are required, perform a subsequent water test.

If the joint leaks after the second test, remove, replace, and retest the seal.

410.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for furnishing, fabricating, and placing structural steel, roadway seals, drainage troughs, catch basins, downspouts, cleaning, painting, and all material, labor, equipment, tools and incidentals necessary to complete the work.

410.04.01 Joints in structures will not be measured but the cost will be incidental to the pertinent Superstructure Concrete item.

410.04.02 When an item for ***Modifying Existing Bridge Roadway Joints*** is included in the Contract Documents, the cost of furnishing, fabricating, and placing new structural steel, new roadway seals, modifying existing joints on bridge roadway including saw cutting and removal of existing concrete, new concrete, steel plates, cutting of existing steel, welding, drainage troughs, catch basins, downspouts, etc., shall also be included in the Contract unit price per linear foot for the item. The measurement will include the horizontal distance from the inside face to inside face of parapets plus the vertical distance of the curb faces and parapets.

410.04.03 When an item for ***Drainage Trough for Bridge*** is included in the Contract Documents, the furnishing and placing of drainage troughs including catch basins, downspouts, structural steel, and hardware will be measured and paid for at the pertinent Contract unit price per linear foot. This price will include cutting of angles, cleaning, painting, drilling of concrete, expansion bolts, etc. The measurement will be along the centerline distance from end to end of the installed drainage trough fabric.

410.04.04 Cleaning existing drainage troughs and cleaning and painting metal attachments will not be measured but the cost will be incidental to other pertinent items.

SECTION 411 – BEARINGS

411.01 DESCRIPTION. Furnish and install bearings.

411.02 MATERIALS.

Steel Plates	909.02
Bronze or Copper Alloy Bearing and Expansion Plates	910.01
Elastomeric Bearing Pads	910.02.01
Pre-formed Fabric Pads	910.02.03
Epoxy Adhesives	921.04

411.03 CONSTRUCTION.

411.03.01 Storage and Handling. Store all types of bearings at the site under cover and on suitable blocking or platform at least 4 in. above all types of surfaces and vegetation. Protect from damage at all times and, when placed, keep them dry, clean, free of dirt, oil, grease, and other foreign substances.

411.03.02 Installation. Place preformed fabric pad on surfaces meeting the requirements specified in Section 414.03.07(c) prior to installing the masonry bearing plate.

Ensure that all bearings and pedestals of truss, stringer spans, and the center and end bearing of swing spans are rigidly and permanently located to correct alignments and elevations.

Refer to the applicable portions of Section 408 for the attachment of bearings or plates to steel superstructures.

411.03.03 Steel, Bronze, or Copper Bearings. When steel, bronze, or copper alloy bearings are specified, thoroughly clean the machined bearing surfaces immediately before installation. As soon as practicable after installation, apply one prime coat to all unpainted exposed surfaces of the bearings scheduled for painting. Proceed with the application of the specified field coats.

411.03.04 Elastomeric Bearing Pads. Prior to installation, give the pads and abutting surfaces a final cleaning to ensure that they are free of dust, dirt, oil, grease, moisture, and other foreign substances. Use an approved solvent that is compatible with the adhesive prior to application of the epoxy adhesive. Mix and apply the epoxy adhesive according to the manufacturer's recommendations.

When elastomeric pads are used without masonry bearing plates, grind the masonry bearing surfaces to remove all laitance before applying the adhesive. Apply the adhesive to the surfaces of the masonry bearing areas that will be in contact with the bearing pads and to the full contact area of the bearing pad. After the pads are in place, use blocking or other approved mechanical methods to secure the pads in their final position until the adhesive sets.

Surface temperatures and predicted ambient air temperature for the next four hours shall be 50 F or higher at the time of application unless otherwise specified or recommended by the epoxy adhesive manufacturer and approved.

411.04 MEASUREMENT AND PAYMENT. Bearings will not be measured. The cost will be incidental to other pertinent items specified.

SECTION 412 – BRIDGE MOUNTED SIGN SUPPORTS

412.01 DESCRIPTION. Furnish and construct bridge mounted sign supports and sign luminaire supports. This work does not include sign panels, electrical work, or luminaires.

References to Grade 50W structural steel shall be construed to include similar structural steel having weathering characteristics.

412.02 MATERIALS.

Epoxy Grout	902.11(d)
Structural Steel	909.01

Anchor Bolts, Nuts and Washers	909.06
High Strength Bolts, Nuts and Washers	909.07
Paint	912.05, Paint System B

On new structures, construct the sign support using the same structural steel and fasteners used for the fabrication of the structure. When A 709, Grade 50W structural steel is used, make the vertical supports from material meeting A 709, Grade 36 or 50.

On existing structures, use structural steel meeting A 709, Grade 36 or 50 for the sign support. When the existing structure consists of A 709, Grade 50W structural steel, construct the sign support from steel meeting A 709, Grade 50W, except make the vertical supports from steel meeting A 709, Grade 36 or 50. Use fasteners meeting the requirements of Section 909.07 and use Type 3 when used with A 709, Grade 50W.

Vertical supports for the sign panels shall be galvanized per A 123. All bolts, nuts, and similar fasteners in contact with the galvanized material shall be mechanically or hot dipped galvanized meeting the thickness, adherence, and quality requirements of A 153.

412.03 CONSTRUCTION. Construct the sign support according to the applicable portions of Section 408. Paint according to Section 413, except as specified herein.

Set the anchor bolts by epoxy grouting or casting in place when applicable.

On new structures, clean and paint the non-galvanized portions of the sign support using the same system specified for the structure. Portions of the sign support mounted on structures constructed with Grade 50W steel shall also be cleaned and painted where attached to areas designated for painting.

On existing structures not constructed with Grade 50W steel, either the entire sign support may be galvanized or those areas not designated to be galvanized may be painted. Refer to Section 413 for cleaning and painting non-galvanized portions of the sign support. Blast clean to a surface condition of Near White SSPC-SP 10 prior to painting. Unless otherwise specified, refer to Section 413B.03.25 for repair of damaged coatings on existing structures.

Portions of the sign support mounted on existing structures constructed with Grade 50W steel and attached to areas that are painted shall also be cleaned and painted.

412.04 MEASUREMENT AND PAYMENT. ***Bridge Mounted Sign Supports*** will not be measured but will be paid for at the Contract lump sum price. The payment will be full compensation for all material, labor, equipment, tools and incidentals necessary to complete the work.

SECTION 413 – CLEANING AND PAINTING STRUCTURAL STEEL

PART 413A – CLEANING AND PAINTING NEW STRUCTURAL STEEL

413A.01 DESCRIPTION. Clean and paint new structural steel used for work such as new construction, deck widening, and repairs that require installation of new structural steel. When the existing steel is not scheduled for repainting, this work will include repairing existing coatings damaged during the Contractor's operations and areas where new steel ties into existing steel. When the existing steel is scheduled for repainting, refer to Section 413, Part B. When the new or existing steel is prepared by abrasive blast cleaning in the field, refer to Section 413, Part B for containment and environmental monitoring requirements.

413A.01.01 Areas to be Coated. Areas of shop cleaning and priming, and field cleaning and painting pertain to the following surfaces:

(a) Nonweathering Steel - All surfaces. Refer to Section 413B.01.01(a).

(b) Weathering Steel.

(1) The outside facing surfaces of the fascia stringers for all structures over roadways and for structures over water that contain curb openings. For dual structures, this includes the median fascia. These surfaces include the underside of the top flange, the web facing away from the structure, the top of the bottom flange, the outside edge of the bottom flange, the underside of the bottom flange, the inside edge of the bottom flange, and the top of the bottom flange on the inside facing surface up to and including the fillet weld. A sharp well defined transition between the new paint on the flange and the bare steel above the fillet is not required. Overspray onto the web is acceptable. All attached bearings are included in the cleaning and painting.

(2) At abutments, the end 10 ft of all stringers and all other structural steel within the 10 ft area (e.g., stiffeners, cross bracing, and bearings).

(3) At piers, 10 ft in each direction from the center line of the pier (giving a total length at each pier of 20 ft) and all other structural steel within the area.

(4) At bolted field splices, 12 in. beyond the longest splice plate for each particular splice and all splice material.

(c) Roadway Joints.

(1) **New Roadway Joints.** Prior to any shop painting operations, clean all surfaces of the expansion dam and backwall angles. Apply the prime coat in the shop to the entire area of the backwall and expansion dam angles including those areas in

contact with concrete, except the portion that is masked to receive adhesive for the seal.

(2) **Existing Roadway Joints and New Portions.** Prior to any painting operations on existing expansion joints and new steel used to modify them, all surfaces of the expansion dam angles and backwall angles to be painted or receive adhesive for the seal shall be thoroughly cleaned. The area that will be in contact with the seal shall then be completely masked for full length and depth of seal.

The backwall and expansion dam angles shall have all coats applied to the entire area that will be exposed in the finished structure, both above and below the seal.

413A.01.02 General. Refer to Section 413B.01.02.

413A.01.03 Minimum Contracting Requirements for Field Painting. Refer to Section 413B.01.03.

413A.01.04 Definition of Bridge. Refer to Section 413B.01.04.

413A.02 MATERIALS.

Paint Systems	413A.02.01 and 912.05

413A.02.01 Paint Systems. Refer to Section 413B.02.01.

New Steel (Includes New Structures, Repairs, and Widenings). The paint shall meet Paint System B. Touch up paint for the shop primer prior to Coats II and III shall conform to Coat I of Paint System C as approved by the coating manufacturer.

Existing Coatings Damaged Due to Steel/Deck Repairs or New Connections. Use spot coats of Coat I of Paint System H, and Coats II and III of Paint System B.

Bolts and Field Welds. Prime all bolts and field welds with Coat I of Paint System C prior to the application of Paint System B, Coats II and III.

Roadway Joints. The color of the finish coat shall conform to Federal Standard 595, Color No. 26440.

(a) **New Roadway Joints.** Section 912.05, System B.

(b) **Existing Roadway Joints and New Portions.** Section 912.05, System E.

413A.02.02 Abrasives. Refer to Section 413B.02.02.

413A.03 CONSTRUCTION.

413A.03.01 Submittals. Refer to Section 413B.03.01.

413A.03.02 Inspection Equipment. The shop and field Contractor shall provide for the exclusive use of the Engineer, the equipment for the QA observations of the Contractor's cleaning and painting operations. Refer to Section 413B.03.04.

413A.03.03 Paint Quality Assurance (QA) Inspector Notification.

(a) **Field.** Refer to Section 413B.03.05.

(b) **Shop.** Notify the Engineer at least 5 working days prior to beginning cleaning and painting.

413A.03.04 Floodlighting. Refer to Section 413B.03.06.

413A.03.05 Shop Priming of New Steel. Solvent clean, abrasive blast clean, and prime all new structural steel in the shop with Coat I of Paint System B. Perform blast cleaning and painting after all shop fabrication is complete.

413A.03.06 Field Cleaning and Painting. Solvent clean, pressure wash, and hand/power tool clean the surfaces of the shop primed steel after it is erected. Follow with touch up using Coat I of Paint System C. Apply Coats II and III of Paint System B to all exposed structural steel in the completed structure.

When new steel is added to existing steel and the existing steel is not scheduled for repainting, repair the existing coating at new steel connection points and at locations where the existing coating is damaged by the steel installation work. Solvent clean and hand/vacuum-shrouded power tool clean the surfaces. Follow with the spot application of the penetrating sealer of Paint System H and the spot application of Coats II and III of Paint System B.

413A.03.07 Painting Sequence. Refer to Section 413B.03.08.

413A.03.08 Surface Preparation. Prepare surfaces as specified in Sections 413B.03.10(a) through (h), the pertinent SSPC Specifications, and the Contract Documents. Surface conditions shall meet the pertinent SSPC-VIS Standards. Surface preparation performed in the shop shall also meet the requirements of Section 413A.03.12.

413A.03.09 Methods of Cleaning. Methods shown in the following table apply to both shop and field cleaning, and shall be performed in the order shown. The methods are invoked based on the paint system specified. Refer to Section 413B.03.10 for methods of cleaning.

SUBSTRATE CONDITION	PAINT SYSTEM	METHODS OF CLEANING
Abrasive Blast Cleaned Steel	B (Coat I, II, and III)	Shop coating - (a) and (h) Shop touch up of damaged primer: Damage extending to substrate - (f) Damage not extending to substrate - (d) and (e) Field coating of shop primed steel - (a) and (b), followed by localized repair of damage: Damage extending to steel substrate - (f) Damage not extending to substrate - (d) and (e)
Bolts and Field Welds	C (Coat I) B (Coat II and III)	Field - (a) followed by (d) and (e)
Existing Coatings Damaged Due to Steel Repair, New Connection, or Contractor's Operations.	H (Coat I) B (Coat II and III)	Field - (a) followed by (d) and (e)
Existing Roadway Joints and Modified Portions	E (Coat I, II, and III)	Field - (a) followed by (f) or (h)

413A.03.10 Base Metal Readings (BMR). BMR shall be obtained in the fabrication shop on the bare steel in conformance with SSPC-PA 2. Report this reading along with the dry film thickness readings from the shop for the shop-applied coatings. If not obtained or reported, field inspectors will assume a 1.0 mil BMR in conformance with SSPC-PA 2.

413A.03.11 Repair of Surface Imperfections. Refer to Section 413B.03.13.

413A.03.12 Surface Condition Prior to Painting. Refer to Section 413B.03.15.

413A.03.13 Paint Storage and Mixing. Refer to Section 413B.03.16.

413A.03.14 Paint Representative. Refer to Section 413B.03.17.

413A.03.15 Shop Priming and Field Finish Painting. Meet SSPC-PA 1 for painting application and Sections 413A.03.16 thru .21.

413A.03.16 Time Restrictions for Field Painting. Do not apply field paint between December 15 and April 15. Apply shop paint at any time provided it is done indoors under controlled environmental conditions and in conformance with the manufacturer's recommendations.

413A.03.17 Weather Restrictions for Painting. Refer to Section 413B.03.20.

413A.03.18 Shop Application of Prime Coat. Apply the prime coat in the shop from agitated containers and as recommended by the manufacturer in a single application

employing multiple spray passes. Apply the dry film thickness specified in Section 912.05, except reduce the thickness to approximately 1.0 mil within the areas of field welding and on the top and both edges of the top flange where steel stud shear developers will be attached. Measurements shall be according to SSPC-PA 2.

Remove all dry spray, runs, mud cracking, and damaged primer. Feather the area prior to touch up so that the repainted surface has a reasonably smooth appearance. Use organic zinc primer to touch up the inorganic zinc primer coat in the shop and field unless otherwise approved by the manufacturer and the Engineer. Ensure that touch ups have the same dry film thickness as the coat being repaired. Organic zinc may be applied by brush.

413A.03.19 Field Application of Prime, Intermediate, and Finish Coats. Prior to field coating, pressure-wash the surfaces of the steel with potable water as specified in Section 413B.03.10(b) to remove dirt and contaminants as described in Section 413B.03.15.

Unless otherwise specified, apply Coats II and III after all field welded areas, bolted areas, and damaged primer coatings are cleaned and primed as specified or as directed.

Apply all paint according to the manufacturer's recommendations except the dry film thickness shall conform to the requirements of Section 912.05. Spray painting will be permitted provided the Engineer approves the location and method of spray application. Paint all areas adjacent to machinery and mechanical components, etc., by brush application unless the Engineer approves spray application. Surfaces inaccessible for painting by regular means shall be painted using sheepskin daubers or by other means as necessary to ensure coverage of the proper coating thickness.

The thickness measuring instruments shall be maintained, calibrated, adjusted, and measurements taken in conformance with SSPC-PA 2. Stripe coat all edges, outside corners, crevices, welds (including welds of fabricated members), rivets, bolts, nuts, and washers. Apply a stripe coat of the intermediate coat prior to the application of the full intermediate coat. Apply a stripe coat of the finish coat prior to the application of the full finish coat. Apply stripe coats by brush, dauber, or roller.

Ensure that each coat is free of shadow-through, skips, misses, and thin or heavy coating thickness. Repair defects prior to the application of the next coat. Keep the surface to be coated dust free during painting operations, and protect newly coated surfaces from the cleaning operations. If a previously cleaned area becomes soiled, contaminated, or rusted, re-clean the area to the specified condition and completely recoat at no additional cost to the County.

Apply the finish coat within 30 days after the intermediate coat unless approved in writing by the paint manufacturer. If the recoat window is exceeded, re-clean the surface as approved by the paint manufacturer and the Engineer.

413A.03.20 Bolts and Field Welds. Do not shop coat bolts for field assembly. After field welding and prior to applying Coat II (first field coat) clean these bolts, field welds, and

adjacent areas. Cleaning shall be as specified in 413A.03.09. Apply the first field coat (Coat II) within 24 hours of cleaning. Before Coat II is applied, solvent clean any prime coat stained from rusted bolts according to SSPC-SP 1.

413A.03.21 Control of Overspray and Spills. Refer to Section 413B.03.22.

413A.03.22 Caulking. Refer to Section 413B.03.23.

413A.03.23 Defective Work. Refer to Section 413B.03.24.

413A.03.24 Repair of Coatings. Refer to Section 413B.03.25.

413A.03.25 Final Identification. Refer to Section 413B.03.26.

413A.03.26 Field Cleaning Waste Containment. Refer to Section 413B.03.27.

413A.03.27 Field Cleaning Containment System Plan Guidelines. Refer to Section 413B.03.28.

413A.03.28 Containment System Requirements by Method of Preparation. Refer to Section 413.03.29.

413A.03.29 Worker Protection. Refer to Sections 413B.03.30 and 413B.03.31.

413A.03.30 Environmental Protection. Refer to Section 413B.03.32.

413A.03.31 Environmental Protection Plan of Action. Refer to Section 413B.03.33.

413A.03.32 Methods for Assessing Emissions. Refer to Section 413B.03.34.

413A.03.33 Field Cleaning Waste Disposal. Refer to Section 413B.03.35.

413A.03.34 Waste Handling Plan of Action. Refer to Section 413B.03.36.

413A.03.35 Waste Sampling and Analysis. Refer to Section 413B.03.37.

413A.03.36 Hazardous Waste Transportation and Disposal. Refer to Section 413B.03.40.

413A.03.37 Nonhazardous Waste Disposal. Refer to Section 413B.03.41.

413A.04 MEASUREMENT AND PAYMENT. The Contract unit price for the item specified will be full compensation for all cleaning and painting, scaffolding, platforms, containment systems, permits, working drawings, daily quality control records, Professional Engineer's services used for containment, industrial hygienist services, air monitoring, sampling and testing of materials for toxic metal content, including any revisions and

resubmissions that may be required during the execution of the work, providing safe access for inspections, hand wash station/clean up area, floodlighting, test plates, drums, collection and storage at the temporary storage site, hauling and disposal at an approved industrial waste site or hazardous waste site, removing and replacing planking, removal of debris, and all material, labor, equipment (including test equipment), tools, and incidentals necessary to complete the work.

413A.04.01 Cleaning and painting new structural steel will not be measured but the cost will be incidental to the pertinent Fabricated Structural Steel item.

413A.04.02 All costs associated with repair of existing coatings due to new connections and existing coatings damaged during steel/deck repairs will not be measured but will be incidental to the pertinent Repair, Structural Steel, or Cleaning and Painting items.

PART 413B - CLEANING AND PAINTING EXISTING STRUCTURAL STEEL

413B.01 DESCRIPTION. Clean and paint existing structural steel, and repair existing coatings damaged during repairs or by the Contractor's operations. Refer to Section 413A for cleaning and painting new structural steel.

413B.01.01 Definitions of Areas to be Cleaned and Painted. The following terms designate the specific areas to be cleaned and painted:

(a) **All Steel Surfaces.** Steel superstructure elements including but not limited to steel beams, girders, rockers, bearing assemblies, trusses, floor beams, stringers, joists, purlins, cross-bracings, lateral-bracings, diaphragms, sway-bracings, scupper downspouts, and support brackets for utilities, light poles, and sidewalks. It does not include substructure elements, railings, sign structures, utilities, or light poles.

(b) **Outside Facing Surfaces of Beams.** The exterior/fascia beams of the structure, including the underside of the top flange and the web facing away from the structure, the top of the bottom flange, the outside edge of the bottom flange, the underside of the bottom flange, the inside edge of the bottom flange, and a portion of the top of the bottom flange on the inside facing surface. The transition between the existing and new coating on the top of the bottom flange shall occur approximately half way between the edge of the flange and the fillet. A sharp well-defined transition between the new and existing coating is not required, but the existing coating shall be feathered. Clean and paint all attached bearings.

(c) **Inside Facing Surfaces of Beams.** Beams adjacent to longitudinal joints including the underside of the top flange and the web facing toward the longitudinal joint, the top of the bottom flange, the inside edge of the bottom flange, the underside of the bottom flange, the outside edge of the bottom flange, and a portion of the top of the bottom flange on the outside facing surface. The transition between the existing and

new coating on the top of the bottom flange shall occur approximately half way between the edge of the flange and the fillet. A sharp well-defined transition between the new and existing coating is not required, but the existing coating shall be feathered. Clean and paint all attached bearings.

(d) **Bearings and Beam Ends.** Bearing assemblies and structural steel for the specified distance from the ends of the beams at the abutments, and the specified distance in each direction from the center-line of the piers for a total of twice the specified distance.

(e) **Roadway Joints.** All roadway joint steel on the outside, top, and inside surfaces of the parapets, and from the parapet to the first pavement marking.

The paint system, finish coat color, and areas to be cleaned and painted for each structure shall be as specified in the Cleaning and Painting Table included in the Contract Documents.

413B.01.02 General. Perform the work according to SSPC Standards and the manufacturer's recommendations.

Notify the Engineer of structural defects including cracks, missing bolts or rivets, and deterioration detected during cleaning and painting.

Protect utility pipes, conductors, light fixtures, and conduits from these operations. Do not clean and paint them unless specified.

Perform Quality Control (QC) inspections to ensure that each phase of the work meets Specification requirements.

All maintenance of traffic required for corrective action shall be at no additional cost to the County. When a railroad is included in the project, all railroad fees shall be as specified, except that any additional impact on the railroad and associated fees due to corrective actions or additional inspections shall be at no additional cost to the County.

Ensure that all operations meet the requirements of OSHA, including exposure to lead, arsenic, and cadmium. Comply with 29 CFR 1926 construction standards and the applicable Federal, State, and local laws, including COMAR 26.16.01.

Existing paint systems and abrasives used for blast cleaning may include toxic metals such as lead, arsenic, cadmium, and chromium. Consider them as hazardous waste when removed, unless tests conducted as specified in the Toxicity Characteristic Leaching Procedure (TCLP), EPA Method 1311 prove otherwise.

Prior to bidding, become familiar with the current environmental regulations and safety procedures. In accordance with the EPA's RCRA regulation, the County shall be considered the "Waste Generator" of the paint wastes generated by the work on existing structures.

The Contractor shall be considered the "Hazardous Waste Generator" of all other waste associated with the work. These include wastes produced such as petroleum waste, solvent related waste, unapplied waste paints, used rags, used protective clothing, and other personal protective clothing (PPE) determined to be wastes. Obtain an EPA Hazardous Waste Generator ID Number, and dispose of waste under manifest as required by RCRA (Title 40 CFR parts 260 thru 265, and 271).

Prevent waste from entering into the environment by containing, collecting, storing, testing, and disposing of all waste in accordance with Federal, State, and local regulations.

413B.01.03 Minimum Contracting Requirements for Field Painting. The Contractor/subcontractor removing or applying paint shall be certified as specified in (a) below. When the paint being removed contains toxic metals, the Contractor/subcontractor removing the paint shall be certified as specified in (b) below. All certificates shall be effective prior to Award of Contract and shall remain in effect for the duration of the Contract. Refer to Section 413B.03.01.

(a) **SSPC-QP1.** Standard Procedure for Evaluating Qualifications of Painting Contractors: Field Application to Complex Structures.

(b) **SSPC-QP2, Category A**. Standard Procedure for Evaluating Qualifications of Painting Contractors to Remove Hazardous Paint.

413B.01.04 Definition of Bridge. The definition of the word "Bridge" as defined in Section GP-1.05 does not apply to this Specification. References to "Bridges" in this Specification shall mean any structure carrying traffic, regardless of their length.

413B.02 MATERIALS.

Paint Systems	912.05

413B.02.01 Paint Systems. All coats within the paint systems specified herein shall be from the same manufacturer. When multiple paint systems are used, all overlapping paint systems shall be from the same manufacturer. The color of the touch up finish coat on existing steel shall match the existing finish coat. The color of the finish coat shall be as specified.

413B.02.02 Abrasives. Abrasive media shall produce blasted surfaces having a surface profile height of 1.5 to 4.0 mils as determined according to D 4417, Method C. Provide material safety data sheets (MSDS) for the abrasives and a letter from the abrasive supplier indicating that expendable abrasives meet SSPC-AB 1, and recyclable abrasives meet SSPC-AB 3. Verify the cleanliness of recycled abrasives according to SSPC-AB 2.

413B.03 CONSTRUCTION.

413B.03.01 Submittals. Submit the following drawings, plans, and information for accomplishing the work. Except for (e) below, submit six copies on company letterhead to the Baltimore County Bureau of Engineering and Construction. Do not proceed with the work until the submittals are approved by the Engineer.

(a) **Copy of SSPC-QP Certification.** Refer to Section 413B.01.03.

(b) **Personnel Qualifications.** Provide applicable personnel qualifications to the Project Engineer prior to using the personnel on site. Refer to Section 413B.03.02.

(c) **Quality Control (QC) Plans.** Refer to Section 413B.03.03 for detailed submittal requirements for shop and field Quality Control Plans. Send all shop QC Plan submittals to the Engineer. Submittals shall meet the requirements of Sections 900.01 and 912.01. Submit all field QC Plans as specified herein.

(d) **Paint Manufacturer Certifications and Letters.** Submit the following information per Sections 900.01 and 912.01 to the Engineer:

(1) When detergents or additives are proposed for incorporation into the water used for washing, provide MSDS and a letter from the coating manufacturer that approves the use of the detergents with their coating.

(2) The manufacturer shall provide a letter that approves any proposed solvents for use in solvent cleaning prior to painting or between coats. Provide MSDS for the solvents.

(3) Provide the paint manufacturer's application and thinning instructions, MSDS, and product data sheets.

(4) When caulking is used, provide a letter from the coating manufacturer identifying the recommended caulking material, the application sequence for integrating the caulking into the coating system between Coats II and III, and the minimum cure time prior to paint application.

(5) If the only portion of bridge to be painted is the roadway joint, the paint need not be tested if, prior to use, a copy of the certified test results has been furnished to the Engineer specifying that the paint conforms to Section 912.

(e) **Containment Plans.** Refer to Sections 413B.03.28 and .29. Make submittals as specified in Section 499.

(f) **Worker Protection Compliance Program.** Required when abrasive blast cleaning is conducted in the field or paint containing toxic metals is being disturbed. Refer to Section 413B.03.31.

(g) **Environmental Protection Plan of Action.** Required when abrasive blast cleaning is conducted in the field or paint containing toxic metals is being disturbed. Refer to Section 413B.03.33.

(h) **Waste Handling Program.** Required for the handling of all hazardous waste regardless of the presence of toxic metals. The Waste Handling Program shall also include disposal of unused paint and solvent. Refer to Section 413B.03.36. A written program is not required for the handling of non-hazardous waste.

Do not construe approval of the submittals to imply approval of any particular method or sequence for conducting the work, or for addressing health and safety concerns. Approval of the proposed plans shall not remove the responsibility to conduct the work in accordance with Federal, State, or local regulations, this Specification, or to protect the health and safety of all workers involved in the project and any members of the public who may be affected by the project. The Contractor remains responsible for the adequacy and completeness of the programs and work practices, and adherence to them.

413B.03.02 Personnel Qualifications and Responsibilities. Provide documentation that all applicable project personnel meet the training and accreditation requirements of COMAR 26.16.01.

(a) **QC Inspectors.** A QC inspector shall be on site full time during cleaning and painting operations. Provide documentation that personnel performing quality control related functions are experienced and qualified to perform the work, and have completed the training specified for SSPC-QP1, and when paint containing toxic metals is being disturbed, SSPC-QP2.

(b) **Competent Person.** A competent person as specified in SSPC-QP2 shall be on site full time when paint containing toxic metals is being disturbed. This person shall perform all quality control related functions involving the oversight of worker and environmental protection, containment performance, and waste handling. Provide documentation of qualifications, including experience and records of training as specified in SSPC-QP2. This person shall hold a current SSPC C3 Competent Person Certificate or current C5 refresher, a certificate of completion of 29 CFR 1926.62(l) Lead in Construction Training, and shall be accredited in accordance with COMAR 26.16.01.

(c) **Certified Industrial Hygienist (CIH).** Provide the services of a CIH when the work involves the disturbance or removal of paint containing toxic metals. Provide evidence that the CIH has the following qualifications and insurance requirements:

(1) Certification by the American Board of Industrial Hygiene.

(2) Field sampling and oversight experience involving removal of paint that contains toxic metals from structures.

(3) $1,000,000 errors and omissions insurance coverage for this type of work.

All field sampling and testing shall be performed by the CIH or by an employee working under the direct supervision of the CIH, and shall be witnessed by a representative of the County. Notify the Baltimore County Bureau of Engineering and Construction, Design Division – Structural Design Section at least 24 hours prior to sampling and testing.

The CIH shall review all results of sampling and testing performed on the project. The CIH, or a person working under the direction of the CIH, shall prepare written reports interpreting these results for compliance to the applicable regulations. Submit a copy of all reports, analysis, etc., to the Engineer within five working days after sampling.

Submit a written certification within five days after the end of each month stating that the Contractor has complied with the Plans of Action and Compliance Programs specified within this Specification for worker protection, environmental protection, and waste handling; and has addressed any deficiencies found. The certification shall be prepared and signed by the CIH or a person working under the direction of the CIH.

413B.03.03 Quality Control (QC) Plan, Inspection Procedures, and Recording Systems. Submit a Quality Control Plan for providing daily job quality control per SSPC-QP1 for surface preparation and painting operations. The Quality Control Plan shall include the following:

(a) Records of standards and specifications for coating inspection work and their utilization.

(b) System for filing inspection reports.

(c) Demonstration that inspection equipment and calibration standards and procedures for calibrating the inspection equipment are available.

(d) Procedures to stop nonconforming work.

(e) Procedures for verifying proper coating application.

(f) Procedures to ensure that each major operation is inspected and the inspection results documented. Contractor QC inspections shall include:

(1) Effectiveness of protective coverings to control project debris, paint spatters, overspray, drips, paint spills, etc., while painting over roadways, waterways, machinery areas, and areas in the vicinity of abutments and private properties.

(2) Ambient conditions.

(3) Compressed air cleanliness and, if required, acceptability for breathing.

(4) Surface preparation (solvent cleaning, pressure washing, hand/ power tool or abrasive blast cleaning, etc.).

(5) Coating application (specified materials, mixing, thinning, and wet film thickness).

(6) Dry film thickness per coat.

(7) Recoat times and cleanliness between coats.

(8) Coating continuity and coverage (free from runs, sags, overspray, dryspray, pinholes, shadow-through, skips, etc.).

Maintain on site copies of the Contractor's daily job quality control records and make them available to the Engineer at any time. Submit records from on site audits.

413B.03.04 Inspection Equipment. Provide for the exclusive use of the Engineer, the following equipment for the QA observations of the cleaning and painting operations. Maintain, calibrate, and verify the equipment in a condition that is satisfactory to the Engineer. The equipment will remain the property of the Contractor at the conclusion of the Contract.

(a) The latest editions of SSPC-Vis 1, SSPC-Vis 3, or SSPC-Vis 4, as applicable to the project, or other approved visual standards.

(b) SSPC Manual Volumes 1 and 2 (Latest Editions).

(c) Spring Micrometer with Coarse and Extra Coarse Surface Profile Replica Tape.

(d) Electric or Sling Psychrometer, F.

(e) U.S. Weather Bureau Psychrometric Tables.

(f) Surface Thermometer, 0 to 150 F.

(g) Probe Thermometer for Paint Temperature.

(h) High/Low Thermometer for Paint Storage Area.

(i) Wet Film Thickness Gauge.

(j) Digital Magnetic Dry Film Coating Thickness Gauge capable of transferring data to a computer (SSPC-PA 2, Type 2).

(k) Plastic Calibration Shims for Digital Magnetic Dry Film Thickness Gauge.

(l) Inspector's Mirror.

(m) Wind Meter.

(n) Clean, White, Lint-Free, Absorbent Rags.

(o) Light Meter for measuring light intensity during surface preparation, painting, and inspection work.

(p) Putty Knife at least 40 mils thick and 1 to 3 in. wide.

(q) Blotter Paper.

413B.03.05 Paint Quality Assurance (QA) Inspector Notification. Notify the Baltimore County Bureau of Engineering and Construction, Design Division – Structural Design Section at least five working days prior to beginning field cleaning and painting of new and existing steel. A paint inspector will be provided to assist the Engineer in performing the QA observations of the cleaning and painting portion of the work. Failure to comply with this notification shall be cause for not accepting the work performed. The County reserves the right to require removal and re-application of paint applied without QA acceptance at no additional cost to the County. Any test to determine acceptance shall be at no additional cost to the County. Do not perform additional work until a determination has been made.

413B.03.06 Floodlighting. Provide floodlighting, including power sources, to supply adequate illumination to all surfaces being prepared, painted, or inspected, including the underside and inside of the containment system, when containment is employed. Floodlighting shall meet SSPC-Technology Guide No. 12, be maintained in good working condition, and be of an approved design. Adjust the floodlighting to avoid glare to marine and vehicular traffic.

413B.03.07 Field Cleaning and Painting. Refer to the Contract Documents for the appropriate cleaning and painting requirements.

413B.03.08 Painting Sequence. Do not paint the outside facing surfaces of beams until all concrete has been placed and parapet form brackets removed. However, the primer coat may be applied to these areas prior to placing the form brackets provided that it is properly touched up prior to placing the next coat of paint. Protect concrete from being stained by painting operations. Restore painted or stained concrete surfaces to originally intended color without damaging the concrete.

Proceed with cleaning and painting by sections, bays, or other readily identifiable part of the work as approved.

Start the work at the top and proceed toward the bottom.

413B.03.09 Surface Preparation. Prepare surfaces as specified in the pertinent SSPC Specifications and the Contract Documents. Surface conditions shall meet the pertinent SSPC-VIS Standards, and the test plates/sections specified in Section 413B.03.11.

413B.03.10 Methods of Cleaning. Methods shown in the following table apply to both shop and field cleaning and shall be performed in the order shown. The methods are invoked based on the Paint System specified.

PAINT SYSTEM	SUBSTRATE	METHOD OF CLEANING
C & D	Abrasive blast cleaned steel	Existing Paint to be Removed – Localized (a) and (b) and complete (h)
E, F, & H	Overcoating existing paint	Existing Paint to be Overcoated – Localized (a) and complete (c) followed by (d) and (e)

(a) **Solvent Cleaning.** Use solvents, emulsions, cleaning compounds, steam cleaning, or similar approved materials and methods in accordance with SSPC-SP 1 to remove grease, oil, diesel smoke residue, soot, and similar surface contaminates. Use soap steam cleaning for steel open grid decks and walkways and machinery areas of drawbridges. Before it evaporates, remove contaminated solvent by wiping or rinsing with clean solvent to prevent a film of contaminants from remaining on the surface. Solvent wiping may be required between coats. Use solvent approved in writing by the paint manufacturer.

(b) **Low Pressure Water Cleaning (LPWC).** Use potable water on all bearings, transverse and longitudinal joints, and beam ends prior to abrasive blast cleaning to remove salts, bird droppings, dirt, and debris. At beam ends, wash to the limits defined in Section 413B.01.01(d). Use LPWC as necessary between coats to remove surface contamination.

Perform LPWC per SSPC-SP 12, except use a nozzle pressure of 2000 to 2500 psi together with a rotating tip 12 to 18 in. from the surface. The pressure washer shall be equipped with easily accessible gauges and a pressure regulator. Perform LPWC no more than 96 hours prior to blast cleaning. Use this method to remove concrete spatter, dirt, debris, salt contaminants, grease, oil, and similar surface interference material from newly coated structures prior to the application of additional coats. Should the surface not be blast cleaned within 96 hours after LPWC, the Engineer will determine if additional preparation is required.

When the water is to be recycled and the coating being cleaned contains toxic metals, test for toxic metals before reuse. Do not reuse water that exceeds the threshold value for any toxic metal.

(c) **High Pressure Water Cleaning (HPWC).** Use potable water prior to hand and power tool cleaning in preparation for overcoating to remove loose paint, loose rust, loose mill scale, salts, bird droppings, dirt, debris, grease, oil, hydrocarbons, diesel smoke residue, soot, chalk, and similar surface interference material.

Perform HPWC per SSPC-SP 12, WJ-4, except use nozzle pressures of 4000 to 6000 psi and a rotating tip. A biodegradable detergent may be added to the water for the removal of grease, oil, and hydrocarbons if approved. The pressure washer shall be equipped with easily accessible gauges and a pressure regulator. Perform the cleaning at close range to the surface, approximately 6 in., using a pattern of overlapping drops followed by cross-hatching with the same overlap. At the end of cleaning, ensure that the swirling patterns created by the rotating tip are not visible on the surface. Perform the HPWC within 96 hours of applying the first coat. Should the surface not be painted within 96 hours, the Engineer will determine if additional preparation is required.

When the water is to be recycled, and the coating being cleaned contains toxic metals, test for toxic metals before reuse. Do not use water that exceeds the threshold value for any toxic metal.

(d) **Power Tool Cleaning.** Perform per SSPC-SP 3 and as depicted in SSPC-Vis 3. The use of 40-grit sanding discs are recommended. Refer to (e) for inaccessible areas.

(e) **Hand Tool Cleaning.** Perform per SSPC-SP 2. The use of 60-grit sanding paper is recommended.

Restrict the use of this method to areas that are inaccessible for power tool cleaning.

(f) **Power Tool Cleaning to Bare Metal.** Perform per SSPC-SP 11 and as depicted in SSPC-Vis 3, with a surface profile of at least 1.0 mil.

(g) **Brush Off Blast Cleaning.** The end surface condition shall meet SSPC-SP 7, Brush Off Blast Cleaning and as depicted in SSPC-Vis 1. Ensure that abrasives are dry and free of oils, grease, and other harmful materials such as lead dust, at the time of use.

(h) **Near White Metal Abrasive Blast Cleaning.** Do not use steel shot in the field. When using steel shot in the shop, add a sufficient amount of steel grit. Maintain the mixture to produce an etched surface texture, as opposed to the peened surface texture that results when blast cleaning with shot alone. The end surface condition shall meet SSPC-SP 10, Near White, and as depicted in SSPC Vis 1. Ensure that abrasives are

dry and free of oils, grease, and other harmful materials such as lead dust at the time of use.

413B.03.11 Test Plates/Sections. When abrasive blast cleaning is specified, furnish two 12 x 12 x 1/4 in. steel test plates and clean them to meet SSPC VIS Standards and the Contract Documents. Apply a clear protective coating to these standard test plates and use them as a job sample standard for cleaning operations. When approved as an alternative to the test plates, portions of an actual work piece may be used in order to reach agreement on the degree of cleaning before production surface preparation begins. When the SSPC VIS Standards accurately depict the agreed upon degree of cleaning on the test section, the prepared section does not have to be sealed and retained for future reference. When the SSPC VIS Standards do not accurately depict the degree of cleaning, the test section shall be sealed and retained, or the test plates utilized. For the production cleaning operations, the written requirements of this Specification, the SSPC definitions, the test plates, and the SSPC VIS Standards shall be used in that order for determining compliance with the Contractual requirements.

413B.03.12 Removal of Vegetation, Planking, and Signage. Prior to surface preparation, remove vegetation overhanging or fouling the structure.

When the structure has planking (timber or plywood) between the beams, carefully remove it in the areas of work operations. Store and maintain the planking in good condition. Dispose of all debris on the planking. Unless otherwise directed, the planking will not have to be reinstalled until cleaning and painting operations are complete. The Engineer may direct that portions of the planking be reinstalled prior to opening any lane to traffic during the same working day. The Engineer may also direct that planking be reinstalled during periods of work stoppage.

When the fascia webs of the structure contain street identification signs, remove them prior to beginning cleaning operations in the area. Clean and paint areas exposed by the sign removal, including bolt holes. Whenever a sign is removed, notify the Engineer. The Engineer will notify the Baltimore County Bureau of Traffic Engineering. Street signs may be reinstalled by the Baltimore County Bureau of Traffic Engineering utilizing the Contractor's maintenance of traffic. They will coordinate this work with the Contractor.

413B.03.13 Repair of Surface Imperfections. Regardless of the method of cleaning, remove surface imperfections such as sharp fins and slivers, rust scale, weld spatter, and pack rust by a combination of cleaning procedures such as using hand or power impact tools (chipping hammers or scaling hammers), blast cleaning, etc., without scarring good steel.

413B.03.14 Feathering and Removal of Defects in Existing Coating. For projects involving the touch up or overcoating of newly installed steel or existing coatings in the field, regardless of the method used for cleaning, feather the edges of old paint permitted to remain. Remove portions of paint on previously painted surfaces that are chalky, powdered, cracked, or otherwise unacceptable. Remove runs and sags in the existing paint on the

outside facing surfaces of fascia beams over highways. Ensure a smooth appearance after application of the new coating.

413B.03.15 Surface Condition Prior to Painting. Remove residual dust, dirt, and grease from the surface as the final procedure prior to painting and between coats whenever the coating is contaminated. Cleaning includes the removal of all dust, puddles, grease, oil, exhaust from trucks, debris, concrete spatter, and other foreign matter on the surfaces being painted. Also remove debris on surfaces adjacent to those being painted. Concrete spatter stains that discolor the primer need not be removed provided material is not dislodged when wiping the surface with a cloth. Cleaning involves vacuuming, solvent cleaning, hand/power tool cleaning, and pressure washing as appropriate. Should an area of previously cleaned steel become soiled, contaminated, or rusted, re-clean the area prior to painting at no additional cost to the County.

Prior to the application of paint in the shop and field, the QC personnel shall inspect the surfaces and establish that they have been prepared according to the Specifications. Upon QC acceptance, obtain approval that the surfaces to be painted during that day have been cleaned as specified.

413B.03.16 Paint Storage and Mixing. Store paints and thinners in well ventilated areas that are not subject to excessive heat, open flames, electrical discharge, and direct rays of the sun. Adhere to the manufacturer's recommendations. Store materials in heated areas when necessary. Use materials on a rotating stock basis, and leave containers closed until used. Do not use paints that cannot be stirred to normal consistency. Store paint in tightly covered containers at an ambient temperature of at least 45 F. Maintain containers in a clean condition, free of foreign materials and residue.

Remove and discard thin skins formed in the container. Do not use material that is livered, gelled, thick-skinned, or otherwise questionable.

Mix paints per manufacturer's instructions and as approved. Do not thin the paint unless authorized by the paint manufacturer and approved. The Engineer shall be present whenever the paint is thinned. Do not use materials that are beyond their pot life or shelf life. For multiple component paints, only complete kits shall be mixed and used. Partial kit mixing is prohibited.

Remove waste chemical solutions, oily rags, and other waste daily. Take precautionary measures to ensure protection of workers and work areas from fire hazards and health hazards resulting from handling, mixing, and applying materials.

413B.03.17 Paint Representative. The representative shall be a technical representative of the paint manufacturer and shall be present during the initial execution of the work to approve with the Engineer the degree of cleanliness prior to painting, and the method of application of the coating system. The Engineer may stop paint operations for failure to meet this requirement regardless of the reason for the failure. Areas cleaned prior to ceasing paint operations shall be re-cleaned if required.

413B.03.18 Field Painting. Meet SSPC-PA 1 for painting application and Sections 413B.03.19 thru .22.

413B.03.19 Time Restrictions for Field Painting. Do not perform field painting between December 15 and April 15.

413B.03.20 Weather Restrictions for Painting. All surfaces to be painted shall be sound and cleaned per the Contract Documents. Do not paint when:

(a) There is rain, snow, fog, or mist dampening the surface.

(b) The relative humidity exceeds the maximum humidity specified by the paint manufacturer.

(c) The ambient air temperature in the shade is below 40 F.

(d) The surface temperature is below the minimum temperature specified by the paint manufacturer; however, paint shall not be applied when the surface temperature is below 35 F.

(e) The surface temperature is expected to drop to 32 F or below before the paint has cured the minimum time and temperature for recoat specified by the manufacturer.

(f) The surface temperature is less than 5 F above the dew point.

(g) The surface temperature exceeds the value recommended by the manufacturer.

Whenever it is suspected that moisture is condensing upon the surface, the psychrometer will be used to check dew point, etc. If the conditions measured by the psychrometer are marginal, the Engineer may permit a well-defined area of the surface to be lightly moistened with a damp cloth and observed. If the dampness evaporates in 15 minutes, the surface will be considered satisfactory for the application of paint. Regardless of any environmental test results, when fresh paint is damaged by the elements, replace or repair the paint at no additional cost to the County.

Schedule the operations so that all cleaned surfaces are painted within 24 hours. If rust bloom appears or the air or steel temperature falls below five degrees above the dew point after cleaning and prior to application of the primer coat, re-clean the affected areas to the satisfaction of the Engineer at no additional cost to the County.

413B.03.21 Application of Prime, Intermediate, and Finish Coats. All surfaces shall meet the specified degree of preparation prior to the application of the paint system.

Apply all paint according to the manufacturer's recommendations except the dry film thickness shall conform to the requirements of Section 912.05. Spray painting will be

permitted provided the Engineer approves the location and method of spray application. Paint all areas adjacent to machinery and mechanical components, etc., by brush application unless the Engineer approves spray application. Surfaces inaccessible for painting by regular means shall be painted using sheepskin daubers or by other means as necessary to ensure coverage of the proper coating thickness.

The thickness measuring instrument shall be maintained, calibrated, adjusted, and measurements taken in conformance with SSPC-PA 2. Stripe coats shall be applied using brush, dauber, or roller to all edges, outside corners, crevices, welds, rivets, bolts, nuts, and washers prior to application of coatings in conformance with the following schedule:

SYSTEM	COAT
B	II & III
C	I* & II
E	I & II
F	II & III
H	II & III

*Striping of Coat I is permitted after the application of Coat I if the stripe coat is tinted per manufacturer's recommendation.

Ensure that each coat is free of shadow-through, skips, misses, and thin or heavy coating thickness. Repair defects prior to application of the next coat. Keep the surface to be coated dust-free during painting operations, and protect newly coated surfaces from the cleaning operations. When a previously cleaned or painted area becomes soiled, contaminated, or rusted, re-clean the area to the specified condition and completely re-coat at no additional cost to the County.

Apply each coat within 30 days after the prior coat, unless approved in writing by the paint manufacturer. If the re-coat window is exceeded, re-clean the surface as approved by the paint manufacturer and the Engineer.

413B.03.22 Control of Overspray and Spills. Protect the environment from paint droplets, overspray, and spills by providing containment for the paint application area. Assume responsibility for any damage resulting from wind and cleaning and painting operations. Up to 2 in. of overspray will be permitted onto the adjacent surface of the bridge deck next to the top flange. No other overspray will be permitted. Whenever the method of protection fails to function at the required level of efficiency, immediately suspend all operations except those associated with minimizing adverse impact to the environment. Do not resume operations until modifications have been made to correct the cause of the failure. Use fire retardant containment screens, curtains, and tarpaulins.

The Engineer may stop paint operations due to windy conditions. However, operations shall stop if the wind velocity exceeds 20 mph, unless specific and approved precautions are taken to prevent the escape of paint droplets and over-spray.

413B.03.23 Caulking. Caulk the following areas with a material approved by the paint manufacturer. Install caulking between the intermediate and finish coats:

(a) Areas of plate delamination that are 1/8 in. or greater that cannot be cleaned and sealed during the application of the coatings.

(b) Gaps between steel members that are 1/8 in. or greater that cannot be cleaned and sealed during the application of the coatings.

(c) Interface between the steel and concrete surfaces where through-girders penetrate the concrete. Apply caulking to the surfaces above the deck only. Do not caulk surfaces below the deck.

(d) Gaps at the interface of steel and concrete surfaces that cannot be cleaned and painted.

413B.03.24 Defective Work. Neither conditions during application nor County acceptance of paint shall remove the responsibility of obtaining a satisfactory paint system. When rusting occurs or a paint coat lifts, blisters, wrinkles, or shows evidence of having been applied under unfavorable conditions, the workmanship is poor, impure or unauthorized paint has been used, or for any other reason the painting is unsatisfactory, remove the affected paint and thoroughly clean the steel and repaint. Ensure that there is a uniform appearance throughout the structure.

413B.03.25 Repair of Damaged Coatings due to Contractor Operations. Notify the Baltimore County Bureau of Engineering and Construction, Design Division – Structural Design Section to determine the methods of cleaning and painting to be used.

413B.03.26 Final Identification. When the final coat of paint is dry, stencil a legend on the structure indicating the type of paint used in each coat, and the month and year in which each application was completed. The letters shall be 2 to 2-1/2 in. high and be applied with black paint to the inside surface of a fascia beam near the abutment at a location selected by the Engineer. Stencil paint shall be compatible with the paint system applied. Apply additional stencils when more than one paint system is used.

413B.03.27 Field Cleaning Waste Containment. Meet the SSPC Guide 6 containment levels specified in Sections 413B.03.28 and .29. Applicable portions of these requirements apply to shops when existing steel coated with hazardous material is cleaned in the shop. With the exception of paint removal on the top flanges of members in preparation for deck replacement, provide a written Containment System Plan per Section 413B.03.28 unless otherwise directed.

413B.03.28 Field Cleaning Containment System Plan Guidelines. Unless otherwise directed, the following submittal requirements apply when a containment system is specified, regardless of the presence of toxic metals. Even if a written Containment Plan is not required,

meet the technical requirements listed below when containment is used. Provide all submittals to the Engineer. Provide the following:

(a) Working drawings of the proposed containment system, showing the design of the paint removal, containment, rigging, and ventilation system (if applicable), including all calculations and assumptions. The working drawings shall:

(1) Indicate which structures are covered by the plans submitted. Show the containment system in plan and elevation views, including details of clips and hangers.

(2) Identify all containment system components on the plan sheets.

(3) Indicate the type and size of scaffolding or rigging to be used.

(4) Indicate sizes of the containment areas, and when ventilation is specified, the capacity of the dust collectors, equipment data sheets, and types of airflow systems to be provided including volume of air from ventilation fans and minimum velocity of air movement.

(b) The containment system and equipment shall not encroach upon the minimum structure clearances specified.

(c) Secure all curtains, screens, and tarpaulins used for containment. Make connections to the steel work of the structure with clamps or other approved devices. Do not drill holes into the existing structure or weld to the existing steel work. Do not make permanent attachments or fastenings to the structure. Do not attach any load to the structure railings unless details and calculations showing loading have been approved.

(d) Use fire retardant containment curtains, screens, and tarpaulins.

(e) Indicate maximum waste load permitted on the containment system, expressed in inches of debris.

(f) Indicate all restrictions on the structure, and if it is posted.

(g) When the containment or rigging system or methods of erection will apply a load to the structure (e.g., suspended platform) the submittals shall include an analysis of the load that will be added to the existing structure, including blast waste. When vehicles containing surface preparation materials or waste will be stationed on the structure, indicate allowable load and location. The load analysis shall be performed, signed, and sealed by a Professional Engineer registered in the State of Maryland. The analysis shall ensure that the system will not affect the structural integrity of the structure.

When the containment or rigging system does not impose a load to the structure (e.g., tarpaulin materials suspended from the structure at an abutment or cables and picks used for access), a Professional Engineer analysis and review of the drawings is not required.

(h) All drawings requiring a Professional Engineer review and seal as defined in (g) above shall be prepared and submitted per Section 499. Drawings not requiring a Professional Engineer review and seal can be provided on standard paper. Submit 10 copies of each drawing. When a Professional Engineer stamp is required, each sheet shall be signed and sealed by the Professional Engineer. The submittal letter shall be on company letterhead. At least one copy of the submittal shall have an original seal.

(i) When the structure is over water, show a skimming boom for emergency backup.

413B.03.29 Containment System Requirements by Method of Preparation. Refer to Section 413B.03.10.

(a) Washing. When pressure washing newly installed steel coated only with inorganic zinc primer, the surfaces may be washed without any containment or collection of the water. Prevent spray and runoff water from entering traveled areas such as roadways, walkways, and railroads.

Whenever pressure washing is being performed on other painted surfaces, prevent paint chips from falling into rivers, streams, wetlands, wetland buffers, or other bodies of water, and when specified, from falling onto the ground. Should inadvertent spills or releases of paint chips occur, clean them up before the end of the shift, or immediately if directed.

(1) When pressure washing paint containing toxic metals or inorganic zinc/vinyl systems, the containment shall meet SSPC Class 2W. All wash water and debris shall be collected and disposed of per the applicable regulations and Sections 413B.03.27 and .35, respectively. Prevent paint chips from falling onto the ground.

(2) When pressure washing all other systems (systems other than inorganic zinc, inorganic zinc/vinyl, or systems that contain toxic metals), collect all dislodged paint chips, but the water need not be captured. When dislodged chips are collected on suspended containment screens, the maximum mesh opening shall be 17 mils. When working over ground, chips may be collected from the ground in lieu of utilizing containment screens, provided all chips are collected before the end of the shift. Dispose of collected paint chips and debris per applicable regulations and Section 413B.03.35.

(b) Power Tool and Hand Tool Cleaning. Prevent paint chips from falling onto the ground or into rivers, streams, wetlands, wetland buffers, or other bodies of water.

Clean up any inadvertent spills or releases of paint chips before the end of the shift, or immediately if directed.

(1) If paint system contains toxic metals, the containment for open power tool cleaning shall meet SSPC Class 2P. Dispose of collected paint chips and debris per the applicable regulations and Section 413B.03.35.

(2) If paint system does not contain toxic metals, the containment for open power tool cleaning shall meet SSPC Class 3P. Dispose of collected paint chips and debris per the applicable regulations and Section 413B.03.35.

(3) For roadway joints and other small areas approved by the Engineer, High Efficiency Particulate Air (HEPA) filter vacuum shrouded power tools may be used in lieu of containment in areas of paint containing toxic or nontoxic metals. Vacuum-shrouded power tools may eliminate the need for containment if it can be demonstrated that all paint chips and debris are sufficiently collected by the vacuum.

(c) Spot Abrasive Blast Cleaning or Brush Off Blast Cleaning. Prevent paint chips from falling onto the ground or into rivers, streams, wetlands, wetland buffers, or other bodies of water. Clean up any inadvertent spills or releases of abrasives or paint chips before the end of the shift, or immediately if directed.

With the exception of new steel installed with inorganic zinc primer, the containment for spot abrasive blast cleaning or brush off blast cleaning (regardless of the presence of toxic metals) shall meet SSPC Class 2A. Dispose of collected paint chips and debris per the applicable regulations and Section 413B.03.35.

Containment for spot abrasive blast cleaning or brush off blast cleaning of newly installed inorganic zinc primer shall meet SSPC Class 3A. Dispose of collected paint chips and debris per the applicable regulations and Section 413B.03.35.

(d) Total Paint Removal by Abrasive Blast Cleaning. Prevent paint chips from falling onto the ground or into rivers, streams, wetlands, wetland buffers, or other bodies of water. Clean up any inadvertent spills or releases of abrasives or paint chips before the end of the shift, or immediately if directed.

When totally removing any coatings by abrasive blast cleaning (regardless of the presence of toxic metals), the containment shall meet SSPC Class 2A. Dispose of collected paint chips and debris per the applicable regulations and Section 413B.03.35.

Meet ambient air and worker exposure requirements established by the Maryland Department of the Environment and MOSH.

Maintain containment systems while work is in progress. Do not deviate from the approved working drawings. Deny public access to all rigging, scaffolding, containment systems, and work sites at all times.

When cleaning structures over water, provide a skimming boom for emergency backup consisting of a float with a skirt or other approved system that shall be employed immediately to collect floating debris. Clean the skimming boom at least once a day. Upon completion of the project, clean the skimming materials or if cleaning is not possible or practical, dispose of as hazardous or non-hazardous waste as applicable.

413B.03.30 Worker Protection and Exposure Monitoring. In addition to complying with all applicable OSHA and MOSH regulations, when the project involves coatings that contain toxic metals, provide the services of a CIH per Section 413B.03.02(c) and submit a Worker Protection Compliance Program per Section 413B.03.31. The CIH, or a technician working under the direction of the CIH shall monitor worker exposures during paint disturbance operations at each structure and provide worker protection oversight.

Regardless of the presence of toxic metals, provide a hand wash station with soap and towels at each work site. As dictated by the monitoring results and the applicable OSHA standards, provide a clean up area with a shower, soap, hot and cold potable pressurized water; a change area with a locker; and an approved container for collecting and disposing of waste at each work site. The hand wash and shower facilities shall be available for Contractor and County personnel. Hygiene facilities shall meet 29 CFR 1926.51, Sanitation Standard.

413B.03.31 Worker Protection Compliance Program. A Worker Protection Compliance Program is not required when the coatings being disturbed do not contain toxic metals.

The program shall be on company letterhead and meet OSHA and the MOSH - Lead in Construction Standards, and other applicable toxic metal standards. The Compliance Program shall be reviewed and signed by the CIH and at least one copy of the submittal shall have an original CIH seal. The program shall include a commitment for the CIH, or a person working under the direction of the CIH, to provide written certification each month that the Contractor has complied with the Worker Protection Compliance Program, including biological monitoring. The letter shall be provided to the Contractor within five working days after the end of the month, and the Contractor shall provide the Engineer with a copy of the letter the following workday.

413B.03.32 Environmental Protection. At the end of the shift each day and upon completion of all project activities, the surrounding property and the entire project area shall be cleaned free of visible debris from the cleaning and painting activities.

413B.03.33 Environmental Protection Plan of Action (EPPA). An EPPA confirming that the environment is protected from contamination is required when the coatings are being abrasive blast cleaned (regardless of the presence of toxic metals), or the coating being disturbed contains toxic metals (regardless of the method of preparation). When an EPPA is

required, it shall be reviewed and sealed by a CIH and shall include procedures for monitoring air, soil, and water.

Include a location plan showing the type and location of high volume ambient air monitors if applicable, and the procedures that will be followed for visible emissions assessments and inspections of the soil, water, surrounding property and structures, and pavement. Submit six copies of each plan signed and sealed by the CIH. All submittals shall be in writing and on company letterhead. At least one copy shall have an original seal. Address the proposed procedures that will be implemented for the following as defined in Section 413B.03.34:

(a) For any paint disturbance using dry methods of preparation, address the daily visual emissions observations that will be performed and the corrective action that will be implemented in the event emissions or releases occur.

(b) When paint containing toxic metals is being disturbed, address the provisions for high volume ambient air monitoring (TSP-Monitoring); monitor citing, calibration, and operation; filter handling and shipping; and laboratory analysis, including the name and qualifications of the laboratory. Test results shall be reviewed and summarized by the CIH, and provided to the Contractor within five days of sample collection. Provide copies to the Engineer on the next work day following receipt.

(c) For any paint disturbance, address the visual assessments for soil/water/sediment that will be undertaken each day and upon project completion, together with the proposed clean up activities.

(d) Include a commitment from the CIH or a person working under the direction of the CIH, that within five days after the end of the month a written certification will be furnished certifying that the Contractor has complied with the EPPA. Provide a copy of the letter to the Engineer on the next work day following receipt.

413B.03.34 Methods for Assessing Emissions. Unless otherwise specified, the following requirements apply to all projects, regardless of the presence of toxic metals:

(a) SSPC Level 1 Visible Emissions. The following Level 1 visible emissions criteria apply when any paint is disturbed by dry methods such as blast cleaning or power tool cleaning.

Level 1 Emissions are defined as random visible emissions of a cumulative duration of no more than 1 percent of the workday or approximately five minutes in an eight-hour day. Level 1 is required for all structures. The Contractor's QC person, or Competent Person in the case of toxic metals projects, shall perform at least two 15 minute documented observations during each work shift. In addition to the 15-minute observations, all Contractor personnel shall be directed to routinely observe the work area and to report unacceptable emissions to QC or supervisory personnel, or to the Competent Person. When unacceptable emissions are detected, locate and

immediately correct the source of the emissions. Retain the records on site, and make them available to the Engineer.

The visible emissions criteria are not required when the paint is cleaned or disturbed using water. When water is used on existing coatings that contain toxic metals or on inorganic zinc/vinyl systems, all water shall be collected and emissions are prohibited. When water is used to clean all other coating systems, the water need not be collected and emissions are not restricted.

(b) Ambient Air Monitoring. Unless otherwise directed, ambient air monitoring is required when the coatings being disturbed contain toxic metals, and whenever the paint removal operations are located within 500 ft of houses, schools, parks, playgrounds, shopping areas, or similar areas of public exposure.

(1) Abrasive Blast Cleaning. Daily ambient air monitoring at each structure being abrasive blast cleaned shall begin one day prior to beginning work and during the first 10 days of productive abrasive blast cleaning operations. When the results indicate that the containment is controlling emissions, full time monitoring may be discontinued unless otherwise directed. However, monitoring shall be repeated for two consecutive days every month thereafter during the work shift while blast cleaning or other dust producing operations are underway.

When the results of the original 10 days of monitoring or the periodic monthly tests are unacceptable, monitoring shall continue full time. Monthly monitoring may be initiated or resumed only when approved, and only after the results of the testing indicates that the containment is controlling emissions.

Full time monitoring shall also be resumed when unacceptable visible emissions or residues are observed on the ground or water.

(2) Hand and Power Tool Cleaning. Begin daily ambient air monitoring at each structure one day prior to beginning work and during the first five days of hand tool cleaning and power tool cleaning. When the results indicate that the containment is controlling emissions, full time monitoring may be discontinued, unless otherwise directed. Resume monitoring when visible residues are observed on the ground or in the water, or visible dust is observed exceeding the Visible Emissions criteria established above.

(3) Monitor Placement and Reporting. Place total suspended particulate (TSP) monitors in areas of potential public exposure (e.g., adjacent to homes, businesses, parks, or pedestrian walkways) that are within 500 ft of each project site during cleaning operations in conformance with Method D of SSPC Guide 6. The CIH shall provide for Engineer acceptance, the proposed monitoring locations in advance, together with the rationale for the selection of each site. Monitoring shall be conducted at least seven hours per work shift. All TSP

monitoring samples shall be analyzed using Method 40 CFR 50 Appendix B and G by a laboratory approved by the American Board of Industrial Hygiene.

The CIH shall use an Adjusted Daily Allowance (ADA) as described in SSPC Guide 6 (not an average daily allowance) for evaluating the TSP monitoring results. The CIH, or a person working under the direction of the CIH, shall provide the Contractor with a written report and analysis of monitoring results, including the relevant acceptance criteria based on the ADA, within five days of sample collection. Provide the results to the Engineer on the next work day following receipt.

(c) Removal of Visible Project Debris. At the end of the shift each day and upon completion of all project activities, the surrounding property, structures, and the entire project area shall be cleaned free of visible project debris.

Prevent paint chips, abrasives, dust, and debris from being deposited onto surrounding property, vehicles, concrete, pavement, slope protection, soil, water, sediment, etc. When there are spills or releases of such material, immediately shut down the operations producing the emissions and clean up the debris. Change work practices, modify the containment, or take other appropriate corrective action as needed to prevent similar releases from occurring in the future. Contain and collect water used for washing paint containing toxic metals or existing inorganic zinc/vinyl systems. Water used to wash all other paint systems need not be contained and may contact the ground and water.

413B.03.35 Field Cleaning Waste Disposal. Store all project waste, regardless of the presence of toxic metals, in roll-offs or sealed 55-gallon drums. Containers shall be labeled with the structure number, Contract number, Contractor's name, contents, and the date. Refer to Sections 413B.03.36 thru .41.

When the waste is hazardous, comply with SSPC Guide 7. Each day, collect clothing and other waste material and seal them in approved containers. When drums are used, they shall be sealed 55-gallon open head type drums meeting Interstate Commerce Commission Specification 17-H. All containers shall be in new condition.

413B.03.36 Waste Handling Plan of Action. Required for the handling, storage, and disposal of all hazardous waste, regardless of the presence of toxic metals. When the project involves the removal of paint containing toxic metals, the program shall be signed and sealed by the CIH. At least one copy of the submittal shall have an original seal.

The Plan of Action shall address the following:

(a) Names, addresses, and licenses for the proposed hazardous waste transporters and disposal facilities.

(b) Hazardous waste handling and storage procedures.

(c) Waste and waste water sampling and analysis procedures.

(d) Provide all test results to the Engineer within five days of sample collection.

413B.03.37 Waste Sampling and Analysis. When the project involves hazardous waste, the CIH, or an employee working under the direct supervision of the CIH, shall take at least four samples of the accumulated residues of each waste stream collected at each structure or a sample from every third drum, whichever is greater. All sampling shall be random and representative.

The samples shall be analyzed for TCLP as outlined in COMAR 26.13.02 and the EPA Test Procedure Manual, SW-846 for all RCRA 8 Metals. Waste shall not accumulate for more than 30 days before sampling. The representative samples collected shall be analyzed by an approved laboratory and the results returned to the Engineer within five working days of collection. Additional samples may be required if the average test results exceed 3.5 mg/l for lead, or exceed the threshold levels for other toxic metals allowed by COMAR and EPA procedures. The disposal method will be based on the results of these analyses, except that waste generated using steel abrasives shall be handled, stored, and disposed of as hazardous waste regardless of the test results.

413B.03.38 Temporary Waste Storage Site. Obtain an approved temporary storage site, and haul the waste material away from the work site at the end of each working day. Ensure that the storage site prevents the migration of the contaminated material into the environment and that it is protected from vandalism and unauthorized access by the general public. Remove the waste from the temporary storage site within 75 days from the initial date of accumulation or before the completion of work, whichever comes first. When the Contract Documents specify that the waste containers shall be stored at a particular facility owned by the County, contact that facility to schedule delivery.

413B.03.39 Waste Water Disposal. Test the waste water collected from bridge washing and hygiene facilities for toxic metals. Tests shall be performed using EPA Method 6010 by a laboratory approved by the American Board of Industrial Hygiene.

Provide the Engineer with the test results and written plans for the disposal of the water, including the name and address of the licensed transporter and disposal facility. If Baltimore County authorizes the disposal of the water down the sanitary sewer system, provide a letter from Baltimore County authorizing the disposal.

413B.03.40 Hazardous Waste Transportation and Disposal. Maryland law provides that when samples tested using TCLP exceed the threshold value (5 mg/l for lead), they shall be considered hazardous waste and be removed under manifest by a licensed hazardous waste transporter to a permitted disposal facility. When tested waste material is determined to be hazardous waste, request through Baltimore County an EPA identification number as specified in COMAR 26.13.03.03. Provide the Engineer with written plans for the

transportation and disposal of the waste, including the name and address of the licensed transporter and disposal facility.

Waste containing less than the threshold value by the TCLP test, including the confidence interval, shall be disposed of in accordance with Section 413B.03.41 for RCRA 8 Metals.

Prepare a manifest for hazardous waste to be transported from the approved temporary storage site. The manifests shall be prepared and contain the information stipulated in COMAR 26.13.03.04 and as otherwise required by State regulations. Forward the manifests to the Engineer.

Drums of other wastes, such as solvent contaminated rags, disposable protective clothing, disposed dust collector filters, and other contaminated substances shall be sampled individually and tested appropriately.

COMAR 26.13.03.05 stipulates the "Pre-Transport" requirements and the amount of time permitted for the accumulation of hazardous waste. A certified waste hauler shall transport waste to a landfill permitted to accept this material.

Obtain a list of certified haulers and other information regarding handling and disposal of blast waste by contacting the Department of Environment, Hazardous Waste Administration.

413B.03.41 Nonhazardous Waste Disposal. Waste containing less than the threshold value (refer to Section 413B.03.40) by the TCLP test, including the confidence interval, may be disposed of as an industrial waste at a landfill permitted to accept this material. Dispose of all waste in accordance with local regulations.

Waste containers/dumpsters shall be covered when not in an active filling process.

413B.04 MEASUREMENT AND PAYMENT. The Contract unit price for the item specified will be full compensation for all cleaning and painting, scaffolding, platforms, containment systems, permits, working drawings, daily quality control records, Professional Engineer’s services used for containment, industrial hygienist services, air monitoring, sampling and testing of materials for toxic metal content, including any revisions and resubmissions that may be required during the execution of the work, providing safe access for inspections, hand wash station/clean up area, floodlighting, test plates, drums, collection and storage at the temporary storage site, hauling and disposal at an approved industrial waste site or hazardous waste site, removing and replacing planking, removal of debris, and all material, labor, equipment (including test equipment), tools, and incidentals necessary to complete the work.

413B.04.01 ***Cleaning and Painting Existing Structural Steel*** will not be measured but will be paid for at the Contract lump sum price.

413B.04.02 All costs associated with repair of existing coatings due to new construction, structural repairs, and damage caused by Contractor's operations will not be measured but will be incidental to the pertinent Repair, Structural Steel, or Cleaning and Painting items included.

SECTION 414 – PORTLAND CEMENT CONCRETE STRUCTURES

414.01 DESCRIPTION. Furnish, place, finish, and cure concrete bridges, culverts, and miscellaneous structures including cofferdams, forms, and falsework.

414.02 MATERIALS.

Curing Materials	902.07
Form Release Compound	902.08
Concrete Mixes	902.10 and 414.02.04
Grout	902.11
Linseed Oil	902.12
Drains, Downspouts, Weep Holes, and Pipes	905
Reinforcement	908.01
Cast Iron Scuppers	909.04
Anchor Bolts	909.06 and 909.07.01
Steel Forms Which Remain In Place	909.10
Joint Sealer	911.01
Preformed Joint Fillers	911.02
Preformed Polychloroprene Elastomeric Compression Joint Seals	911.04
Water Stops and Flashing	911.08 and 913.05
Production Plants	915
Fusion Bonded Epoxy	917.02
Water	921.01
Epoxy Adhesives	921.04

414.02.01 Admixtures. Do not use calcium chloride or other admixtures containing chloride salts in concrete placed on steel bridge deck forms.

414.02.02 Requirements for Accessories. Ensure that accessories such as inserts and ties that will remain in completed superstructures within the top 5 in. of final deck slab concrete

are either epoxy coated or made of material other than aluminum that will not rust. These same requirements pertain to accessories that will remain in parapets, sidewalks, or other portions of the structure designated to have epoxy coated reinforcing steel. Do not use inserts in the top half of slabs exposed to vehicular traffic unless specified.

414.02.03 Precast Reinforced Concrete Box Sections. Meet M 259 or M 273 including concrete design strength. All details shall be as specified. Construction joints between the walls and the bottom and top slabs are optional. Certify as specified in Section 305.03.06.

414.02.04 Composition of Concrete Mixes for Slip Form. For construction of parapets and median barriers on bridges, use Mix No. 6 with a 1 in. maximum slump. Measure the slump at the placement point as the concrete is charged into the slip form machine. Use crushed stone meeting M 43, size number 7 for the coarse aggregate, proportioned to be 63 percent of the total aggregate in the mix. Other size coarse aggregate may be used provided the slip form results are acceptable.

414.03 CONSTRUCTION. Produce concrete at the work site or away from the work site by an approved central mixing plant, or by approved truck mixing as specified in Section 915.

When specified, remove portions of existing parapets or end posts as specified in Section 402.03.

414.03.01 Equipment. Use equipment of sufficient capacity to complete any unit or section of concrete between construction joints in one continuous operation consistent with approved placement operations.

With written approval, hand mixing may be permitted for small volumes of concrete used in isolated portions of the structure where structural integrity is not critical and the volume does not exceed 1 cu.yd.

414.03.02 Forms.

(a) Design Criteria.

(1) Design Loads. Per AASHTO LRFD Bridge Construction Specifications, Temporary Works. Assume the lumber in the forms to weigh 50 lb/cu.ft..

(2) Design Stresses.

Timber Design. Per ACI Standard Recommended Practice for Concrete Formwork (ACI 347). Deflections for form members shall not exceed 1/270 of the span or 1/4 in. Unit stresses stipulated in AASHTO for treated timber may be increased by 25 percent, but shall not exceed the values listed below.

Compression Perpendicular to Grain	450 psi
Compression Parallel to Grain	1600 psi

Flexural Stress	1800 psi
Horizontal Shear	
Beams up to 6 in. deep	200 psi
Beams over 6 in. deep	150 psi
Axial Tension	1200 psi

Plywood. For plywood without backing, calculate the strength of plywood based on the grain of the face plies running parallel to its span. Install the plywood in this manner.

Steel Members for Forms. Per AASHTO LRFD Design Specifications and AASHTO LRFD Bridge Construction Specifications. For design where no dynamic loading is involved, the AISC Standard Manual of Steel Construction, Allowable Stress Design may be used as the accepted design code.

Steel Forms Which Remain in Place. The maximum deflection shall not exceed 1/180 of the span and not in excess of 1/2 in. Do not use camber to compensate for deflection in excess of these limits. The design spans of the form sheets shall be the clear distance between beam or girder flanges less 2 in.

The unit working stress in the steel sheet and supporting members shall not be more than 0.725 of the specified minimum yield strength of the material furnished but not to exceed 36,000 psi. Compute physical design properties in accordance with the American Iron and Steel Institute Specification for Design of Cold Formed Steel Structural Members.

(b) Working Drawing Approval. Submit detail, form, falsework, and centering plans and design loads for approval as specified in Section 499. Working drawings for forms shall include all members proposed for use as well as form ties and bracing. Do not submit details for form ties separately; incorporate them in the general working drawings submittal. The rate of placing concrete shall be noted on the working drawings. Approval of the working drawings does not relieve the Contractor of responsibility as specified in Section TC-4.01. The provisions of Section 408.03.28 also apply when working drawings are submitted for falsework and centering.

(c) Forms at Construction Joints and Corners. Provide ties or bolts 3 to 6 in. from each side of construction joints for tightening the forms against the hardened adjacent concrete prior to placing fresh concrete. At joints where forms have been removed and reconstructed, extend the form over the concrete already in place and draw tightly against the previously placed concrete. Provide fillets at all sharp corners, except when otherwise specified, and provide a bevel or draft in the case of all projections. Chamfer all exposed corners of concrete with 3/4 x 3/4 in. milled chamfer strips, except on unexposed footings or where specified.

(d) Form Scaffolds and Platforms. Build form scaffolds and platforms along the outside of bridge deck fascias during construction of forms for bridge decks. Design and

construct them as integral parts of the form supports. Furnish separate design calculations with the working drawing submission. Assume the responsibility of Section TC-4.01 even after approval of the working drawings.

(e) Forms for Unexposed Surfaces. Ensure that sheathing, studs, and bracing are of sound material, and that studs and wales are straight, true, and surfaced on two edges to a uniform width. Ensure that the inside faces of the forms are constructed sufficiently smooth so that the resulting concrete surfaces are accurately formed.

(f) Forms for Exposed Surfaces. Unless otherwise specified in the Contract Documents, support the bridge deck concrete between stringers with steel forms which remain in place, except in panels where a longitudinal deck construction joint is located between stringers. Ensure that forms that are used for widening and rehabilitation provide exposed finished concrete surfaces that match the existing structure.

(1) Lined Forms for Exposed Surfaces. Use approved composition board, sanded plywood, or metal for contact surfaces of lined forms for surfaces exposed to weather or view. Ensure that all studs are surfaced two edges to a uniform width. The studs and backing shall be solid, straight, and free of detrimental defects. However, the backing need not be of the quality used for contact forms for unexposed surfaces.

Sheathing for form backing shall be surfaced two sides to a uniform thickness of at least the dimension approved on the working drawings. Ensure that form sheathing is built solidly, securely nailed to studs, and placed to prevent any bulging of the lining.

(2) Unlined Forms for Exposed Surfaces. Use five ply sanded plywood of the specified thickness for surfaces exposed to weather or view. Use plywood manufactured especially for concrete formwork using waterproof glue. All studs and wales shall be surfaced two edges to a uniform width.

Use full size sheets of plywood except where smaller pieces cover an entire area. Solidly back joints to prevent leakage, and nail the edges of abutting sheets to the same stud or blocking with sixpenny nails not more than 8 in. apart. Where rustication occurs, construct horizontal plywood joints behind a rustication strip. Otherwise, place horizontal joints at the same respective elevations in all portions of the structure. Where vertical rustication occurs, construct vertical joints in the lining behind a rustication strip. Otherwise, keep vertical joints to a minimum, butted tightly together and sealed with crack filler as the plywood is nailed in place.

(g) Steel Forms Which Remain in Place.

(1) Installation. The surface in contact with concrete shall be smooth and free of surface irregularities. Ensure that working drawings specify the grade of steel, the physical and sectional properties, and a clear indication of where the forms are supported by steel beam flanges subject to tensile stresses.

Do not weld form supports to flanges of steel that are not considered weldable or to portions of flanges that are subject to tensile stresses.

Welding and welds per AWS Bridge Welding Code pertaining to fillet welds.

Unless otherwise specified, use steel forms between stringers to support bridge deck concrete, except where a longitudinal deck construction joint is located between stringers.

(2) Procedure Check and Inspection. Remove at least one section of the forms at a location and time selected by the Engineer from each span of each bridge in the Contract. If the bridge has a longitudinal joint, remove a form on each side of the joint from each span. Do this as soon after placing the concrete as practical to provide visual evidence that the concrete mix and the placement procedures are obtaining the desired results. Remove an additional section if the Engineer determines that there have been any changes in the concrete mix or in the placement procedures that warrant additional inspection.

At locations where sections of the forms are removed, replacement of the forms will not be required, but the adjacent metal forms and supports shall be repaired to present a neat appearance and ensure their satisfactory retention. As soon as the form is removed, the concrete surfaces will be examined for cavities, honeycombing, and other defects. If the Engineer finds irregularities but determines that the irregularities do not justify rejection of the work, repair the concrete as directed.

Give the concrete an ordinary surface finish as specified in Section 414.03.07(a). If the concrete where the form is removed is unsatisfactory, remove additional forms, as necessary, to inspect and repair the slab. Modify the method of construction as required to obtain satisfactory concrete. Remove all unsatisfactory concrete and replace or repair as directed.

Provide facilities required for the safe and convenient conduct of the Engineer's inspection procedures.

(h) Steel Forms Which Do Not Remain in Place. The contact surface shall be smooth and free of bolts, bolt heads, nuts, rivet heads, welding seams, and surface irregularities. Forms that produce unacceptable results will be rejected, and shall not be reused.

(1) For Round Columns and Piers. Use steel forms that are at least 10 gauge, have a minimum number of horizontal joints, and are column height.

(2) For Pier Caps and Crash Walls. Prefabricated girder type steel forms may be used for forming pier caps or crash walls. Use one piece where practical for each element of these forms including side, bottom, and end. Arrange splices to provide a symmetrical pattern.

(3) For Reinforced Concrete Box Culverts and Rigid Frames. Use steel forms or forms constructed of wood or composition wood panel sheathing set in metal frames. Steel forms for box culverts and rigid frames shall be at least 10 gauge.

(i) Fiber Column Forms. Fiber column forms shall only be used for round columns. The forms shall produce columns truly round and straight. Protect forms from dampness before concrete is placed. Do not splice fiber forms.

(j) Release Agents. Apply form release compound immediately before placing concrete.

(k) Temporary Supports. Build temporary supports used for centering and falsework on good firm foundations. Unless otherwise provided, ensure that they bear upon strata at or below the frost line unless rock is available. Where required, drive piling for support. Ensure that the strength and bracing of the temporary supports will provide a completed structure having the shape specified. Use jacks or hardwood wedges in connection with the temporary supports to take up settlement either before or during placing of concrete. Set temporary supports to give the structural camber specified, and allowance for shrinkage and settlement. If during construction, any weakness, settlement, or distortion develops, stop the work and remove any masonry affected. Strengthen the temporary structures before resuming. Construct centering to permit gradual and uniform lowering.

(l) Defective Forms. Use an approved device for removing or modifying steel forms which remain in place. Burning is prohibited.

(m) Form Ties. Use approved form ties. Ensure that ties leave no metal closer than 2 in. from the surface. They shall not be fitted with lugs, cones, washers or other devices that act as spreaders within the form or for any purpose that leaves a hole larger than 7/8 in. diameter. When prefabricated steel girder forms are used, use tapered ties no greater than 1-1/2 in. diameter. Ensure that ties are clean and free of rust. When ties are removed, pressure-grout the holes with a non-shrink mortar mixed to match the color and texture of the concrete.

Coat the removable portions of ties with a clear lubricant or other approved material.

During removal of form ties, avoid spalling the concrete on the exposed surface. Do not cut the ties back from the surface.

(n) Form Support Brackets or Devices. Devices attached to previously placed concrete may be used, provided all parts are acceptable. No metal part of an insert, threader, or anchor that remains in the concrete shall be within 2-1/2 in. of the surface. Do not attach brackets or other devices until the concrete is cured and it has attained a compressive strength of at least 3000 psi. All voids left in the concrete after removal of brackets and other devices shall be no greater than 2 in. diameter. Fill them with mortar and finish the surface as specified in Section 414.03.07(a).

(o) Form Removal. For determining the time when falsework and forms may be removed, backfill placed, and when loads may be applied to structures, make an adequate number of concrete test specimens in addition to those required to check the quality of the concrete being produced. After meeting all formwork requirements, remove and dispose of all forms except those specified to remain in place.

Do not use methods of form removal likely to cause overstressing of the concrete. Do not remove forms and their support without approval. Remove supports in a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.

(p) Year Built Marking. Supply the correctly sized forms and molds, and cast the year of completion into each structure, as determined by the Engineer.

414.03.03 Anchor Bolt Placement. Place anchor bolts as specified in Section 408.03.31.

414.03.04 Concreting. Clean forms before placing concrete. Ensure that temporary struts, stays, and braces holding the forms in correct shape and alignment are not buried in the concrete. If faces of completed or proposed excavated footing areas are disturbed prior to concreting, extend the footings to bear on acceptable undisturbed faces at no additional cost to the County.

Place all concrete (except tremie concrete) in the dry.

(a) Foundations. Assume responsibility for any reinforcement fabricated prior to approval of foundations. If bearing material varies more than assumed in design, the Engineer may direct the footing be lowered, raised, or deepened; sub-foundation placed; piles used; or a combination of these methods used to best obtain bearing. If planned footings are changed vertically, revise reinforcing steel as required. Use plain non-reinforced Concrete Mix No. 1 to construct sub-foundation concrete for bridges, retaining walls, and wing walls of box culverts or rigid frames. This concrete need not be vibrated, and the usual curing and cold weather requirements may be reduced to three days. Selected backfill using No. 57 aggregate may be used for sub-foundation for box culvert barrels, headwalls, and miscellaneous structures.

(b) Concrete Placement. Avoid segregation of the material and the displacement of the reinforcement. The use of troughs, chutes, and pipes for conveying concrete more

than 15 ft from the mixer to the forms will be permitted only when approved. Open troughs and chutes shall be metal or metal lined. Where segregation occurs due to steep slopes, equip chutes with baffles.

Where placing operations involve dropping the concrete more than 5 ft, deposit it through a tube made of sheet metal, canvas, or other approved material. Do not use aluminum hoppers or tubes. Keep lower ends as close as possible to the newly placed concrete but not more than 3 ft above the concrete. All tubes shall be at least 6 in. diameter unless otherwise directed. Do not disturb the forms after initial set of the concrete, and do not place any strain on the projecting ends of the reinforcement.

Place concrete in horizontal layers not more than 12 in. high except as provided herein. When less than the complete area of a layer is placed in one operation, terminate it in a vertical bulkhead. Place and vibrate each layer before the preceding layer has taken initial set.

Place concrete in columns and walls in one continuous operation unless otherwise directed. Allow concrete to set at least 12 hours before placing the caps.

Where walls, piers, columns, struts, and posts have horizontal construction joints, do not place succeeding lifts until the lower placement has set for 12 hours.

Prior to subsequent placement, clean all accumulations of mortar splashed upon the reinforcement. Avoid damaging the concrete seal bond near and at the surface of the concrete while cleaning the reinforcing steel.

(c) Superstructure Placement.

(1) Grade Controls for Bridge Deck Slabs. Place bridge deck slabs supported by new stringers to the specified line and grade. Take all necessary precautions, including a check on all new bridge seat elevations as the last order of work before setting stringers. Complete any adjustments resulting from this check before starting additional work. After the structural steel is set, make a final check of elevations of all the steel stringers at points corresponding to those for dead load deflection and finished roadway elevations. Make computations and have them approved. Set controls at proper elevations to produce finished tops of concrete bridge decks that will be true to the planned line and grade of the roadway.

Perform grade control for bridge deck slab replacements as specified in Section 402.03.02.

(2) Superstructure Placement Restrictions. Do not erect the superstructure until the substructure forms have been sufficiently stripped to determine the character of the concrete in the entire substructure. In all spans, use plywood forms to cast the concrete bridge deck slabs outside of the stringers.

Unless otherwise specified, pump concrete for deck slabs whenever the volume of concrete in the pour exceeds 50 cu.yd.

Place all superstructure concrete according to the following schedule:

SUPERSTRUCTURE CONCRETE PLACEMENT SCHEDULE		
DATES	BEGIN CONCRETE PLACEMENT AFTER	FINISH BURLAP PLACEMENT BEFORE
May 15 - June 15	7:00 PM	11:00 AM
June 16 - Aug. 14	9:00 PM	7:00 AM
Aug. 15 - Sept. 15	7:00 PM	11:00 AM
Sept. 16 - May 14	No time restrictions	

Do not place or work superstructure concrete in any manner when the temperature in an unshaded location at the placement site is above 80 F. Use floodlighting when existing light is less than 20 average horizontal foot-candles over the construction area.

Submit a Situation Plan showing the locations and aiming of floodlights. After reviewing this plan, the Engineer will witness a test of the floodlighting system at the proposed construction area. The floodlighting system shall be capable of maintaining 20 foot-candles without producing a glare on traffic. Floodlighting systems shall be as approved. When portable generators are used, have an emergency backup system available at all times on the job site.

(3) Rate of Concreting for Bridge Deck Slabs. Make provisions to ensure that the placement rate of concrete is at least 35 cu.yd./hour per crew. Under special circumstances, the Engineer may give written approval to lower this requirement.

Submit evidence of an adequate source of concrete and placing and finishing equipment capable of meeting the minimum rate of placement while providing the intended quality finish. Submit this evidence at least one week prior to the proposed placement of the bridge deck slab.

Place concrete in slab spans in one continuous operation and in one layer for each span.

Do not mound concrete on forms supported by beams, stringers, or girders. Distribute the concrete to a depth not exceeding the planned slab thickness plus 6 in. before spreading, consolidating, and finishing.

Follow the placing sequence in the numerical order specified without modification. Allow at least 40 hours between the completion of one placement and the start of the next numbered placement.

(d) Box Culverts. If the top slab is the riding surface of the roadway, place as specified in Section 414.03.04(c). Construct box culverts by casting in place or use precast reinforced concrete box culvert sections. Whichever method is indicated in the Contract Documents, the alternate method may be used unless otherwise specified. However, all time constraints such as maintenance of traffic, curing, and completion date shall be met.

If precast sections are used, at least 15 ft of all box culvert ends and all footings, wing walls, headwalls, and toe walls shall be cast in place. Additionally, terminate the precast sections at least 1 ft from footings and toe walls. Show lifting devices on the working drawings. Fill lifting holes with nonshrink grout after the precast units are in place. Set the precast reinforced concrete box sections tightly together, and seal the joints per the manufacturer's recommendations.

Place the bottom slabs of cast in place concrete box culverts for their full depth in one mass or layer and allow to set at least 12 hours before performing any additional work.

Do not place the top slab on single cell box culverts spanning in excess of 10 ft and on multiple cell box culverts until the concrete in the sidewalls has set for at least 12 hours. Construction joints at the top of sidewalls may be omitted in some cases provided the top slabs are placed as follows:

(1) For single cell box culverts spanning 10 ft or less, the sidewall construction joint may be omitted and the top slab placed on the sidewalls, provided the concrete in the sidewalls is allowed to set for approximately two hours before starting to place the top slab.

(2) Regardless of size or number of cells, a written request may be made to place the top slab on the walls of box culverts per (1) above. Submit the proposed plan, including rate and method of placement, and type and size of equipment. With initial approval, the first section of the structure will serve as a demonstration to confirm that there is no excessive cracking or any other detriment, and that satisfactory results will be obtained. After receiving final approval, continue placing the remainder of the box culvert. If at any time the Engineer determines that the results are no longer satisfactory, revert to placing the concrete with the 12 hour delay as specified above.

(e) Forming Concrete Parapets and Median Barriers on Bridges. Either the slip form method or conventional fixed form method may be used. However, do not use the slip form method on bridges maintaining traffic or on parapets when railing is specified.

If the slip form method is proposed, demonstrate ability to produce acceptable results. If the demonstration is unacceptable or acceptable results are not maintained during production, stop the slip form operation, remove the unacceptable work, and modify the construction methods. If construction modifications do not produce acceptable results, use the fixed form method. No additional compensation will be made, and no increase will be made in any Contract price. Nor will any revisions be made to the amount of time to complete the Contract as a result of any required removals, modifications, or changes in the method of placing parapets or barriers.

Notify the Engineer in writing of the proposed method of constructing the parapets and median barriers prior to beginning superstructure work.

The following shall apply to the consideration of slip forming:

(1) Submit evidence of being capable of producing high quality slip formwork. Prior to beginning any slip form construction, submit a detailed work plan. Include the type of equipment, materials, and procedures to be used, subcontractors involved in the construction, key personnel who will be performing the work (names, training, experience, etc.), as well as detailed information on the proposed process to satisfactorily complete the work.

(2) When possible, include reference in the work plan to at least three other similar projects completed in the State of Maryland or surrounding states. As far as practical, these projects shall have been built using the same equipment, personnel, material, and procedures proposed for the project. The Engineer may visit these completed projects to evaluate the acceptability of the finished product.

    If the Engineer determines that satisfactorily slip formed parapets or median barriers have been demonstrated at the locations submitted in the work plan, the requirements of the off bridge test site specified below may be waived, and the first 50 ft of slip forming on the bridge will be considered the test section for the structure. This test section shall be completed and approved prior to placing the remaining portions of parapet or bridge median barrier.

(3) Do not begin any slip forming operation without written approval of the work plan.

    Any proposed revisions or deviations to the approved work plan shall be submitted and approved prior to making the change.

    If (2) above is not met, complete an acceptable off bridge test section prior to placing any portion of the parapet or bridge median barrier. Place the appropriate test section of parapet or median barrier using the same equipment, sensor line, support spacing, material, personnel, and procedures described in the work plan. This test section shall match the structure’s horizontal curve as much as practical,

be at least 50 ft long, and be placed at a location selected by the Contractor near the bridge site.

Place the off bridge test section with vertical irregularities varying upward and downward at least 3/4 in. Demonstrate that the method of slip forming can compensate for this deviation and provide a top of parapet or median barrier that is true to the proposed line and grade and not necessarily parallel to top of bridge deck. This necessitates that the equipment provide for variations in height of vertical face of parapet where it intersects the top of deck slab.

Position, support, and space the sensor line in the same manner that will be used on the bridge decks, with no stakes, holes, etc., used to support it. Use the sensor support spacing recommended by the slip form machine manufacturer and as necessary to maintain the planned line and grade. Use the same rate of slip forming proposed for the bridge. Saw cut joints in the test section at the same approximate spacing and in the same manner as proposed for the finished bridge. The Engineer will evaluate the procedure, material, equipment, and appearance of the test section.

Take three test cores from the test section at directed locations to determine the concrete quality. Honeycombing, sags, tears, or other evidence of poor quality concrete will be cause for rejection of the test section. If the test section is rejected, either place additional test sections until approved, or use the fixed form method.

Do not remove the accepted test section until all parapets or median barriers on the bridges are complete. The slip forming on the bridges will be compared to the approved test section to ensure that similar acceptable structures are being achieved. Following completion and acceptance of all bridge parapets and median barriers, remove and dispose of the off bridge test section.

The entire testing procedure, including removing and disposing of test units, regardless of whether the procedure is approved or rejected, shall be at no additional cost to the County.

When dual bridges are separated by a joint, construct the two parapets that make up the median barrier in separate operations; not simultaneously. Allow the first median parapet section to cure for at least 40 hours prior to constructing the second section of median parapet. The Contractor shall place additional reinforcing steel to brace the parapet against displacement during the extrusion process. A detail will be included in the Contract Documents. The alignment and rigidity of the reinforcing steel will be strictly enforced to ensure that the minimum clearances specified for concrete cover are maintained.

Ensure that an uninterrupted flow of concrete is provided to the slip form machine. Once the slip form machine is set in motion, keep it advancing until it

reaches the proposed stopping point. Organize and schedule the operations in a manner that the next concrete truck will be able to move into position at the slip form machine as soon as the previous truck pulls away without interrupting the machine's uniform advancement. Under no circumstances may the slip forming be operated in a manner that requires removal of a concrete truck from the bridge before moving another truck into place.

Except for the slip form machine and its concrete supply trucks, do not allow vehicular traffic on the bridge while slip forming operations are in progress.

After setting up the slip form machine and placing the sensor wire, perform a dry run of the equipment in the presence of the Engineer. Demonstrate that the parapet or median barrier will envelop preset embedded obstacles and will meet with flush surfaces such as pull boxes, expansion joint plates, etc.

Use concrete of a consistency that the shape of the structure is maintained without support after extrusion. The surface shall be free of surface pits larger than 3/16 in. diameter. Finish the concrete with a light brushing with water only. Finishing with brush applications of grout is prohibited.

If a tear occurs at the top of the parapet or median barrier during the slip forming operation, remove it immediately. Make the repair using acceptable concrete practices. Blend the repair into the barrier to the extent that there is no distinguishable difference in the wall face or top. The rate at which the slip form machine is advanced shall be the same as used on the approved test section.

The shape of the finished parapet or median barrier shall conform to the dimensions specified. The vertical face at the bottom of the concrete safety shaped parapets and median barriers shall not exceed 3-1/2 in. Ensure that the finished parapet or median barrier does not deviate from the proposed grade and alignment in excess of 1/4 in. per 10 ft.

Use a diamond blade to saw cut joints in the finished parapet or median barrier. Make cuts and space joints as specified. The trapezoidal shaped control joints on the outside of parapets will not be required if slip forming is used. Terminate slip form placements only at a parapet control joint. Saw cut the joints as soon as possible after initial concrete set and after the concrete has set sufficiently to preclude raveling during the sawing. Complete the sawing the same day the concrete is extruded and before any shrinkage cracking occurs. Do not leave concrete overnight without saw cutting the joints.

When portions of the bridge are superelevated, produce the configuration specified, i.e., level top surface, wall normal to deck surface, etc.

(f) Temperature Controls. Ensure concrete temperatures meet the requirements specified in Section 902.10. Heat concrete below these temperatures by one of the following methods:

(1) When the method of heated mixing water is used, do not introduce water above 170 F into the mix.

(2) When the method of heated aggregates is used, heat aggregates containing frozen lumps separately. Do not allow materials containing frozen lumps, ice, or snow to enter the mixer. Heat aggregates by steam coils or other dry heat but do not discharge live steam or hot water into them. Do not use a flamethrower or any direct flame.

When the ambient air temperature is below 40 F, raise the temperature of the air in contact with the reinforcement to 40 F prior to placing concrete. When the ambient air temperature is above 70 F and the reinforcement or steel forms are exposed to the direct rays of the sun, cool the reinforcement and forms to 70 F or less by means of a water spray prior to placing concrete.

Do not place superstructure concrete during any period for which abnormal wind or storms are forecast locally by the National Weather Service.

(g) Pumping. Provide approved equipment that is suitable and adequate in capacity for the work. Arrange the equipment so that no vibrations result that might damage freshly placed concrete. Do not use pumps or discharge lines containing parts made of aluminum.

(h) Use of Conveyors. Concrete may be moved from the mixer to its final position by conveyors. Use conveyors in sections, by which concrete is deposited from one conveyor belt onto the next through a hopper. Limit the maximum rise on any individual section of the conveyor to 30 degrees from the horizontal. For concrete slumps less than 2 in., limit the belt travel speed to 900 ft/minute. Decrease this speed for slumps exceeding 2 in. Conveyers used for placement of decks shall be supported by main load carrying members. Place polyethylene or other acceptable material under the conveyor line to contain any spillage.

414.03.05 Depositing Concrete Under Water. Refer to Section 404.03.04. Do not deposit concrete in water or expose it to the action of water before setting, unless specified or approved. Use a tremie pipe that is at least 10 in. diameter and equipped with a watertight plug.

Equip the bottom of the pipe with a baffle or deflector plate. The number and location of pipes will be dependent on the size of the pour. Do not disturb the tremie concrete after placement, nor place successive layers on top until the previously placed concrete has developed the necessary strength as determined by the Engineer. Do not deposit concrete in water that is less than 35 F. When concrete is deposited in water 36 to 45 F, heat the concrete

and place it at a temperature of 60 to 80 F. Do not pump water during concrete placement. Regulate the consistency of the concrete to prevent segregation. Cut down portions of tremie concrete that project more than 6 in. above the top of the as-planned elevation.

(a) Cofferdams. Where cofferdams are used, construct separate forms within the cofferdams except where footing concrete is to be placed against a base of undisturbed material and where the cofferdam is to remain in place and act as the concrete form. In the space between form and cofferdam, keep the water level below the bottom elevation of concrete for at least 12 hours.

(b) Concrete Seals. When feasible, concrete seals for parts of structures under water shall be placed continuously from start to finish to avoid horizontal construction joints. Keep the surface of the concrete as nearly horizontal as practicable at all times to ensure thorough bonding. In these cases, place each succeeding layer of the seal before the preceding layer has taken its initial set. Maintain the slump of tremie concrete between 4 and 8 in. but as close to 4 in. as possible. After dewatering and prior to placing any succeeding layers of concrete, thoroughly clean the top of the foundation seal (tremie concrete).

(c) Concrete Exposed to Saline Water. Do not allow saline water to come in direct contact with the concrete until it conforms to the following table:

CONCRETE IN SALINE WATER	
SALINE CONTENT OF WATER BY WEIGHT IN PARTS PER THOUSAND	SALINE WATER SHALL NOT CONTACT CONCRETE UNTIL FOLLOWING MINIMUM TIME IN DAYS HAS ELAPSED AFTER INITIAL SET*
0 to 10	0
10+ to 15	7
15+ to 20	14
20+ to 25	21
Over 25	30
* The Engineer may approve a waiver in writing.	

Unless otherwise specified, wet cure the concrete for at least seven days while being maintained at 50 F or above.

414.03.06 Consolidation. Except for concrete deposited under water, consolidate concrete by means of internal vibrators. These provisions also apply to precast members or units.

Apply vibration at points uniformly spaced and not further apart than twice the radius over which the vibration is visibly effective.

(a) Internal Vibration. Internal vibrators shall be of an approved type and design. The intensity of application shall visibly affect a mass of concrete of 1 in. slump over a radius of at least 18 in. and have a frequency of vibration of at least 4500 impulses per minute.

(b) External Vibration. External vibrators shall be of an approved type and design. Use external vibration as directed for the following sections: very thin, very heavily reinforced, numerous inserts, or where form surfaces are sharply inclined or battered. For steel grid floors, consolidate filler concrete by applying external vibration to the steel grid.

414.03.07 Finishing Concrete Surfaces. Concrete surfaces shall be finished using one of the following types. However, use an ordinary surface finish as described in (a) below unless otherwise specified.

(a) Ordinary Surface. Immediately following the removal of forms, remove all fins and irregular projections from all surfaces except those that are not to be exposed or not to be waterproofed. On all surfaces, thoroughly clean broken corners or edges and cavities. After having kept them thoroughly moist, point and true them with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Remove any excess mortar, and cure the mortar patches as specified in Section 414.03.09. Carefully tool and clean construction and expansion joints. Ensure that joint filler is exposed for its full length with clean and true edges. Resulting surfaces shall be true and uniform. If the surface cannot be repaired in an acceptable manner, apply a special surface finish as described in (b) below.

(b) Special Surface. Remove fins and projections. Then saturate the surface with water and keep it wet for at least two hours. Thoroughly rub a grout mix of the same proportions as the concrete onto the surface by section using burlap pads or cork floats completely filling all voids, pits, and irregularities. After this grout has dried sufficiently, wipe off the excess using dry, clean burlap. Cure the surface as specified in Section 414.03.09(f), except use a colorless liquid curing compound. Apply this finish to the exterior faces of cast-in-place superstructures and end posts for bridges over highways, and all interior faces of cast-in-place parapets, bridge median barriers, and end posts. Do not apply this finish to members constructed by the slip form method.

(c) Horizontal Surfaces. Finish all upper horizontal surfaces such as the tops of parapets, copings, and bridge seats by placing an excess of concrete material in the forms and striking off even with a wood template. Apply a steel trowel finish to the tops of handrail (posts and caps), headwalls, parapets, wing walls, and barriers.

Finish the bridge seat bearing areas of the substructure masonry to the elevations specified. Check the elevation of each bearing area prior to finishing to ensure conformance. Ensure that each area is level in all directions, and make adjustments prior to the setting of the concrete. Steel trowel the area. Grind bearing areas that are not flat after final finishing to achieve an acceptable surface.

Bearing areas will be rejected whenever the elevation is below that of the surrounding masonry.

(d) Bridge Deck Slabs. Use an approved power operated cylinder or roller finishing machine. Set the finishing machine and transverse construction joints parallel to the nearest support lines (abutment or pier). If the skew angle changes at supports, adjust the angle of the screed accordingly as the finishing machine progresses across the deck slab. Place the concrete so that the front edge of the newly placed concrete is as nearly as possible parallel to the skew of the finishing machine. Place the concrete uniformly but not more than 10 ft ahead of the finishing machine, and not more than 6 in. above the top elevation of the finished deck slab.

Do not span the finishing machine greater than the length recommended by the manufacturer. Combine machines or use two machines in which both use a common rail. The proposed method and the location and anchorage of accessories that will remain in the completed superstructures as a result of this requirement are subject to the approval of the Engineer and shall meet the requirements of Section 414.02.02.

After the concrete has been struck off, check the surface with a long handled 10 ft straightedge operated in a position parallel to the centerline of the structure. The straightedge shall be as light weight as possible to avoid distortion of the slab surface, and have a working face no more than 2 in. wide.

To locate any irregularities in the surface, progress longitudinally in overlapping 5 ft increments and transversely in 2 ft increments.

Finish the concrete surface with a full width strip of burlap, mechanically or manually dragged across the surface.

(1) Slab Grooving. Groove all bridge decks including slab bridges and box culverts built to grade. Start the grooving operation after the bridge deck slab has been cured as specified in Section 414.03.10, and attained a minimum compressive strength as specified in Section 414.03.15. Groove the bridge deck perpendicular to the center line.

Use a mechanical saw device to cut grooves that are 1/8 in. wide, 3/16 ± 1/16 in. deep, and variably spaced from 5/8 to 7/8 in. apart. Extend the grooves across the slab to within 1 ft of the gutter lines. Do not cut across armored joints or any joint in which an existing joint seal may be damaged; stay clear by 2 ± 1 in. on each side. On joints skewed 70 degrees or less, make one pass parallel to the armored joint unless otherwise directed. Remove the residue resulting from grooving operations from all surfaces in an acceptable manner. Leave all surfaces in a washed, clean condition.

(2) Deck Slab Tolerances. Any slabs found to have deficient thickness may be rejected. Limit surface deviation in a transverse or longitudinal direction to 1/8 in. per 10 ft

from a straight line. For vertical curves, limit deviation (from the curve specified) to 1/8 in. per 10 ft in a longitudinal direction. Do corrective work prior to grooving.

(e) Sidewalks and Safety Curbs. Use an approved screed to strike off the concrete to the elevation and slope specified. Wood float the concrete to give a gritty surface free from depressions or high spots. Then edge the joints with the appropriate edging tool. Strip curbs and finish as soon as possible.

(f) Culvert Slabs. When the tops of culvert slabs are the roadway riding surface, finish them according to (d) above. If invert slabs and the tops of culvert slabs are not part of the roadway, or when they are to be overlaid with hot mix asphalt, screed them by hand or machine and apply a float finish. Maintain the surface within 1/4 in. of the grade specified.

The contractor does not need to straightedge culvert inverts if the culvert has a span less than 10 ft.

414.03.08 Curing. These requirements apply to curing of all concrete surfaces except bridge deck slabs or top surfaces of culverts with integral wearing surfaces, which shall be cured as specified in Section 414.03.10.

Start curing as soon as the concrete has set sufficiently.

Keep the surfaces wet, even in areas where there is no ready water supply.

(a) Cure culvert invert slabs and all footings for five days using the method specified in Sections 414.03.09(a),(b),(c), or (d).

(b) Cure vertical surfaces in the forms for seven days. However, the forms may be removed after 24 hours for structural elements 6 ft or less in height, or after 48 hours for structural elements greater than 6 ft high, with the provisions specified herein. Cure the surface as specified in Section 414.03.09(d) for the remainder of the seven day curing period. Do not remove the forms when cold weather protection is required. Forms carrying loads shall remain in place for at least seven days and until the concrete has attained a compressive strength of 3000 psi. Internal bulkheads may be removed after the concrete has been in place for 24 hours, if it is necessary to do so to continue the work without interruption. When a higher strength concrete than specified is used, forms carrying loads shall remain in place for at least three and a half days and until the concrete has attained a compressive strength of 3000 psi.

Fiber column forms may be removed at times specified above, but no later than 10 days after placing concrete.

When parapets or median barriers on structures are formed by the slip form method, begin curing as specified in Section 414.03.09(f) using a fugitive dye liquid membrane-forming compound immediately after the concrete is finished. Immediately after each

joint is saw cut, cure the concrete surfaces for the remainder of the seven days of cure as specified in Section 414.03.09(d).

(c) Cure tops of end walls, end support walls, headwalls, etc., for three days with burlap or cotton mats as specified in Sections 414.03.09(b) or (d), respectively.

(d) Cure horizontal surfaces for seven days as specified in Sections 414.03.09 (b),(c),(d), or (e).

414.03.09 Curing Methods.

(a) Flooding. Structure units that will be below water in the completed structure may be gradually flooded when approved after the concrete is 12 hours old, provided the curing water meets the requirements of Section 921.01. Maintain the water at 35 F or above for the specified curing duration.

(b) Burlap. Use two layers. Overlap successive strips at least 6 in. Place the second layer at least 45 degrees to the first layer, or in lieu of this, the 6 in. overlap of the second layer may be placed midway between the first layer. Thoroughly saturate by immersion in curing water for at least 24 hours prior to placement, and keep it saturated throughout the specified curing duration.

(c) White Opaque Polyethylene Backed Nonwoven Fabric. Use one layer. Overlap successive strips at least 6 in. Thoroughly saturate by immersion in curing water for at least 24 hours prior to placement and keep it saturated throughout the specified curing duration.

(d) Cotton Mats. Use one layer thoroughly saturated with curing water prior to placement and kept saturated throughout the specified curing duration. Keep the material in tight contact with the concrete.

(e) White Opaque Burlap Polyethylene or White Opaque Polyethylene Film. The Contractor shall place white opaque burlap polyethylene sheeting, with the burlap side of the sheeting facing down, on at least one layer of wet burlap. When white opaque polyethylene film is used, place it on at least two layers of wet burlap. Only one layer of cotton mats is required in any usage. These materials may only be used atop the wet burlap or cotton mats on unobstructed flat and reasonably level surfaces.

Lap adjacent mats or sheets at least 1 ft. Bring the ends down around the sides of the concrete being cured and securely fasten to make an airtight seal.

Leave both of these materials in place for the same length of time as required for burlap or cotton mats. These protective coverings need not be wetted down; however, keep the covered burlap or cotton mats wet for the specified duration.

(f) Liquid Membrane. Apply this material according to the manufacturer's recommendation or as directed. Apply by sprayers and keep it thoroughly agitated before and during use.

(g) Water-based Cure and Seal Compounds shall be applied in conformance with manufacturer's recommendations or as directed by the Engineer. The material shall be applied with a sprayer and shall be thoroughly agitated before and during use. Apply two coats to ensure proper surface coverage.

414.03.10 Bridge Deck Slabs. Cure bridge deck slabs and culvert top slabs with integral wearing surfaces, including sidewalks, as specified herein.

Have misting equipment available. Prior to placing concrete, operate the misting equipment for the Engineer to verify that the equipment and procedure are capable of misting the entire placement area without damaging the fresh concrete. Do this at the location of proposed use each day that a deck placement is to be made. Keep ample spare parts, water, fuel, etc. readily available. Keep an approved unit available for backup.

Cover the finished concrete with wet burlap as specified in Section 414.03.09(b). Progress by covering the concrete immediately after the concrete has been finished, but do not leave any portion of the concrete uncovered for more than 45 minutes after placement. Use mist spraying when directed and when the concrete is not covered with wet burlap within 30 minutes after placement. Misting does not relieve the requirement for covering the concrete within the 45 minutes after placement. Once misting is started, continue until wet burlap is complete in place.

After the concrete is covered with wet burlap, cure it as specified in Section 414.03.09(b) for the remainder of the seven day period. Keep the two layers of burlap continuously and uniformly saturated throughout the curing period. White opaque burlap polyethylene sheeting and white opaque polyethylene film or clear polyethylene film shall not be used over wet burlap except when approved for cold weather protection. Use a sufficient quantity of soaker hoses to meet these requirements. Take immediate action to remedy improper saturation of any area throughout the entire curing period.

Provide a sufficient number of experienced personnel and necessary equipment to ensure proper placement, protection, and curing of the concrete according to these Specifications.

Provide temporary troughs, dams, etc., necessary to keep runoff water from reaching any traveled roadway, shoulder, or sidewalk. Submit the proposed methods of controlling runoff water in these areas. Include locations of all troughs and dams, as well as the proposed methods of attaching them to any portions of the structure. Do not weld or drill holes in any portion of a permanent member of the structure.

The approved procedure will be evaluated after it is underway. If any areas are not functioning in an acceptable manner, modify them to satisfy the requirements for retaining and directing the flow of water.

In rehabilitation construction, where the full use of temporary troughs, dams, etc., is not practical, make approved modifications to the provisions for controlling the runoff water.

414.03.11 Construction Joints. Construction joints are permitted only where specified or authorized in writing.

Clean the surface of the hardened concrete and keep it moist until the additional concrete is placed. Use a grade strip to level the top surface of concrete. At chamfers, steel trowel the top surface of the concrete adjacent to the chamfer.

Where a featheredge might be produced at a construction joint, as in the sloped top surface of a wing wall, use an inset form to produce a blocked-in addition to the preceding placement. Ensure that the inset form will produce at least a 6 in. edge thickness of concrete in the succeeding placement.

Place epoxy bonding compound on the surface areas of concrete that existed prior to the beginning of the Contract that will be in contact with new concrete. Apply epoxy bonding compound to the entire face of all deck slab construction joints. Ensure that the surfaces to be coated are clean, sound, and dry. Mix and apply the bonding compound in accordance with the manufacturer's recommendations.

414.03.12 Linseed Oil Protective Coating. Apply to the integral concrete bridge deck slabs, box culvert wearing surfaces, and sidewalks on bridges and box culverts, when the pertinent Linseed Oil Protective Coating item appears in the Contract Documents.

Prior to the application of the linseed oil protective coating, ensure that the concrete surfaces to be treated are cured, dried, and thoroughly cleaned of all dust, dirt, and deleterious material; and that required permanent paint or tape lane markings have been applied on the structures.

If the concrete is wet, allow it to dry for one to two days at a temperature of at least 60 F. If the concrete surfaces are extremely dry, take the following actions as directed, and at no additional cost to the County:

(a) Wet the concrete thoroughly and allow it to dry for one or two days.

(b) Apply a third protective coating at the same rate per gallon as the second coat.

Ensure that the ambient temperature at the time of application is at least 50 F. Ensure that the ambient air temperature following the second application is at least 40 F. Apply two coats on all top surfaces that are not grooved. Apply the first coat at a rate of 40 sq yd/gal. Apply the second coat at a rate of 67 sq yd/gal. On bridge decks and top slabs of box culverts that are grooved, apply the first coat at a rate of 25 sq yd/gal. Apply the second coat at a rate of 45 sq yd/gal. Do not apply the second coat until the first coat is dry. If additional coats are

required, allow at least 24 hours between them. The drying time may be increased as the ambient temperature falls below 70 F.

414.03.13 Cold Weather Protection. Protect and heat concrete after it has been placed when the air temperature in the shade and away from artificial heat drops to 40 F or lower at the time of placing or at any time within the number of days specified herein. Provide protection and heating as follows:

(a) Protect ordinary concrete and maintain a temperature of at least 50 F for at least seven days following placement.

(b) Do not heat concrete to more than 100 F. At the end of the heating period, cool the concrete surfaces to the temperature of the outside air by slowly reducing the artificial heat at a uniform rate until the temperature of the outside air is reached within a 24 hour period.

Have tarpaulins, insulating devices, and other suitable materials at the site to enclose or protect portions of the concrete requiring protection. Have materials as close as possible before placing the concrete, and install them as rapidly as possible to keep exposure to cold weather to a minimum. Where heating is required, completely enclose the spaces to be heated and use approved heaters to keep the temperature at required levels.

Provide a sufficient number of maximum/minimum thermometers to record temperatures in each concrete placement undergoing cold weather protection.

The curing period for all structure concrete requiring cold weather protection shall meet the cold weather protection period except when the normal curing period is longer.

414.03.14 Underpinning Old Foundations. If underpinning is required, perform the work as directed. Restore or lower the old foundations with Mix No. 6 concrete having a maximum slump of 1-1/2 in. Perform excavation and underpinning operations in part section, so as not to remove more than 10 percent of the supporting area under the old foundation at one time. When directed, install underpinning by hand, pneumatic, or pumping processes. The usual curing and cold weather requirements will be deleted for the underpinning with other provisions for curing and protection improvised on the job as may be directed.

414.03.15 Loads on Concrete Structures. Refer to Section 402.03.05. Do not erect structural steel or concrete superstructures on concrete substructures until curing is complete, all forms are removed, and substructure concrete has reached a compressive strength of 3000 psi.

Do not apply loads to any new portion of bridge deck or box culvert built to grade until the final section of that unit of the deck has completed its specified curing period. No vehicles, including heavy construction equipment, will be permitted on any new portion of bridge deck or box culvert built to grade until the concrete cylinder breaks for the final section of that unit of the deck has attained a compressive strength of 4500 psi.

Do not place backfill on any new portion of box culverts not built to grade until the final section of that unit of the slab has completed its specified curing period and the concrete in that section has attained a compressive strength of 3000 psi.

414.03.16 Prevention and Removal of Stains on Concrete. Prevent rust from structural steel, and staining by asphalt materials or any other substance from discoloring any portion of the concrete. Use construction procedures that prevent staining of any of the concrete. Where unpainted structural steel is specified, protect the pier caps, columns, and abutments with a wrapping of reinforced polyethylene or similar material, and leave it in place to prevent staining until after the structure is completed. If any portion of the concrete is stained, remove the stain and restore the original color without damaging the concrete. Do the work as directed and at no additional cost to Baltimore County. Do not use chemical solvents without approval.

414.03.17 Safety Hazards. Perform gas detection in and ventilation of confined spaces as directed by the Engineer.

414.03.18 Defective Work. Within 24 hours of removing the forms, remove and repair defective work as directed.

(a) At the edges of material remaining in place, make a cut perpendicular to the finished surface to the full depth of the material removed, but not less than 1 in. If the removal of defective concrete affects the structural requirements, remove and replace the member as directed.

(b) Clean defective areas.

(c) Coat defective areas with an epoxy bonding compound.

(d) Patch defective areas with concrete mortar or epoxy matching the color, contour, and texture of surrounding concrete as close as possible.

414.04 MEASUREMENT AND PAYMENT. Portland cement concrete structures will be measured and paid for as specified. The payment will be full compensation for all forms and form removal, reinforcement steel, curing and misting, scuppers, grooving, mechanical, and electrical work, all cost incidental to the conducting of tests for oxygen content and presence of gases and applying mechanical ventilation to confined spaces, year built markings, and all material, labor, equipment (including safety equipment), tools and incidentals necessary to complete the work.

The construction of drainage and weep holes, any pipe necessary, expansion material, flashing, dampproofing, membrane waterproofing, epoxy bonding compound, joints and their placement will not be measured but the cost will be incidental to the concrete item. No

deduction in concrete quantities will be made for pipes or conduits having diameters less than 8 in., reinforcement steel, anchors, or any other appurtenances.

414.04.01 Portland cement concrete for ***Footing Concrete***, ***Subfoundation Concrete***, and ***Tremie Concrete*** will be measured and paid for at the Contract unit price per cubic yard.

414.04.02 Portland cement concrete for ***Substructure Concrete for Bridge***, ***Superstructure Concrete for Bridge***, and ***Reinforced Concrete Box Culverts*** will not be measured but will be paid for at the Contract lump sum price. When an Epoxy Coated Reinforcing Steel Bars item for the pertinent structure is included in the Contract Documents as part of a Special Provision, the cost for epoxy protective coated reinforcement steel will be excluded from the Contract lump sum price for ***Superstructure Concrete for Bridge***. When a bridge deck rehabilitation project, other than bridge widenings, requires modification to the backwalls and wing walls and there is no substructure concrete item, the concrete will be incidental to the ***Superstructure Concrete for Bridge*** item.

414.04.03 Wing walls and footings for reinforced concrete box culverts will not be measured but the cost will be incidental to the ***Reinforced Concrete Box Culvert*** item.

414.04.04 Parapets (including end posts) on bridges, wing walls, reinforced concrete box culverts, and retaining walls; or concrete median barriers on bridges and top slabs of reinforced concrete box culverts will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Concrete Parapet*** or ***Concrete Median Barrier*** items.

414.04.05 Parapet and end post modifications on bridges, wing walls, reinforced concrete box culverts, and retaining walls; or concrete median barriers on bridges and top slabs of reinforced concrete box culverts will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Parapet Modification*** item. The payment will also include saw cutting, removal of portions of the existing parapet or end post, drilling, and grouting.

414.04.06 Floodlighting for placement of superstructure concrete will be measured and paid for at the Contract unit price per night used for the pertinent ***Floodlighting*** item. The payment will also include fuel, backup generator, setup, relocation, and removal.

414.04.07 Linseed oil protective coating will be measured and paid for at the Contract unit price per square yard for the pertinent ***Linseed Oil Protective Coating*** item. The payment will be full compensation for all coats including time and cost when a third coat or the application of water is required on dry surfaces.

414.04.08 Cofferdams, temporary supports, or piling will not be measured but the cost will be incidental to the formwork.

414.04.09 Retaining walls will be measured and paid for as specified in Section 450.04, Retaining Walls.

SECTION 415 – LIGHTWEIGHT SUPERSTRUCTURE CONCRETE

415.01 DESCRIPTION. Furnish and install lightweight concrete.

415.02 MATERIALS.

Lightweight Concrete	902.10, Mix 10

415.03 CONSTRUCTION. Conform to Section 414.03 and as specified herein.

Handle lightweight aggregates in a manner that provides a thorough sprinkling of the aggregates during the stockpiling to produce damp aggregate. Sprinkle to obtain uniform distribution of moisture and then permit the aggregates to drain as long as necessary to produce uniform moisture content. Maintain the moisture content as much as practical until the aggregate is used. Add the admixtures to the mix according to the manufacturer's recommendations.

415.03.01 Existing Structures. Remove existing bridge decks according to Section 402.03.01. Note that the deck replacement material may be lighter than the existing deck and the deflection caused by the lighter material will be less than the material removed. Therefore, compute modified rebound figures to be used in lieu of dead load deflections to establish grade controls to produce finished tops of concrete bridge decks that will be true to as planned line and grade.

415.04 MEASUREMENT AND PAYMENT. Lightweight concrete structures will be measured and paid for as specified. The payment will be full compensation for all forms and form removal, reinforcing steel, curing and misting, scuppers, mechanical and electrical work, all cost incidental to the conducting of tests for oxygen content and presence of gases and applying mechanical ventilation to confined spaces, year built markings, and for all material, labor, equipment (including safety equipment), tools, and incidentals necessary to complete the work.

The construction of drainage and weep holes, any pipe necessary, expansion material, flashing, dampproofing, membrane waterproofing, epoxy bonding compound, joints and their placement will not be measured but the cost will be incidental to the lightweight concrete item. No deduction in lightweight concrete quantities will be made for pipes or conduits having diameters less than 8 in., reinforcing steel, anchors, or any other appurtenances.

415.04.01 ***Lightweight Superstructure Concrete*** will not be measured but will be paid for at the Contract lump sum price unless otherwise specified.

415.04.02 Lightweight concrete parapets and median barriers will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Lightweight Concrete Parapet*** or ***Lightweight Concrete Median Barrier*** items.

415.04.03 ***Floodlighting*** will be measured and paid for as specified in Section 414.04.06.

415.04.04 ***Linseed Oil Protective Coating*** will be measured and paid for as specified in Section 414.04.07.

SECTION 416 – REINFORCING STEEL

416.01 DESCRIPTION. Furnish and place uncoated and epoxy coated reinforcing steel.

416.02 MATERIALS.

Grout	902.11(c)
Deformed Steel Bars	908.01
Plain Round Steel Bars for Column Spirals	908.02
Wire Mesh	908.05 and .06
Fusion Bonded Epoxy Powder Coating for Steel and Touch Up System	426 and 917.02
Galvanizing	A 153

416.02.01 Supports. Use approved coated metal, plastic, plastic tipped, or galvanized material. Aluminum is unacceptable. All materials are subject to approval.

For epoxy coated steel, use wire supports completely covered with 1.5 to 9.0 mils of adherent epoxy coating except for minimum necessary contact marks. Hold the reinforcing steel in place with plastic coated tie wires fabricated for this purpose.

Steel bars used as supports for epoxy coated steel shall be coated in the same manner as reinforcing steel.

416.03 CONSTRUCTION.

416.03.01 Working Drawings. Submit working drawings for approval prior to the start of any fabrication, unless otherwise specified. Refer to Section 499.

416.03.02 Plan Dimensions. All dimensions related to reinforcing steel are out to out measurement except the spacing is measured center to center.

416.03.03 Cutting and Bending. Cut and bend reinforcing bars at the mill or shop to the shapes specified before shipment to the job site. Bending shall not be performed in the field except to correct errors, damage by handling and shipping, or minor omissions in shop bending.

Saw or shear epoxy coated reinforcing bars on skewed bridges and in other locations that are specified to be cut in the field; flame cutting is prohibited.

Ensure that all bending conforms to the tolerances specified in the Contract Documents.

416.03.04 Shipping, Handling, and Protection of Material. Ship reinforcing steel bars in standard bundles; tagged and marked in accordance with the provisions of the Code of Standard Practice of the Concrete Reinforcing Steel Institute. Keep bundles intact, undamaged, and properly identified until ready for use.

Bundle coated steel together for shipment using excelsior or other approved materials, and banded using plastic or padded metal bands. Perform all lifting with a lifting beam and multiple supports consisting of a sufficient quantity of straps or slings to prevent abrasion within the bundle from excessive bending or distortion.

Store bundles at the site on suitable blocking or platforms at least 4 in. above any type of surface and vegetation. Keep free from vegetation growth, accumulations of dirt, oil, or other foreign material. Keep blocking sufficiently close to avoid bending and distortion of the bars. Correct any distortion of the bars or damage to epoxy coating as directed. Touch up any damage to the epoxy coating as specified in Section 426.03. Adequately cover epoxy coated bars for protection from ultraviolet rays from the time of delivery when they are to be stored outside for more than 90 days.

416.03.05 Placing and Fastening. Accurately place all reinforcing steel, including dowel bars, in the position specified in the Contract Documents or working drawings, and hold firmly during the depositing and setting of the concrete. Do not insert into the plastic concrete.

Tie all intersections, except alternate intersections need not be tied where spacing is less than 1 ft in each direction. On bridge decks and the top slabs of box culverts, tie all intersections in the top mat of reinforcing. Do not bend reinforcing steel bars after embedment in concrete.

Before placing concrete, clean all mortar from the reinforcing. Do not place concrete until the reinforcing bars are inspected and approved. Approval shall not relieve the Contractor of the responsibility for correcting problems caused by any shifting of the bars during the placement of concrete.

Support reinforcing bars and maintain their distances from faces of forms by using approved templates, blocks, ties, hangers, or other supports. Support bars in the bottom of footings on approved precast concrete blocks with embedded tie wires or suspend in place. Support bars in the tops of footings by using approved supports.

Do not use metal, metal with plastic tipped legs, or plastic chairs against formed surfaces that will be exposed in the finished structure.

The Engineer will perform a final visual inspection of epoxy-coated steel at the construction site after the steel is in place and immediately prior to placing the concrete. Patch designated repair areas using epoxy as specified in Section 426.03. Do not place concrete on a patched area until the patching material has cured for one hour. Allow four hours of normal working time after the reinforcing and forms are in place for the inspection.

416.03.06 Splicing. Furnish bars in the lengths and spliced as specified in the Contract Documents and approved working drawings. Do not perform additional splicing without approval. Make lap splices with the bars in contact and wired together.

Do not weld reinforcing steel or attachments thereto without authorization.

416.03.07 Tying New Concrete into Existing Concrete. On all projects where portions of existing structures are to be used in the finished structure and existing concrete is to be removed, straighten, clean, and protect the existing reinforcing steel to be incorporated in the final structure.

For exposed existing reinforcing steel that is to be incorporated into the final structure:

(a) Cut out any that has lost 20 percent or more of its original cross sectional area as determined by the Engineer. Provide and place a new bar of the same diameter so as to have the minimum required lap at each end of the new bar, or modified as per (c).

(b) Where the required bar lap length is available, use it as a dowel.

(c) Where the required bar lap is not available or limits of concrete removal to achieve bar lap are too great, make a welded or approved mechanical splice.

When existing reinforcing steel extends into an area in which epoxy coated reinforcing steel is required, abrasive blast clean and epoxy coat using the touch up system. Refer to Section 426.

If expected reinforcing steel is missing, or a pattern differing from that shown on the existing Contract Documents is uncovered, contact the Engineer for evaluation.

Where dowel bars are required to tie new concrete into an existing structure, install as specified in Section 403.03.

416.03.08 Substitution. Substitute different size bars only when approved by the Engineer. There will be no additional compensation for substituting larger size bars in lieu of the bars specified.

416.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for cleaning, coating, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Measurement and Payment shall be in accordance with one of the following as specified in the Contract Documents:

416.04.01 Reinforcing steel bars or epoxy coated reinforcing steel bars will not be measured but the cost will be incidental to other pertinent items specified unless a ***Reinforcing Steel Bars*** or ***Epoxy Coated Reinforcing Steel Bars*** item appears in the Contract Documents.

416.04.02 ***Reinforcing Steel Bars*** or ***Epoxy Coated Reinforcing Steel Bars*** will not be measured but will be paid for at the pertinent Contract lump sum price.

416.04.03 ***Reinforcing Steel Bars*** or ***Epoxy Coated Reinforcing Steel Bars*** will be measured and paid for at the Contract unit price per pound based on the original approved overall lengths of bars computed on the basis of the nominal unit weight per linear foot.

416.04.04 Incorporating existing reinforcing steel in the final structure including straightening, bending, splicing, and removal and replacement will not be measured but the cost will be included in the pertinent Concrete item.

SECTION 417 – DAMPPROOFING AND MEMBRANE WATERPROOFING

417.01 DESCRIPTION. Furnish and apply dampproofing and waterproofing to concrete surfaces.

417.02 MATERIALS.

Asphaltic Materials	913.01
Asphalt Primer	913.02
Fabric Saturated with Asphalt for Waterproofing	913.03
Dampproofing and Waterproofing Membrane	913.04

417.03 CONSTRUCTION. Apply dampproofing and waterproofing using asphaltic materials, primers, and fabric; or by the roll or sheet method as specified in Section 417.03.07.

417.03.01 Storage. Store waterproofing fabrics and membranes in a dry protected place. Keep containers of asphalt materials closed when not in use.

417.03.02 Surface Preparation. Do not apply dampproofing or membrane waterproofing until curing is complete and surfaces are protected from the cold. Ensure that all surfaces are dry, smooth, and free from projections and holes.

When dampproofing and membrane waterproofing are both specified for application, apply the membrane waterproofing first. Do not apply dampproofing or membrane waterproofing when the temperature is less than 40 F.

417.03.03 Dampproofing. If asphaltic coatings are used for dampproofing, use two prime coats and one seal coat. Apply dampproofing to the following concrete surfaces that will be in contact with backfill:

(a) Rear face of abutments and abutment wing wall stems.

(b) Rear faces of headwalls and wing walls for pipes 36 in. in diameter or larger and for culverts.

(c) Rear face of retaining wall stems.

(d) The following areas pertain to reinforced concrete box culverts:

(1) Top of top slabs when not built to grade.

(2) Entire outside surfaces of side walls.

(3) Additionally, bottom of bottom slabs of precast units.

417.03.04 Waterproofing. If asphaltic coatings are used, use a prime coat, three mop coats, and two layers of fabric.

Apply waterproofing to construction joints that are next to backfill above normal water surface when backfill is on one side and atmosphere on the other side. Apply a width of at least 16 in., centered on the joint.

417.03.05 Application of Dampproofing. Confine coatings to the areas to be covered. Prevent coating of parts of the structure exposed to view in the completed structure. Apply dampproofing to the full face of all contraction joints.

Apply the dampproofing according to the manufacturer's recommendations. When no recommendations are provided, apply the dampproofing material to the cured, cleaned, and dry surfaces as follows:

(a) Paint with two coats of primer for absorptive treatment at a rate of 1/8 gal/sq yd per coat. Do not apply the second coat until the first coat has thoroughly dried. Do not heat this material.

(b) After the second prime coat has thoroughly dried, apply one seal coat by brush or roller at a rate of 1/8 gal/sq yd. When necessary, this material may be heated, but not in excess of 150 F.

417.03.06 Application of Membrane Waterproofing. Coat the cured, cleaned, and dry surfaces with a prime coat. Cover with mop coats and layers of fabric.

Coating Procedure. Coat with a primer at a rate of 1/8 gal/sq yd. Apply the prime coat 24 hours in advance of applying any mop coats and ensure that it is dry before applying the first mopping. Do not heat the primer.

Heat asphalt for mop coats to a temperature between 300 and 350 F. Stir frequently to avoid local overheating. Provide heating kettles equipped with thermometers.

Begin the waterproofing at the low point, so that water will run over and not against or along the laps.

Make the first strip of fabric half width. Make the second full width, lapping the full width of the first sheet. Make the third and each succeeding strip thereafter full width and lapped so that there will be two layers of fabric at all points and three layers with laps not less than 2 in. wide at edges of strips. Make all laps at ends of strips at least 12 in. wide. Thoroughly seal down the cloth at all laps.

Beginning at the low point, mop a section 20 in. wide for the full length of the surface with the hot asphalt. Immediately after the mopping, press the first strip of fabric into place eliminating all air bubbles. Mop this strip and an adjacent section of the surface to a width equal to slightly more than half the width of the fabric, and press a full strip and a full width of the fabric into place as before. Mop the forward or upper half of this second strip and mop an adjacent section of the concrete surface with hot asphalt. Apply the third strip of fabric shingled on so as to lap the first strip at least 2 in. Continue this process until the entire surface is covered. Give the entire surface a final mopping of hot asphalt. Ensure that there is a complete coating of asphalt between all layers of fabric.

In all cases, ensure that the mopping on concrete covers the surface so that no gray spots are visible, and on cloth is sufficiently heavy to conceal the weave. Apply asphalt at the rates of 1.2 gal/sq yd on horizontal surfaces and 1.4 gal/sq yd on vertical surfaces. Regulate the work so that at the close of a day's work, all cloth in place has received the coatings required for that stage of completion.

417.03.07 Roll or Sheet Waterproofing Membrane. An alternate system of waterproofing or dampproofing consisting of rolls or sheets of membrane material may be used in lieu of the above coatings. Apply the rolls or sheets according to the manufacturer's recommendations.

417.03.08 Membrane Care. At the edges of the membrane and at points punctured by appurtenances such as drains or pipes, flash it in an acceptable manner to prevent water from getting between the waterproofing and the waterproofed surface. Repair any damage to the membrane. Extend repairs beyond the outermost damaged portion, and extend the second ply at least 3 in. beyond the first.

417.04 MEASUREMENT AND PAYMENT. Dampproofing and membrane waterproofing will not be measured but the cost will be incidental to other pertinent items specified.

SECTION 418 – PNEUMATICALLY APPLIED MORTAR

418.01 DESCRIPTION. Remove deteriorated concrete, and furnish and place pneumatically applied mortar.

418.02 MATERIALS.

Curing Materials	902.07
Reinforcing Steel	908.01, 908.02, and 908.08
Anchor Bolts	909.06
Water	921.01

Use Type II cement meeting the requirements of Section 902.03, and furnish in the original 94 lb paper sacks supplied from the cement manufacturer.

Use fine aggregate meeting the Fine Aggregate-Portland Cement Concrete requirements of Section 901.01. Ensure that the maximum moisture content does not exceed 6 percent by weight.

Pneumatically applied mortar shall have a 28 day compressive strength of 5000 to 9000 psi. Ensure that all mixes are approved prior to starting work.

418.02.01 Test Panels. When specified, prepare and cure test panels of various mix combinations, admixtures, and materials. Prepare one test panel for every 100 cu.ft. of mortar in place. Prepare additional test panels as directed. Panels shall be 36 in. square and 8 in. deep. Include the same reinforcing as the structure in at least half of each panel. Each application crew shall fabricate a separate panel using the equipment for each mix design, and in each shooting position encountered.

Core each test panel and deliver the cores to the Laboratory for testing. Cores shall have a diameter of at least 4 in. and be at least 8 in. long. Cores will be tested in compression at 7, 14, and 28 days. Core strength correction will be per T 24.

The Engineer will examine the cut surface of each specimen. Expose additional surfaces by sawing or breaking the panel when necessary to check soundness and uniformity of the material. All cut or broken surfaces that are not dense and free from lamination and sand pockets will be rejected.

418.03 CONSTRUCTION. Submit the proposed methods of protecting the public against injury and damage from demolition operations. When required protective shields shall meet the requirements of Section 402.03.01.

Provide safe access to all areas of the existing structure to be repaired. Prior to the start of any repair work, conduct a thorough inspection in the presence of the Engineer. The purpose of this inspection will be to identify the location and extent of concrete deterioration and repair. The Engineer will establish the extent of removal and determine when sound concrete is encountered.

Restrictions. Wait at least 72 hours after completing repairs to a section of a stringer or pier before chipping on any section that has a common side or point.

If at any time an area is identified as having deteriorated concrete beyond the following limits, immediately stop work in these areas. The Engineer will notify the Bureau of Engineering and Construction, Design Division, Structural Design Section. Do not resume work until after obtaining approval from the Structural Design Section:

(a) More than 6 in. beyond the original finish surface.

(b) More than 3 in. beyond the reinforcing steel.

(c) More than 1 in. beneath the bearing.

418.03.01 Equipment. Ensure that all equipment is calibrated and capable of thoroughly mixing all material.

Use a self-cleaning mixer capable of discharging all mixed material without any carry over from one batch to the next. Clean the mixing equipment at least once a day.

Ensure that the air compressor has ample capacity to maintain a supply of clean, dry air adequate to provide the required nozzle velocity for all parts of the work, while simultaneously operating a blowpipe for cleaning away rebound.

Ensure that the air and water pressure are constant and do not pulsate.

418.03.02 Storage. Store and handle cement as specified in Section 902.01. Store sand to prevent segregation or contamination of the material.

Store all reinforcing bundles at the site on suitable blocking or platforms at least 4 in. above all type of surfaces and vegetation. Keep the reinforcing free of dirt, oil, grease, paint, and other foreign matter.

418.03.03 Surface Preparation. Remove deteriorated areas of concrete to sound concrete with no more than a 30 lb chipping hammer. Continue chipping to at least 1 in. behind the reinforcing steel and until there is no sudden change in the depth of the cavity. Provide a ½ in. deep saw cut perimeter having a shoulder perpendicular to the surface of the structure for a depth of at least 1 in.

After the Engineer has determined that it is sound, abrasive blast the cavity surface. Just prior to applying the mortar, thoroughly clean all surfaces followed by wetting and damp drying.

Contain all blast waste and loose concrete, and promptly remove it to an approved disposal site. Keep blast waste and loose concrete out of waterways.

418.03.04 Reinforcement. If sound concrete is encountered before the reinforcing steel is exposed, remove sound concrete to a depth of 1 in. behind the reinforcing steel. If sound concrete is found within 3-1/2 in. of the proposed finished surface, stop the removal and dowel additional No. 4 reinforcing bars installed at 12 in. center to center horizontally and vertically, 2 in. clear of proposed finished surface. Dowel per Section 403 except use any type grout specified in Section 902.11.

Abrasive blast all exposed existing reinforcing steel that will be incorporated in the new work to a near white finish to remove all rust, dirt, scale, and loose concrete. Cut out reinforcing bars that have lost 20 percent or more of their original dimension. Weld new bars in their place. Dual bars of equivalent or greater section may be used. Weld new reinforcing steel to existing reinforcing steel as specified. The Engineer will establish if reinforcing steel is to be reused or replaced.

In addition to the reinforcing steel, reinforce repaired areas with wire mesh.

For anchoring reinforcing to masonry surfaces, set at least 3/8 in. diameter expansion bolts in drilled holes, or set plain round No. 4 bars in approved dry packed mortar tightly driven in drilled holes. Ensure that drilled holes are at least 3 in. deep. All bolts and bars shall be set in solid masonry (not in mortar, joints, or cracks) and have heads or hooks on their outer ends. Where approved, mesh may be wired to existing reinforcing without the use of expansion bolts.

Cut mesh in sheets of proper size. Bend the separate sheets over templates to follow the outlines of the member or surface to be covered. Securely hold in a uniform position by tying to the bolts or bars with 14 gauge black annealed wire. Space ties at no more than 12 in.

Overlap adjacent sheets of mesh at least two squares. Tie them together with a 14 gauge black annealed wire at intervals not exceeding 18 in.

418.03.05 Guides. Use sufficient guides to obtain the full thickness of mortar specified and to ensure uniform and straight lines.

418.03.06 Mixing and Screening. Uniformly dry mix the cement and sand in a batch-mixing machine. Discard mixed materials not applied within one hour. After the materials are dry mixed and before being charged into the placing machine, pass the mixture through a 3/8 in. screen.

418.03.07 Application. Build up each layer by several passes of the nozzle over the working area. Ensure that the mixture emerges in a steady, uninterrupted flow. Should the flow

become intermittent for any cause, direct it away from the work until it becomes constant. Hold the nozzle perpendicular to the application surface, and at a distance from the work as required for obtaining best results for the conditions. When shooting through reinforcement, hold the nozzle at a slight angle from perpendicular to permit better encasement.

For vertical surfaces, begin application at the bottom. Ensure that the first layer completely embeds the reinforcement.

Do not work rebound back into the construction, nor salvage it to be included in later batches.

Do not permit rebound and overspray to fall into waterways. Dispose of this material in an approved disposal site at no additional cost to the County.

When a layer of pneumatically applied mortar is to be covered by a succeeding layer, ensure that it has taken its initial set prior to proceeding. Then remove all laitance, loose material, and rebound by brooming. Use abrasive blasting to remove any laitance that has taken final set, and clean the surface with an air water jet. In addition, the Engineer will sound the surface with a hammer for hollow sounding areas that indicate rebound pockets or lack of bond.

418.03.08 Curing and Cold Weather Protection. Refer to Section 414. Keep mortar continuously wet for at least seven days after application. Liquid membrane forming compound will be permitted with prior approval.

418.03.09 Finishing. Finish the area of repair to match the existing structure.

418.04 MEASUREMENT AND PAYMENT. ***Pneumatically Applied Mortar*** will be measured and paid for at the Contract unit price per cubic foot of mortar in place. The payment will be full compensation for inspections, removal of existing concrete, abrasive blasting, and furnishing all cement, sand, water, test panels, drilled holes, reinforcing bars and wire mesh, mortar, expansion bolts, cores, storage, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 419 – LATEX MODIFIED CONCRETE OVERLAY FOR BRIDGE DECKS

419.01 DESCRIPTION. Remove the specified amount of the existing bridge deck mechanically or through hydromilling, remove additional areas of deteriorated concrete, clean surface areas to be overlaid, replace deteriorated reinforcing steel, and place latex modified concrete (LMC).

Restrictions. Do not place LMC between December 1 and April 30. Do not remove any portion of existing bridge deck that will not be overlaid and cured in accordance with these restrictions.

419.02 MATERIALS.

Fine Aggregate	901.01
Coarse Aggregate	901.01, Size No. 7
Portland Cement Type I	902.03
Concrete for Patching	902.10
Latex Modified Concrete	902.13
Reinforcement	908
Water	921.01

419.03 CONSTRUCTION. Dispose of removed material at an approved spoil area.

419.03.01 Equipment. Ensure that all proposed equipment meets the requirements specified herein, and is approved.

Deck Removal Equipment.

(a) Existing Wearing Surface Removal. This equipment is only required when the existing bridge contains a hot mix asphalt wearing surface. Provide equipment that is capable of removing the wearing surface without damaging armored joints that are to remain or the existing concrete surfaces beyond the specified minimum removal depth. When pavement breakers are proposed, use broad faced chisel blades operated at a slight angle with the horizontal to peel the wearing surface off.

(b) Deck Surface Removal. Power operated mechanical type and high pressure water jet type equipment shall be capable of uniformly removing the specified minimum depth from the existing concrete surface.

(1) Mechanical Type. This equipment is limited to depths not closer than 1/2 in. from the top of the existing reinforcement.

When additional removal is required, use high-pressure water jet, power driven hand tools, or hand tools.

(2) High Pressure Water Jet. This equipment may be used to any depth above and below the reinforcing steel. Control the runoff water to keep it from reaching any traveled roadway, waterway, or any other designated area. Insufficient means of controlling runoff water or the concrete removal depth may be cause for rejection of this equipment. When this is the case, revert to the mechanical type, power driven hand tools, or handchipping at no additional cost to the County. However,

only revert to the mechanical type equipment for removal of the specified minimum depth when the specified minimum depth is at least 1/2 in. above the existing reinforcement.

(c) Power Driven Hand Tools. Use this equipment for removal of unsound concrete and for removal deeper than 1/2 in. above the top of existing reinforcement. This equipment is permitted with the following restrictions:

(1) Do not use pavement breakers heavier than nominal 30 lb class.

(2) Do not operate pavement breakers or mechanical chipping tools at an angle greater than 45 degrees measured from the surface of the deck.

(3) Do not use chipping hammers heavier than a nominal 15 lb class for concrete removal beneath any reinforcing bars.

(d) Hand Tools. Use hand tools such as hammers and chisels for removal of remaining particles of unsound concrete from beneath any reinforcing bar or to achieve the required depth.

(e) Abrasive Blasting. Provide equipment capable of removing rust scale and old concrete from reinforcing bars and of removing small chips of concrete partially loosened by the removal operation.

LMC Proportioning and Mixing Equipment. Equipment used for mixing shall be self-contained, mobile, continuous mixing, and shall be:

(a) Self-propelled and be capable of carrying sufficient unmixed dry bulk cement, sand, coarse aggregate, latex modifier, and water to produce at least 6 cu yd of concrete. Do not store aggregate in the mixing equipment overnight.

(b) Capable of positive measurement of cement being introduced into the mix, have a recording meter visible at all times, and be equipped with a ticket printout that indicates the quantities being mixed.

(c) Calibrated to accurately proportion the mix. Certification of the calibration by an approved testing authority will be accepted as evidence of the accuracy if the yield is shown to be true within a tolerance of 1.0 percent in conformance with MSMT 558.

(d) Capable of providing positive control of the flow of water and latex emulsion into the mixing chamber. Water flow shall be indicated by flow meter and be readily adjustable to provide for minor variations in aggregate moisture.

(e) Capable of being calibrated to automatically proportion and blend all components of indicated composition on a continuous or intermittent basis as required by the finishing operation. It shall discharge mixed material through a conventional chute directly in front of the finishing machine.

(f) Capable of spraying water over the entire placement width as it moves ahead to ensure that the surface is wetted to receive the LMC.

Placing and Finishing Equipment. The combination of labor and equipment for proportioning, mixing, placing, and finishing LMC shall meet the following minimum requirements except when otherwise specified:

TOTAL OVERLAY AREA PER BRIDGE sq.yd.	MINIMUM OVERLAY RATE PER HR cu.yd.
0-328	1.0
329-492	1.5
493-656	2.0
over 656	2.5

(a) Placing and finishing equipment includes hand tools for placement and brushing in freshly mixed LMC mortar and for distributing it to approximately the correct level for striking off with the screed.

(b) Use an approved finishing machine for finishing all areas of work. The finishing machine shall be self-propelled and capable of forward and reverse movement under positive control. Provisions shall be made for raising all screeds to clear the screeded surface for traveling in reverse. Use a rotating cylinder type finishing machine. It shall span the placement transversely, and be equipped with one or more rotating steel cylinders, augers, and vibratory pans.

(c) The finishing machine shall be designed so that when LMC is being mixed and placed under normal operating conditions at the minimum rate, the elapsed time between depositing the LMC on the concrete deck and final screeding does not exceed 10 minutes.

(d) Ensure that construction is supervised by the LMC mixtures representative or as directed by the Engineer.

419.03.02 Deck Removal and Repairs. Remove material to the specified limits. The Engineer will inspect the entire exposed portion of the deck and determine if any repairs are required including the type and extent of the repair. Use power driven hand tools, hand tools, or high-pressure water jet to remove deteriorated areas of deck down to sound concrete. After removing all deteriorated concrete, remove all rust, oil, or other foreign materials detrimental to achieving bond, followed by abrasive blasting, and air blast or vacuum as determined by the Engineer.

Repair any extraneous damage to the existing bridge that the Engineer deems to have been caused by the removal operations, at no additional cost to the County.

If the Engineer determines that the remaining concrete is deteriorated beyond the specified depth of scarification or determines that extraneous material has been removed beyond the specified depth during the scarification process that is not due to Contractor error, make revisions to achieve the new required depth of removal. This additional work will be measured and paid for according to Section 419.04.

Regardless of the depth of removal of existing concrete, place the LMC to the specified elevation and grade.

Existing reinforcing steel utilized in the finished deck shall meet the requirements given in Section 416.03.07, except thoroughly clean these bars by abrasive blasting. Where the bond between existing concrete and reinforcing steel has been destroyed, or where more than half the diameter of the steel is exposed, remove the concrete adjacent to the bar to a depth that will permit concrete bond to the entire periphery of the exposed bar. Ensure that this clearance is at least 1 in. unless lower bar mats make it impractical. Take measures to prevent cutting, stretching, or damaging exposed reinforcing steel.

Keep all areas from which unsound concrete has been removed free of slurry produced by hydromilling of concrete in adjacent areas. Plan the work so that this slurry will drain away from open areas. Remove slurry from prepared areas before proceeding with the surface preparation.

Repair spalled concrete, voids, and other defects that are located within the proposed LMC overlay area according to the methods specified herein. Each repair includes the removal of the additional deck material, all handchipping, and filling the repair area voids with LMC overlay while applying the overlay.

(a) For cavities less than 1 in. deep, no additional work required.

(b) For cavities 1 to 3 in. deep, place wire fabric as specified in Section 418.03.04. Wire fabric is not required for repair areas less than 2 sq ft.

(c) For cavities over 3 in. deep but not full depth, meet the following:

(1) If the repair crosses a proposed construction joint, provide a 1-1/2 x 3 in. keyway at the vertical joint.

(2) Furnish and install temporary protective shields as specified in Section 402.03.01 when the depth of removal reaches half the original concrete deck thickness and deeper removal is anticipated.

(d) For areas where the depth of removal is full depth, meet the following in addition to the requirements of (c):

(1) In large areas, supply forms to enable placement of the LMC overlay and support them by blocking from the stringers.

(2) In small areas, supply forms to enable placement of the LMC overlay. Forms may be suspended from existing reinforcing bars by wire ties.

419.03.03 Surface Preparation. Thoroughly clean the entire surface and abrasive blast before placing the overlay. Use abrasive blasting to clean all reinforcing bars of visible rust and clinging concrete detached from the deck and all areas of concrete against which the overlay is to be placed. Abrasive blasting may be required on the day the overlay is to be placed so that reinforcing bars are free of visible rust, as determined by the Engineer. Abrasive blast within 24 hours of placing the LMC overlay.

Further clean the surface by air blast followed by flushing with water. Prior to placing the LMC overlay, wet the surface and keep it wet for at least one hour. Remove puddles of free water.

419.03.04 Proportioning and Mixing LMC Materials. Mixers shall be clean and the ingredients accurately proportioned.

Mix LMC materials at the site according to the specified requirements for the equipment used. Ensure that the LMC discharged from the mixer is uniform in composition and consistency. Mixing shall enable finishing operations to proceed at a steady pace, with final finishing completed before the formation of the plastic surface film.

419.03.05 Placing and Finishing LMC Overlay. The LMC overlay will be the riding surface of the bridge. Place the top of the LMC overlay to the true as planned line and grade of the roadways. Take all necessary precautions to produce a finished top of LMC overlay that is smooth riding by placing the LMC overlay in a manner that meets the grade of the proposed adjoining portions of the new bridge decks and adjoining roadways.

Place and fasten screed rails in position to ensure finishing the new surface to the required profile. Anchorage for supporting rails shall provide horizontal and vertical stability. Do not treat screed rails with any compound to facilitate their removal.

If not shown on the Contract Documents, the location of longitudinal joints will be determined by the Engineer based on avoiding joints in the vehicular wheel path as much as practical.

Take every reasonable precaution to secure a smooth riding bridge deck meeting the requirements of Section 414.03.07(d). Prior to placement operations, review the equipment, procedures, personnel, and previous results with the Engineer. Inspection procedures will be reviewed to ensure coordination. Include the following precautions:

(a) Completely clean all surfaces for approval prior to placing the LMC overlay.

(b) Brush the LMC mixture onto the wetted, prepared surface. Ensure that all vertical and horizontal surfaces receive a thorough, even coating. Limit the rate of progress so that the brushed material does not become dry before it is covered with additional materials required for the final grade. Remove brushed material that has dried prior to LMC placement, and replace it in an acceptable manner. Dispose of coarse aggregate that accumulates from the brushing operations.

(c) Place the LMC mixture to approximately 1/4 in. above grade and then screed with an approved power operated finishing machine to the specified line and grade. Use a suitable portable lightweight or wheeled work bridge behind the finishing operation. Hand finishing may be required along the edge. Joints shall be edge tooled, except when next to metal expansion dams, curbs, and previously placed lanes.

(d) Separate the screed rails and construction bulkheads from the newly placed material by passing a pointing trowel along their inside face. Make the trowel cut for the entire depth and length of screed rails and bulkheads, after the mixture has stiffened sufficiently. Do not separate metal expansion dams from the overlay.

419.03.06 Curing. Cover the surface of the LMC overlay with a single layer of clean, wet burlap or wet cotton mat as soon as the surface will support it without deformation. Follow immediately with a layer of 4 mil polyethylene film, and cure the surface for 24 hours. After 24 hours, remove the curing material and air cure for an additional 72 hours. With approval, white opaque burlap polyethylene sheeting may be substituted for the polyethylene film, but this material does not replace the wet burlap or wet cotton mat.

419.03.07 Grooving. Groove per the applicable portions of Section 414.03.07(d)(1), but start after the LMC has been cured per Section 419.03.06.

419.03.08 Limitation of Operations. LMC placement includes the applicable deck placement restrictions specified in Section 414.03.04.

No traffic will be permitted on the LMC overlay until the curing of the material is completed and the compressive strength test has reached 3000 psi.

Do not place LMC and concrete adjacent to an LMC surface course less than 96 hours old. This restriction does not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

Do not grind or chip existing concrete pavement within 6 ft of LMC until the LMC has cured for at least 48 hours.

Do not place LMC at temperatures below 45 F. The LMC may be placed at 45 F, if rising temperature is predicted and anticipated for at least 8 hours.

At temperatures below 55 F, the Engineer will require a longer curing period and conformance with applicable portions of Section 414.03.13.

Remove and replace unsatisfactory LMC at no additional cost to the County. Any day during which the curing temperature falls below 50 F will not be counted as a curing day. When during the curing period the curing temperature falls below 35 F, the work may be considered as being unsatisfactory and rejected.

During delays up to one hour, several layers of wet burlap may be used to protect the end of the placement from drying. If the delay exceeds one hour, construct a dam or install a bulkhead and wait 12 hours before resuming placement operations. However, placement may continue provided a gap of sufficient length for the finishing machine to clear the previously placed LMC overlay is left in the lane or strip.

Protect freshly placed LMC overlays from sudden or unexpected rain. Stop all placing operations when it starts to rain. Remove and replace material damaged by rainfall, as determined by the Engineer, at no additional cost to the County.

Do not place linseed oil on LMC finished deck surfaces.

419.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all removing and cleaning, abrasive blasting, air blasting, flushing with water, forming, curing, disposal of material removed, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

419.04.01 ***Removal and Disposal of Existing Wearing Surface from Bridge*** will be measured and paid for at the Contract unit price per square yard for the actual surface area removed from the bridge deck.

419.04.02 Removal to the depth specified in the Contract Documents will not be measured but the cost will be incidental to the pertinent ***Latex Modified Concrete Overlay*** item.

419.04.03 Deck repairs, regardless of the method and depth, will not be measured but the cost will be incidental to the pertinent ***Latex Modified Concrete Overlay*** item.

419.04.04 Furnishing, placing, finishing, and curing of the LMC overlay will be measured and paid for at the Contract unit price per cubic yard for the ***Latex Modified Concrete Overlay*** item. Measurement for the volume of concrete will be based on the meter readings on the mixers dispensing the latex modified concrete excluding the calculated volume of any waste.

419.04.05 ***Repair Bar for Deck Reinforcement*** will be measured and paid for at the Contract unit price per linear foot.

419.04.06 When traffic bearing surfaces are required, supplying and removal of them and any repairs of damage to existing deck will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

419.04.07 Furnishing and installing any formwork required for full depth deck repairs will be measured and paid for at the Contract unit price per square foot for the pertinent ***Formwork for Full Depth Deck Repairs*** item. The measurement will be based upon the exposed opening at the bottom of the deck. The cost for formwork extending beyond these limits will be incidental to the item.

SECTION 420 – PRESTRESSED CONCRETE BEAMS AND SLAB PANELS

420.01 DESCRIPTION. Furnish and place prestressed concrete beams and slab panels, elastomeric bearing pads, bearing plates and other embedded items, all steel strands, jacks, and other required devices. The concrete overlay riding surface for slab panel bridges is included in this work.

420.02 MATERIALS.

Fine Aggregate	901.01
Coarse Aggregate	901.01
Fine Aggregate for Overlay Bonding Grout	901.01, Fine Aggregate/Sand Mortar and Epoxies
Cement	902.03
Admixtures:	
Air Entraining	902.06.01
Retarding	902.06.02 Type D
Water Reducing	902.06.02, .03
Pozzolans	902.06.04, .05
Concrete Overlay	902.10.03, Mix No. 8
Nonshrink Grout	902.11(c)
Reinforcing Steel	908.01
Welded Steel Wire Fabric	908.05
Prestressing Strand	908.11
Elastomeric Bearing Pads	910.02.01
Closed Cell Neoprene Sponge Elastomer	911.10
Fusion Bonded Epoxy Powder Coating for Steel	917.02
Water	921.01
Epoxy Adhesive	921.04
Threaded Tie Rods	A 722

Tie Rod Heavy Hex Nuts	Supplied by tie rod manufacturer; shall provide full tensile strength of tie rod
Concrete Protective Coatings	Contract Documents

420.02.01 Portland Cement Concrete. Ensure that the composition, proportioning, and mixing of concrete produces a homogeneous concrete mixture of a quality that meets the specified material and design requirements.

The required cylinder strength of the concrete at transfer of the tensioning load and the minimum required cylinder strength of the concrete at 28 days will be specified. Include an air-entraining admixture in the concrete mix.

Type G high range water reducing admixtures may only be used if the Engineer determines that the producer can design and show by trial mix that the concrete meets the specified strength requirements and the following:

(a) Slump is not to exceed the admixture manufacturer's recommendation or a maximum of 8 in.

(b) Air content of 5-1/2 ± 1-1/2 percent.

(c) Cement factor of at least 700 lb/cu yd.

(d) Maximum WCM ratio of 0.45.

Testing. The Engineer will take six test cylinders from each member or members cast and cured with the beam as a unit for the purpose of checking the quality of the concrete being produced, for determining the time when forms may be removed, and for determining the time when prestressing forces may be applied to a member.

The manufacturer shall provide metal or plastic molds for all test cylinders. The manufacturer's quality control technician shall make at least three cylinder specimens to be cured under laboratory conditions as specified in R 39 to determine the 28 day compressive strengths. The technician shall make and test the cylinders at the manufacturing site according to T 22 in the presence of the Engineer. A test is defined as the average strength of three companion cylinders.

420.02.02 Reinforcing Steel and Tie Rod Tubes. Except for prestressing strands, all reinforcing steel in and extending from beams and slab panels, and in the concrete overlay shall be epoxy coated.

Tie rod tubes shall consist of corrugated, rigid or semi-rigid type, galvanized steel sheathing, or rigid plastic sheathing.

420.02.03 Debonding Material. Use solid or split plastic sheathing having a thickness of at least 0.025 in. for debonding of pretensioning steel strands.

420.02.04 Joint Sealers. Per the manufacturer's specifications.

420.02.05 Overlay Bonding Grout. Use equal parts by weight of Portland cement and sand, and mix with sufficient water to produce a slurry. Mix to a consistency that provides for application with a stiff brush or broom in a thin, even coating that will not run or puddle.

420.03 CONSTRUCTION.

420.03.01 Working Drawings. Refer to Section 499. Address reinforcing, anchorages, steel strand profiles, lifting inserts, and all other pertinent information.

In cases where methods other than specified are proposed, submit modifications/changes as specified in Section 499. When the Engineer accepts the proposed changes, construct the members accordingly at no additional cost to the County.

420.03.02 Prestressed Concrete Plants. The prestressed concrete manufacturing plant shall be registered and certified under the Precast/ Prestressed Concrete Institute Program. Submit a valid certificate to the Engineer prior to the start of production.

420.03.03 Beds and Forms. Casting beds shall be supported on unyielding foundations. Clean the beds and forms after each use. Prevent accumulation of bond breakers.

Prior to stringing steel strands, inspect the bottom of forms for cleanliness and alignment. Coat the contact surfaces of forms with bond breaker that dries to a surface hardness. Ensure that the coating is dry to prevent contamination of the steel strand.

420.03.04 Meetings. Conduct a pre-pour meeting prior to beginning any prestress concrete work. Ensure a representative of the prestress concrete plant is present.

420.03.05 Protection of Prestressing Steel Strand. Store under shelter and keep it free of deleterious material such as grease, oil, wax, dirt, paint, loose rust, or other similar contaminants. Do not use steel showing corrosion, etching, pitting, or scaling. A light coating of surface rust is acceptable if it can be removed completely from the steel by wiping with a cloth.

Do not store on a surface that contributes to galvanic (or battery-type) corrosion.

Do not use steel strand as a ground for electric welding. Protect it from electric welding sparks.

420.03.06 Reinforcing Steel, Inserts, and Chairs. Place reinforcing steel within the specified tolerances, and secure it to beds and forms using chairs, blocking, or ties. Fabricate cages of bars by tying only. Do not support cages by tensioned strands. Bend tie wire ends into the slab panel. Show the type and placement of inserts on the working drawings.

Except for stainless steel accessories, recess form ties, chairs, and inserts in the concrete by at least 1 in.

420.03.07 Methods of Force Measurement. Use one of the following methods as the primary measuring system. Check it by using one of the other methods as a secondary measuring system:

(a) Curves. Use current stress-strain or elongation curves furnished by the strand manufacturer. An average modulus may be used if acceptable to the Engineer. Provide means for measuring the elongations of the strands to at least 1/8 in.

(b) Pressure Gauges. Use gauges to measure force by the pressure applied to hydraulic jacks. These gauges shall be furnished with dials calibrated with the jacking system.

(c) Dynamometers. Dynamometers connected in tension to the stressing system for the initial force may be used.

Gauging System. Use tensioning systems equipped with accurately calibrated hydraulic gauges, dynamometers, load cells, or other devices for measuring the stressing load to an accuracy of reading within 2 percent. Have a qualified testing laboratory calibrate and issue a certified calibration curve with each gauge. Recalibrate a gauging system whenever it shows erratic results; at intervals not exceeding six months, and when directed. Gauges for single strand jacks may be calibrated by an acceptable and calibrated load cell. Calibrate gauges for large multiple strand jacks, acting singly or in parallel, by proving rings or by load cells placed on either side of the movable end carriage. All jacks and gauges shall be calibrated by an independent laboratory at no additional cost to the County and documentation forwarded to the Engineer.

Provide pressure gauges and dynamometers preferably with full pressure and load capacities of approximately twice their normal working range. Limit loads to within 25 to 75 percent of the total graduated capacity, unless calibration data establishes consistent accuracy over a wider range.

Each gauge shall indicate loads directly in pounds or be accompanied by a chart with which the dial reading can be converted into pounds.

Tensioning systems employing hydraulic gauges shall be equipped with appropriate bypass pipes, valves, and fittings so the gauge reading remains steady until the jacking load is released.

Gauge readings, elongation measurements, and calculations for elongation shall include appropriate allowances for operational losses in the tensioning system due to strand slippage, movement of anchorages and abutments, elongation of abutment anchorage rods, strand rotation, temperature variation, friction, bed shorting, and other forces and influences acting on the strand.

In multiple strand tensioning systems, clean and lubricate the sliding surfaces to minimize friction. Establish a force override (compensatory operational loss correction) for standard strand pattern series.

Thermal Effects. Increase the design prestress force by 0.5 percent for each 5 F ambient temperature below 80 F. No adjustment is required when the ambient temperature is above 80 F. Do not stress steel strands when the ambient temperature is below 40 F. After the steel strands are tensioned, maintain the temperature of the air surrounding the steel strands at 40 F or more until the prestress force is transferred to the concrete.

Control of Jacking Force. Use either manual or automatic pressure cutoff valves for stopping the jacks at the required load. Use automatic cutoffs capable of adjustment to ensure that the jacking load corresponds to the required load. Verify the setting accuracy for the automatic cutoff valves whenever there is reason to suspect improper results and at the beginning of each day's operation.

420.03.08 Stringing Steel Strands. Do not reuse strands containing former vise grip points unless the points are outside the new vise locations. Do not reuse strands that have been draped.

All steel strands shall have the same lay or direction of twist. Use shears or abrasive cutting wheels to cut the ends. Position strands over chairs to eliminate sagging of strands in the bottom rows.

420.03.09 Steel Strand Splices. Only one splice is permitted per strand. For single strand tensioning, the number of strands that may be spliced in each bed is not restricted. For multiple strand tensioning, either splice all strands and adjust the elongation for average slippage, or no splices are permitted.

420.03.10 Steel Strand Vises. Vises shall be capable of anchoring stressing loads positively with minimum slippage and shall be cleaned, lubricated, and inspected between each use. Do not use grips that show wear or distortion, or that allow slippage in excess of 1/4 in. Clean and inspect the full set of vises before starting each prestressing operation.

A maximum permissible time of 72 hours shall be observed for holding tensioned strands in the bed before placing concrete.

420.03.11 Wire Failure in Steel Strands. Remove and replace any seven wire steel strand that contains a broken wire. Check all strands for wire breakage before placing concrete.

420.03.12 Pretensioning. Apply the specified total load to each strand. Apply the load as a total of two loading stages. The initial load shall straighten the strand, eliminate slack, and provide a starting or reference point for measuring elongation.

Limit the initial load to 10 percent of the specified tensioning force. The Engineer shall pre-approve any initial loading exceeding 10 percent (i.e. multiple bed casting). Measure the initial load within a tolerance of ± 100 lb. Do not use the initial elongation measurement to determine the initial force.

In all stressing operations, keep the stressing force symmetrical about the vertical axis; however, in tensioning single strands, the initial and final loads may be applied in immediate succession to each strand.

Use jack mounted pressure gauges as the primary system of force measurement for the final tensioning of straight single strands. Check elongation against pressure gauge readings on all strands. Check vise slippage. The computed elongation, including operational losses and equivalent elongation for the initial tensioning force, shall agree with the pressure gauge reading within 3 percent.

Use jack mounted pressure gauges as the primary system of force measurement for the final tensioning of multiple strands. For uniform application of load to the strands, the position of the face of the anchorage at final load shall be parallel to its position under initial load. Verify parallel movement by measurement of equal movement on opposite anchorage sides and by checking the plumb position of the anchorage before and after final load application. Check vise slippage.

After stressing the steel strands as specified and placing all other reinforcement, cast the concrete member to the specified length. Maintain strand stress between anchorages until the concrete has reached the specified compressive strength.

420.03.13 Steel Strand Tensioning. In all methods of tensioning, measure the stress induced in the strands both by jacking gauges and by elongation.

If any jack or gauge appears to be giving erratic results or gauge pressures and elongations indicate materially different stresses during manufacturing, recalibration will be required. Provide means for measuring elongation to the nearest 1/8 in.

For differences in indicated stress between jack pressure and elongation of up to 5 percent, place the difference so that the discrepancy will be on the side of a slight overstress rather than understress. For discrepancies in excess of 5 percent, carefully check the entire operation and determine the source of the discrepancy before proceeding.

Thoroughly seal split plastic sheathing for debonded steel strands with tape prior to placing concrete.

Cut all pretensioned steel strands flush with the end of the member. Where the end of the member will not be covered by concrete, clean the exposed ends of the strands and the concrete face. Use wire brushing or abrasive blast cleaning to remove all dirt and residue that is not firmly bonded to the metal and concrete surfaces. Coat the strands and the concrete face with a protective coating as specified. Work the protective coating into all voids in the strands.

420.03.14 Surface Finish and Curing. Rough finish the top surface of all members with a rake, wire brush, or other approved means to a full amplitude of 1/4 in. Begin initial curing of all members by fogging, wet burlap, or other approved methods as soon as the concrete is hardened sufficiently to withstand surface damage. Continue the initial curing until the concrete has attained its initial set, but at least three hours; however, when a retarding agent is used, continue the initial curing for at least five hours. Following the initial curing, resume curing using an accelerated curing method.

Accelerated Curing. Use one of the following methods to accelerate curing of the concrete:

(a) Low Pressure Steam Curing. Use a suitable enclosure to contain the live steam and minimize moisture and heat loss. Ensure that the concrete has attained initial set before application of the live steam.

Do not permit live steam to be directed on the concrete or the forms so as to cause localized high temperatures. Maintain the temperature of the interior of the enclosure at 80 to 160 F. During initial application of the steam, increase the ambient air temperature within the enclosure at a rate not to exceed 40 F per hour. Hold the maximum temperature until the concrete has reached the required release strength. Maintain the steam temperature and the curing temperature uniformly throughout the extremities of the prestressed member. At the end of curing, reduce the concrete temperature at an average of 40 F per hour.

Ensure that the producer furnishes at least one recording thermometer for each enclosure. If the enclosure is longer than 300 ft, furnish an additional recording thermometer for each additional 300 ft of length or fraction thereof. The temperature at any point within the enclosure shall not vary more than 10 F from that of the recording thermometer or the average of the recording thermometers if more than one is used.

(b) Radiant Heat Curing. Radiant heat may be applied by means of pipes circulating steam, hot oil, or hot water, or by electric heating elements. Provide a suitable enclosure to contain the heat. Minimize moisture loss by covering all exposed concrete surfaces with plastic sheeting or by applying an approved liquid membrane curing compound to all exposed surfaces. Uniformly maintain the heat application throughout the extremities of the member. Apply the same temperature constraints as outlined for low pressure steam curing.

420.03.15 Detensioning.

(a) Slab Panels. Do not transfer the tension force to the prestress slab panel until the concrete strength as indicated by cylinder strengths meets the specified transfer strength. Except to move to storage, ensure that the design strength is met before handling the slab panel or releasing it for shipment.

Prior to detensioning, remove or loosen forms, ties, inserts, hold downs, and other devices that restrict longitudinal movement along the bed, or use a method and sequence to minimize longitudinal movement.

Release prestressing forces using a method that minimizes sudden or shock loading.

Single strand detensioning may be accomplished by heat cutting the strands. The sequence shall maintain prestressing forces nearly symmetrical around the slab panel's vertical axis.

Eccentricity around the vertical axis shall be limited to one strand. Obtain approval of the cutting pattern prior to use.

Multiple strand detensioning may be accomplished by gradually reducing the force applied to each strand equally and simultaneously.

(b) Beams. The schedule for detensioning of beams having deflected steel strands shall incorporate the following:

(1) The manufacturer's sequence of releasing deflected steel strands and uplift points shall be approved.

(2) All hold down devices for deflected steel strands shall be disengaged, and all hold down bolts removed from the beams.

(3) The manufacturer's sequence of releasing the remaining straight steel strands shall be as approved.

All hold down devices may be released prior to release of tension in deflected steel strands if:

a) The weight of the prestressed beam is more than twice the total of the forces required to hold the steel strands in the low position.

b) The weight or other approved vertical restraints are applied directly over the hold down points to counteract the uplifting forces, at least until the release of deflected steel strands has proceeded to a point that the residual uplifting forces are less than half the weight of the beam.

Follow all procedures for releasing prestressing forces of deflected steel strands. Failure to follow these procedures may result in the rejection of the beams.

Adequately separate all beams in storage immediately following removal from the bed to facilitate the repair of surface blemishes and to allow inspection of the finished surfaces.

420.03.16 Camber. During the period of beam fabrication, select a representative number of beams to be known as "Camber Control Beams", subject to approval.

Clearly and permanently identify them so that the camber readings taken as indicated below can be associated with the proper beam.

Take camber readings as follows:

(a) Just prior to prestressing.

(b) Immediately after prestressing.

(c) At weekly intervals thereafter within the three months after casting.

(d) At biweekly intervals, after the three month period expires.

(e) Just prior to shipment from the casting yard to the job site.

(f) Continue camber determinations at these intervals if the beams are stored or stockpiled at the job site.

Furnish two copies of the camber reports prior to erecting the beam.

420.03.17 Tolerances. The tolerances for each beam or slab panel shall be as shown in Tables 420.03.17 A or B, respectively unless otherwise specified:

TABLE 420.03.17 A

PRESTRESSED CONCRETE BEAM	TOLERANCE
Depth (overall)	±1/4 in.
Width (flanges & fillets)	±1/4 in.
Width (web)	±1/4 in.
Length of Beam	±1/8 in. per 10 ft. or 1/2 in. whichever is greater
Exposed Beam Ends (deviation from square or designated skew)	Horizontal ±1/4 in. Vertical ±1/8 in. per ft. of beam height
Side Inserts (spacing between center of inserts and from the centers of inserts to the ends of the beams)	±1/2 in.
Bearing Plate (spacing from the centers of bearing plates to the ends of the beams)	±1/2 in.
Stirrup Bars Average of all bars Individual bar longitudinal spacing	 ±1/2 in. ±1 in.
Horizontal Alignment (deviation from a straight line parallel to the center line of beam)	1/8 in. per 10 ft., max
Camber Differential between adjacent beams of same type and steel strand pattern	1/8 in. per 10 ft. at time of erection or 1/2 in. max
Center of Gravity of steel strand group	±1/4 in.
Center of Gravity of depressed group steel strand at end of beam	±1/2 in.
Position of hold down points for depressed strand	±6 in.
Camber deviation from plan camber, as measured at release or at beginning of beam storage at the fabricating plant	±50% of plan camber or ±1/2 in. whichever is greater.

TABLE 420.03.17 B

PRESTRESSED CONCRETE SLAB PANEL	TOLERANCE
Depth (Overall)	+1/2 in., -1/4 in.
Width (Overall)	±1/4 in.
Slab Panel Length @ center line (based on Design length specified)	±1/2 in.
Horizontal Alignment (deviation from a straight line parallel to the slab panel center line)	¼ in. max.
Horizontal Misalignment of adjacent form sections	½ in. max.
Camber deviation from specified camber, as measured at prestress transfer or at the beginning of slab panel storage at the fabrication plant	±1/2 in.
Location of each strand	±1/8 in.
Center of Gravity of each strand group	±1/4 in.
Stirrup bars (longitudinal spacing)	±1 in.
Longitudinal Position of handling devices	±3 in.
Concrete Bearing Area (variation from plane surface when tested with a straightedge through middle half of slab panel	±1/8 in.
Tie Rod Tubes (spacing between the tube centers and from tube centers to slab panel ends)	±1/2 in.
Tie Rod Tubes (spacing from tube center to slab panel bottom)	±3/8 in.
Threaded Inserts (spacing between the center of inserts and from center of inserts to ends of slab panels)	±1/2 in.
Skew Ends (deviation from designated skew)	±1/2 in.
Vertical Ends (deviation from specified dimension)	±3/8 in.
Camber deviation from plan camber, as measured at release or at beginning of beam storage at the fabricating plant	±50% of plan camber or ±1/2 in. whichever is greater.

420.03.18 Slab Panel Plant Assembly. Before shipping the slab panel units to the job site, assemble all slab panels for the entire bridge width to ensure that there is no misalignment. Any misalignment of the holes will be cause for rejection of the affected slab panels. Do not drill or core holes into the slab panels.

420.03.19 Marking, Handling, Shipping, and Storage. Mark each member with an erection mark for identification, weight marks for beams 6000 lb or more, and inspection stamps. For beams, paint the erection marks on the top surface of the top flange. Do not place markings of any kind on any surface of a beam that will be visible in the completed structure.

Mark slab panels with an individual, consecutive identification mark at a permanently exposed location. The identification mark shall match that shown on the approved working drawings.

Furnish an erection diagram clearly indicating erection marks that show the position of the member in the structure.

Utilize the cast-in-place lifting devices and a sufficient number of cranes and spreader beams whenever the prestress concrete members are lifted.

Furnish copies of material orders and shipping statements. Show the weight of each individual prestress concrete member.

During shipment, ensure that blocking is placed at intervals that will prevent sag and distortion. Ship all members in the upright position, adequately braced and supported to dampen vibrations during transport as shown on the working drawings. Members too long to fit inside of a truck or trailer shall not cantilever beyond the bed more than one quarter of their length. Support members too long to comply with this requirement on dollies, additional vehicles, or other vehicles that will support the long pieces as approved.

Load restrictions are as specified in Section GP-5.10. Do not ship prestress members until approved, at least five days have elapsed since the prestress transfer, and the minimum 28 day compressive strength has been attained.

Store beams off the ground in an upright position. Protect them as far as practical from surface deterioration, and keep them free of accumulations of dirt, oil, and other deleterious material.

420.03.20 Erection. Refer to Sections 408.03.27, .28, .29, .31, .32, and .33.

Slab Panels. Immediately prior to erecting slab panels, clean the abrasive blasted shear key surfaces with compressed air, stiff bristle fiber brushes, or vacuuming. Pull the slab panels together and field tighten in the transverse direction using tie rods. Perform field tightening by placing the washer and nut on the tensioning end of the tie rod and running them down to the recessed concrete face. Attach a jacking assembly or other type of loading apparatus to the threads extending beyond the nut. Provide the Engineer with certification that the gauge or other load measuring device has been calibrated within one year; however, the Engineer may require the load measuring device to be recalibrated if it appears to have been damaged or mishandled. The loading apparatus shall be capable of applying a load to the tie rod nut equal to 80,000 lb for spans up to 35 ft and 120,000 lb for spans greater than 35 ft. Maintain the load until the tie rod nut is snug tight as defined in Section 408.03.17(d). Do not use a torque wrench to apply the tensioning load. After tightening, grout all tie rod holes.

After field tightening all slab panels, seal the joint below the shear keys using an approved method. Grout the shear keys by overfilling the joints. Drive the grout or compactly tamp it into the keyways; do not vibrate. After a half hour, strike off the excess grout flush with the top of the panels. Follow the manufacturer’s recommendations for grouting in cold or hot weather.

Equipment may be placed on the slab unit prior to placing the concrete overlay if all slab units are in place, the tie rods are tensioned, and the joints have been grouted for at least two days.

420.03.21 Bearing Pads. Store them at the site on suitable blocking or platforms at least 4 in. above all surfaces and vegetation. Keep free from vegetation growth and accumulations of dirt, oil, and other foreign material.

Coat the surfaces of the concrete bearing areas that will be in contact with the bearing pads and the full contact area of the bearing pads with epoxy adhesive. Adhere to the manufacturer's recommendations for mixing and applying the epoxy adhesive material. The surface temperatures when applying epoxy adhesive shall be at least 50 F with a predicted ambient temperature for the next four hours of 50 F or above. Ensure that the surfaces are clean, dry, and sound. Be prepared to use water jets, abrasive blasting, and air blasting, for satisfactorily cleaning the surfaces.

Accurately set the bearing pads in the epoxy adhesive and secure them in place by blocking or other mechanical means until the adhesive sets.

420.03.22 Placing and Finishing Concrete Overlay. Place, cure, groove, protect, etc., the overlay according to Section 420.03 including superstructure placement restrictions.

Place the top of the overlay to the true as planned line and grade of the roadways. Place the overlay in a manner that meets the grade of the proposed adjoining portions of the new bridge decks and adjoining roadways.

Place the entire bridge slab overlay in one continuous pour. No transverse or longitudinal joints will be permitted.

Place the finishing machine's supporting rails outside the overlay. Do not use hold down devices that are shot or drilled into the concrete. Submit plans for anchoring support rails and the concrete placing procedure for approval.

Take precautions to secure a smooth riding bridge deck meeting the requirements of Section 414.03.07(d). Prior to placement operations, review the equipment, procedures, and personnel with the Engineer. The inspection procedures will be reviewed to ensure coordination. Take the following precautions:

(a) Before placing the overlay, thoroughly clean and abrasive blast the entire surface that will be in contact with the overlay. Perform abrasive blasting within 24 hours prior to placing the overlay. Clean the surface by air blast followed by flushing with water. Prior to placing the overlay, wet the surface and keep it wet for at least one hour and remove puddles of water.

No loads, other than construction equipment, will be permitted on any portion of the bridge deck that has undergone preparation prior to placement and curing of concrete overlay.

(b) After cleaning the surface and immediately before placing the concrete overlay, scrub a thin coating of the overlay bonding grout into the prepared surface. Ensure that all parts receive a thorough, even coating and that no excess grout collects in pockets. Control the rate of grout application so that the grout does not become dry before it is covered with the overlay.

(c) Utilize a suitable portable lightweight or wheeled work bridge behind the finishing operation. Hand finishing may be required along the edge of placements.

420.04 MEASUREMENT AND PAYMENT. Prestressed concrete members will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Prestressed Concrete Beams*** or ***Prestressed Concrete Slab Panels*** item. The payment will be full compensation for all concrete, forms, reinforcing, bearing pads, steel strands, sheathing, steel components, steel rods, inserts, tensioning, grout, bearing assemblies, epoxy adhesive, testing, furnishing, and applying concrete protective coatings when specified, transporting, storage, erection, and for all material, labor, equipment, tools and incidentals necessary to complete the work.

420.04.01 Concrete overlay for the precast concrete slab bridge deck will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Superstructure Concrete*** item. The payment will be full compensation for surface preparation, overlay bonding grout, furnishing, placing, finishing, curing and grooving the concrete overlay; fabricating, coating and placing the epoxy coated welded steel wire fabric or reinforcing steel within the concrete overlay, roadway angle, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

SECTION 421 – RESERVED

SECTION 422 – METAL RAILING

422.01 DESCRIPTION. This work shall consist of furnishing, fabricating, coating, and erecting of all metal railings as specified in the Contract Documents.

422.02 MATERIALS. Materials shall be as specified in the Contract Documents.

422.03 CONSTRUCTION. All railings shall be fabricated and erected as specified in the Contract Documents.

The Contractor shall furnish working drawings for approval by the Engineer.

422.03.01 Production, Handling and Shipment. Metal railings and incidental parts shall be carefully handled and stored on blocking, racks, or platforms to prohibit contact with the ground and shall be protected from corrosion or damage. Materials shall be kept free from dirt, oil, grease, and other foreign matter. Surfaces to be painted shall be carefully protected both in the shop and in the field. Damaged material shall be repaired or replaced as directed by the Engineer at the Contractor's expense.

422.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. Measurement and Payment shall be in accordance with one of the following as specified in the Contract Documents:

422.04.01 ***Metal Railing*** will be measured and paid for at the Contract unit price per linear foot.

422.04.02 ***Metal Railing*** will not be measured but will be paid for at the Contract lump sum price.

422.04.03 ***Metal Railing*** will not be measured but the cost will be incidental to other pertinent items included in the Contract Documents.

SECTION 423 – TIMBER STRUCTURES

423.01 DESCRIPTION. This work shall consist of constructing structures or portions of structures using timber, including fabrication, erecting, treating and coating of the timber elements as specified in the Contract Documents or as directed by the Engineer.

For timber piling refer to Section 407. For structural steel refer to Section 408. For concrete refer to Section 414.

423.02 MATERIALS.

Asphalt Cement	904
Structural Steel	909.01
Gray Cast Iron	909.04
Bolts and Hardware	909.09
Structural Timber	921.05
Preservative Treatments for Timber	921.06
Metal Timber Connectors	Per manufacturer & approved by the Engineer
Galvanizing	A 153
Fire Stops and Galvanized Sheet Metal	A 653, Coating Designation G 90

423.03 CONSTRUCTION.

423.03.01 Storage and Handling. Timber shall be open stacked in piles at least 12 in. above the ground surface in a manner to shed water and prevent warping. It shall be protected from

weather by a suitable covering. The storage site shall be cleared of weeds and rubbish before placing material and throughout the storage period. The site selected shall not be subject to flooding. Timber shall be handled with rope or nylon slings to prevent the breaking of outer fibers, bruising, or penetrating the surface.

423.03.02 Cutting and Boring. When practical, cutting and boring of treated timbers shall be done before treatment. All cuts in treated timbers and all abrasions (after having been carefully trimmed) shall be brush coated with two applications of an approved wood preservative before installing the timber in the structure. Whenever forms or temporary braces are attached to treated timber with nails or spikes, the holes shall be filled by driving galvanized nails or spikes flush with the surface, as directed by the Engineer.

423.03.03 Bolt Holes. Bolt holes bored after treatment shall be filled with asphalt cement applied with a caulking gun or as directed by the Engineer before inserting bolts. Holes that are not to receive bolts shall be plugged with asphalt cement coated plugs.

423.03.04 Coating Untreated Surfaces. In untreated timber structures, all contact surfaces between any members (except adjacent flooring members) shall be coated with two coats of an approved preservative before assembling. The back faces of bulkheads and all surfaces of timber that will come in contact with earth, metal or other timber shall be similarly coated. The ends of timber members shall be coated in the same manner.

423.03.05 Protection of Ends of Caps, Wales and Planks. The ends of all caps, wales and planks shall be covered with resin glass composite shields as approved by the Engineer. The shields shall be applied as follows:

(a) Remove all dirt and other loose material from area to be capped.

(b) Apply the first coat of resin to the top and 4 in. down the side of the member.

(c) Apply precut glass cloth, using a 3 in. grooved aluminum roller to achieve “wet-out” and brass staples for anchorage.

(d) When the initial coat of resin has taken a tack free set, apply a second coat of resin to seal the entire application.

423.03.06 Diameter of Holes. Holes bored in timber structures shall conform to the following:

(a) Round drift bolts, spikes, and dowels - 1/16 in. less than the diameter of the device.

(b) Square drift bolts, spikes, and dowels - equal to the smallest dimension of the device.

(c) Machine bolts - same as the diameter of the bolts.

(d) Rods - 1/16 in. larger than the diameter of the rods.

(e) Lag screws - equal to the diameter of the screw at the base of the thread.

(f) Connector bolts - 1/16 in. larger than the diameter of the connector bolts.

423.03.07 Bolt Assemblies. Bolt heads or nuts which come in contact with the timber shall be fitted with a washer of the size and type specified. After all nuts are adequately tightened, the bolt shall be deburred.

423.03.08 Countersinking. Countersinking shall be done wherever smooth faces are required. In treated timber, recesses formed in horizontal surfaces for countersinking shall be painted with an approved preservative. After the bolt or screw is in place, recesses shall be filled with an approved asphalt coating.

423.03.09 Connectors. Connector holes shall be bored through members to be connected. The bolt hole shall be kept perpendicular to the face of the timber. When spike grids or split ring connectors are specified in the Contract Documents, they shall be installed in conformance with the manufacturer's recommendations.

423.03.10 Framing. All timber shall be accurately cut and framed to provide even bearing over the entire contact surface. When making joints, there shall be no shimming and there shall be no open joints.

423.03.11 Sills. Sills shall have true and even bearing on mud sills or concrete pedestals. All earth shall be removed from contact with sills.

423.03.12 Caps. Timber caps shall be placed to secure an even and uniform bearing over the tops of the supporting posts or piles and to secure an even alignment of their ends. All caps shall be secured by drift bolts or as specified in the Contract Documents. The drift bolts shall be in the center of the post or pile.

423.03.13. Bracing. The ends of bracing shall be bolted through the pile, post, or cap. Intermediate intersections shall also be bolted. Spikes or nails shall be used in addition to bolts. When bracing intersects, filler blocks shall be used with a bolted connection.

423.03.14 Stringers. Stringers shall be placed in position so that knots near edges will be in the top portions of the stringers. Bottom edges of stringers shall be sized to provide uniform depth at bearings.

Outside stringers may have butt joints with the ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of the floor beam or cap at each end. The lapped ends of untreated stringers shall be separated a minimum 1/2 in. and shall be securely fastened by drift bolts where specified. When stringers are two panels long, the joints shall be staggered.

Cross bridging between stringers shall be toenailed with at least two nails in each end. The lower ends of all bridging and one side of each diaphragm shall be left disconnected and free to move until after the deck above it has been securely fastened to the stringers.

423.03.15 Floor Planking. Floor planking shall, unless otherwise specified, be S1S1E, hit or miss, and the planks shall be of uniform thickness with a maximum tolerance of 1/8 in. Where necessary to maintain traffic, planks shall be laid in half-of-bridge width sections. Timber plank floors shall always be accompanied with suitable hold down devices. Planks shall be spiked to every stringer or joist or nailer using not less than two spikes, and the length of the spikes shall be at least equal to twice the thickness or depth of the plank. Where planks will be under wheel guards or hold down devices, care shall be taken while selecting planks of as near equal thickness as possible. Before any hold down or wheel guard is bolted, treated shims or wedges shall be firmly driven between low planks and hold down and low planks and wheel guard so that all planks shall be held down with equal pressure. The shims shall occupy at least 50 percent of the area between the bottom of the hold down and the top of the plank and between the bottom of the wheel guard and the top of the plank.

423.03.16 Bridge Railings and Wheel Guards. Bridge railings shall meet a minimum of Test Level 1 (TL-1) as specified in the AASHTO LRFD *Bridge Design Specifications*, Railings. All dimensions for timber rail, posts, and spacers shall be the actual dimensions of the timber.

Locate bridge rail and wheel guard splices so that rail and guard members are continuous over at least two posts. Install bridge railings and wheel guards in sections not less than 12 ft long. Splices shall be shiplapped with the lap equal to the larger of either 8 in. or the greater side of the piece.

423.04 MEASUREMENT AND PAYMENT. Piles are excluded. The payment will be full compensation for all timber (treated or untreated) storage and handling, preservative, composite shields, asphalt cement, metal components, drilling holes, and for all material, labor, equipment, tools, and incidentals necessary to complete the work. Measurement and Payment shall be in accordance with one of the following as specified in the Contract Documents:

423.04.01 ***Timber Structures*** will be measured and paid for at the Contract unit price per 1000 board feet (MBM). The computation of quantities will be based on the nominal sizes specified in the Contract Documents and the exact overall net length of pieces remaining in the completed structure. No allowance will be made for waste.

423.04.02 ***Timber Structures*** will not be measured but will be paid for at the Contract lump sum price.

SECTION 424 – BRICK MASONRY

424.01 DESCRIPTION. This work shall consist of brick laid in full beds of mortar and built to the shapes and dimensions and at the locations specified in the Contract Documents or as directed by the Engineer.

424.02 MATERIALS.

Curing Compound	902.07.03
Brick	903
Mortar	903.06

424.03 CONSTRUCTION. All brick masonry shall be laid in level courses with faces plumb, square and true to the dimensions specified. All exposed surfaces shall be smooth.

Brick facing shall be constructed as specified in the Contract Documents.

424.03.01 Bond. Unless otherwise specified, brick masonry shall be laid in common bond having at least one course in every seven composed entirely of headers. Adjoining courses shall be laid to break joints by half brick as nearly as practical.

424.03.02 Bricklaying. All brick shall be sprayed with water to dampen the surface prior to laying. Only fresh plastic mortar shall be used, and it shall be soft and workable when placed on the wall. A layer of mortar shall be spread on the beds and not more than a shallow furrow that can be readily closed by the laying of the brick shall be made in it. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made so that mortar is squeezed out at the top of the joint. No brick shall be jarred or moved after it has been fully bedded in the mortar. Bricks loosened after the mortar has taken its set shall be removed, cleaned and relaid with fresh mortar. No broken or chipped brick shall be used in the face. No spalls or bats shall be used except where necessary to shape around irregular openings or edges. Full bricks shall be placed at ends or corners where possible and the bats used in the interior of the course. In making closures, bricks shorter than the width of a whole brick shall not be used. Whole brick shall be used as headers.

424.03.03 Joints. All joints shall be slushed with mortar at every course, but slushing alone will not be considered adequate for making an acceptable joint. Exterior faces shall be laid up in advance of backing. Exterior faces shall be back plastered or parged with a coat of mortar not less than 3/8 in. thick before the backing is laid up. Prior to parging, all joints on the back of face courses shall be cut flush. Joints shall not be less than 1/4 in. nor more than 1/2 in. wide. Whatever width is adopted shall be maintained uniformly throughout the work.

424.03.04 Pointing. All exterior head and bed joints shall be tooled with a round tool, slightly larger than the joint, pressed tight against the still plastic mortar so as to provide a concave finish. When nails or line pins are used, the holes shall be immediately plugged with mortar and pointed as soon as the nail or pin is removed.

424.03.05 Cleaning. Upon completion of the work, all exterior surfaces shall be cleaned by scrubbing and washing down with water, or if necessary, cleaning shall be done with a 5 percent solution of muriatic acid which shall then be rinsed off with liberal quantities of clean fresh water.

424.03.06 Curing. After the work has been laid up and pointed, the exposed surfaces of brick masonry shall be cured by one of the following methods:

(a) Brick shall be covered with two layers of burlap and kept wet for three days.

(b) A non-bituminous colorless liquid curing compound shall be applied by means of an approved hand or motor driven spray operated at a pressure between 40 and 60 psi. The liquid compound shall be uniformly applied at a rate of 0.034 to 0.040 gal/sq.yd. The material shall be applied so that the exposed surface is completely coated and sealed in one application. At points where the work shows evidence of insufficient coating, additional material shall be added as directed by the Engineer.

424.03.07 Cold Weather Protection. No brick masonry work or pointing shall be done when there is frost in the brick or when the air temperature is below 50 F, unless the Contractor provides suitable housing, covering and tarpaulins, and heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 50 F for the curing period.

424.03.08 Backfill. Brick masonry shall not be backfilled before seven days after completion of the section.

424.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the work. Measurement and Payment shall be in accordance with one of the following as specified in the Contract Documents:

424.04.01 ***Brick Masonry for Structures*** will be measured and paid for at the Contract unit price per square foot. The Engineer may permit the backfilling of masonry structures sooner than specified if traffic or other conditions warrant this. In no case, however, will this operation be permitted until the third day after the completion of all work.

424.04.02 ***Brick Masonry for Structures*** will be measured and paid for at the Contract unit price per cubic yard.

424.04.03 ***Brick Masonry for Structures*** will not be measured but will be paid for at the Contract lump sum price.

424.04.04 ***Brick Masonry Facing*** will be measured and paid for at the Contract unit price per square foot.

424.04.05 ***Brick Masonry Facing*** will not be measured but will be paid for at the Contract lump sum price.

SECTION 425 – EPOXY PROTECTIVE COATINGS FOR CONCRETE

425.01 DESCRIPTION. This work shall consist of furnishing, and applying of epoxy protective coatings as specified in the Contract Documents or as directed by the Engineer.

425.02 MATERIALS.

Sand	901, Table 901 A
Epoxy Protective Coatings	917.01

425.03 CONSTRUCTION. The epoxy protective coating shall not be applied until at least 30 days after forms are removed. All surfaces to be coated shall be blasted. The surface shall be clean, sound, thoroughly dry and free of oil, grease, curing compound and other foreign matter before applying the first epoxy protective coating. Two coats shall be applied to the specified areas of the structure. The application of each epoxy protective coating shall follow a dry weather period of at least two consecutive days. Adjacent areas not to be coated shall be masked or otherwise protected to prevent staining.

425.03.01 Mixing and Application. Mixing and application shall conform to the manufacturer's recommendations. Epoxy coatings shall be applied by brush or roller. Epoxy coatings shall not be applied to concrete piers and abutments until after structural steel masonry plates have been placed.

425.03.02 Coating Requirements. The second coat of epoxy coating on the top surfaces of the pier caps and abutment bridge seat areas between beams pads shall be sprinkled with an excess of sand while the film is still wet. When the film has hardened sufficiently to resist marring, the excess sand not adhering to the coatings shall be removed. Areas to be coated are:

(a) Abutments and piers that are under an expansion device in the deck shall be coated.

(b) For abutments, coatings shall be applied to the entire horizontal surface of the abutment bridge seat areas (between and around the beam pads) and all exposed surfaces of the beam pads, and the entire contiguous vertical faces of the backwalls and cheek walls.

(c) For piers, coatings shall be applied to the entire horizontal surface of pier bridge seat areas (between and around the beam pads), and all exposed surfaces of the beam pads.

425.03.03 Material Precautions. The manufacturer's Material Safety Data shall be used in handling and use of the material.

425.03.04 Repairs. Any portion of the structures damaged by the Contractor's operations in applying the protective coatings shall be repaired as directed by the Engineer, at the Contractor's expense.

425.04 MEASUREMENT AND PAYMENT. The payment will be full compensation for both coats and all material, labor, equipment, tools, and incidentals necessary to complete the work. Measurement and Payment shall be in accordance with one of the following as specified in the Contract Documents:

425.04.01 ***Epoxy protective coatings for concrete*** will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

425.04.02 ***Epoxy Protective Coatings for Concrete*** will not be measured but will be paid for at the Contract lump sum price.

425.04.03 ***Epoxy Protective Coatings for Concrete*** will be measured and paid for at the Contract unit price per square foot.

SECTION 426 – FUSION BONDED POWDER COATINGS FOR METAL

426.01 DESCRIPTION. Furnish and apply electrostatically applied fusion bonded powder coatings to metal surfaces.

426.02 MATERIALS.

Epoxy Powder Coating	917.02 except creep test will not be required
Polyester Powder Coating	917.03

Use polyester powder coating unless otherwise specified.

426.03 CONSTRUCTION. Apply the coating in an environmentally controlled plant that is fully enclosed. The coating system shall have the capabilities of preheating and post baking.

Ensure that the surface is free of oil and mill coatings.

Grit blast the surface to white metal according to SSPC-SP 5 using a mixture of steel shot and grit. Protect cleaned surfaces from high humidity, rainfall, and surface moisture. Surfaces shall not flash rust before coating. Provide a uniform, angular anchor blast profile having a height of 2 to 5 mils. Check anchor pattern with an approved surface profile gauge.

Apply and cure the material as specified by the coating manufacturer. Neither the metal surface nor the oven temperature shall exceed 500 F during any part of the curing process.

Ensure that the cured coating has a uniform color, gloss, and thickness, and is free of blisters, fish eyes, sags, runs, and any other irregularity.

Ensure that the finished coating thickness is 10 ± 2 mils when tested according to SSPC PA-2, except the balls and sockets on steel sheet piling may have a lesser thickness of coating.

Similarly coat new bolts, nuts, and washers to a thickness of 4 to 7 mils. The nuts shall have oversize threads and fit the bolts after both are coated. Restrain the bolt heads from turning during torquing operations.

The coater shall be responsible for all quality control checking including visual inspection and thickness measurements and shall keep the results of each inspection in a form suitable to the Engineer.

The Engineer shall have access to each part of the process and have the right and opportunity to witness or perform any of the quality control tests on a random sampling basis.

Touch Up. Provide a compatible touch up system for repair of defects, all areas damaged during erection, and all visible open areas. Apply touch up as follows:

(a) Surface Preparation. The surface shall be clean, dry, and free of rust and scale. Blast clean to National Association of Corrosion Engineers (NACE) Near White where possible. Use suitable solvents to remove grease, oil, and other contaminates. Apply coating directly to the cleaned surface before oxidation occurs.

(b) Mixing. Mix ratio of Part A to Part B shall be as recommended by the manufacturer. Thoroughly mix the two parts until a uniform color is achieved. If thinning is required, thin each part separately using a thinner recommended by the manufacturer. Discard material not used within the recommended pot life.

426.03.01 Material Precautions. Use the manufacturer's Material Safety Data in handling and use of this material. Refer to Section 416.03.04 for handling and protection.

426.04 MEASUREMENT AND PAYMENT. Fusion bonded powder coatings for metal will not be measured but the cost will be incidental to the pertinent items specified.

SECTIONS 427 Through 449 – RESERVED

SECTION 450 – RETAINING WALLS

450.01 DESCRIPTION. Construct cast-in-place reinforced concrete footings and stems conforming to the AASHTO definitions of rigid retaining walls. When retaining wall mounted noise barriers are specified, the anchorage assemblies are included in the retaining wall. All components shall be as specified unless prior approval for alternatives is obtained from the County.

When piles or drilled shafts (caissons) are specified, refer to Section 407 or Special Provisions, respectively.

450.01.01 Preapproved Alternate Retaining Walls. Alternate retaining walls may only be used when specified. Only those retaining walls specified will be permitted. All other retaining walls, even though they are preapproved or have been previously used on County projects, are prohibited for use. The County will not consider any other alternate retaining walls as a value engineering change proposal.

Enforcement. These requirements will be enforced on all projects.

Preapproved Alternate Retaining Wall List. Alternate retaining walls are selected from the list of Preapproved Alternate Retaining Walls, which is maintained by the MdSHA Office of Structures. Procedures for adding products to the prequalified list may be obtained from the MdSHA Office of Structures.

Alternate retaining walls that have been previously used on County projects without complying with the preapproval requirements shall be formally submitted through these procedures before they will be added to the Preapproved Lists for consideration to be used on future projects. These and other retaining wall systems may be submitted for addition to the Preapproved Lists, but the County will not permit these submittals to be used on an advertised or awarded project.

Deviations. Submit any proposed deviation in materials, post size or shape; panel size or shape; reinforcing type, size, or placement from what is shown in the Contract Documents or from the preapproved alternate retaining wall details on file in the MdSHA Office Structures. All costs for reviews, whether the details are accepted or rejected, shall be borne by the

Contractor. Any fabrication or creation of any retaining wall element that is a deviation and is made prior to written approval of the County shall be at the risk of the Contractor.

Contract Documents for Preapproved Alternates. If electing to use preapproved alternate retaining wall systems, only one type retaining wall may be constructed throughout the Contract. Submit substitute plans, design calculations, and specifications. Plans shall be similar in size and detail to advertised documents. Working drawings from the fabricator are not acceptable as substitute plan submissions. Include drainage details and all revisions required to construct the alternate retaining wall system. All plans, calculations, and specifications shall be prepared, signed, and sealed by a Professional Engineer registered in the State of Maryland, and who has experience in design of the proposed alternate retaining wall system. The substitute plans shall bear the County's title block and be furnished on reproducible paper, linen, or mylar. Contract Documents for construction of alternate retaining walls shall conform to the Procedures of the MdSHA Office of Structures and to the Baltimore County *Design Manual*. These Plans will be issued as a Contract revision replacing the County's Plans and be kept by the County as permanent records. All work pertaining to Contract Documents for preapproved alternates shall be at no additional cost to the County.

After substitute Plans are approved and issued as a redline revision, submit working drawings bearing the fabricator or supplier's title block for review and approval to the County or directly to the consulting engineer as directed by Section 499.

450.02 MATERIALS. Refer to Section 414.02.

Sample Panel. Refer to the Architectural Treatment specifications in the Contract Documents.

Some projects may require a specified surface such as an ashlar stone pattern, or matching a similar structure or stonework in the area. The Contractor may request or the Engineer may direct that the sample of the texture be submitted for approval prior to submission of the sample panel containing the specified stain.

450.02.01 Reinforcement. Reinforcing bars and welded wire fabric in retaining walls that are less than 10 ft from the edge of paved surface (includes shoulders) shall be epoxy coated. Supports for epoxy coated reinforcement shall be coated the same as the reinforcing steel.

450.02.02 Backfill for Preapproved Alternates. Use size No. 57 stone as backfill for all preapproved alternate retaining walls, regardless of the type backfill recommended or specified by the retaining wall manufacturer. Use geotextile when specified.

450.02.03 Concrete Stain. When a color is specified for the exposed surfaces of the retaining wall, select the stain from the Prequalified List of concrete stains maintained by the MdSHA Office of Materials Technology. The color number shall meet Federal Standard 595.

450.02.04 Textures.

(a) Unless otherwise specified, the exposed surfaces of the retaining wall shall receive a special surface treatment as specified in Section 414.03.07(b).

(b) When a special texture is specified, it shall be produced by using an approved form liner.

450.02.05 Preapproved Alternate Retaining Wall. Match the materials and details as approved and on file in the Bureau of Engineering and Construction, Design Division-Structural Design Section.

450.03 CONSTRUCTION. Construct retaining walls as shown on the Plans, as specified in Section 414.03, and herein. Construct alternate retaining walls according to the details and specifications that are on file with the MdSHA Office of Structures. Should any detail or specification change, the retaining wall firm shall submit the revision to the Engineer for review and approval prior to using that revision on County projects. Revisions shall not be submitted for projects that are already bid.

Do not apply any loading to retaining wall concrete until the concrete in that portion has attained a compressive strength of at least 3000 psi. In addition, complete the backfilling prior to placing any loads on the wall.

450.03.01 Concrete Stain. When stain is specified, apply two coats according to the manufacturer's recommendations or as directed. Before application, ensure that all surfaces are structurally sound, clean, dry, fully cured, and free from dust, curing agents, form release agents, efflorescence, scale, and other foreign materials.

450.03.02 Anchor Bolt Assemblies. When required, install as specified. Assemble anchor assemblies and place them at the specified elevation and spacing. Use templates for proper alignment and spacing of all anchor assemblies prior to concrete placement. Ensure that the threads of the anchors are long enough to provide room for a 1-inch concrete encasement, leveling nuts, washers, base plate, and at least a ½ inch protrusion through the top of the top nut when the wall is properly installed.

All holes and welding required in the assemblies shall be done before galvanizing. Keep all assemblies free of oil and mill coatings.

450.04 MEASUREMENT AND PAYMENT. Retaining walls will not be measured but will be paid for at the Contract lump sum price for the pertinent ***Retaining Wall*** item. The payment will be full compensation for all piles, caissons, footings, forms and form removal, architectural treatment, reinforcement steel, concrete, curing, anchorage assemblies, stains and coatings, excavation, sheeting and shoring, drainage systems, backfill (including size No.

57 stone and geotextiles for alternate retaining walls), and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

When specific items for Piles for Retaining Walls are included in the Contract Documents, they will be measured and paid for as specified in Section 407.04.

SECTIONS 451 Through 469 – RESERVED

SECTION 470 – UTILITIES ON STRUCTURES

470.01 DESCRIPTION. Place utility markers to identify utilities when they are newly installed, replaced, or relocated. Place the identification markers as specified herein and as approved.

470.02 MATERIALS. Use decals or stencil high quality black or white print onto the pipe or carrier. Lettering height shall be 1/3 the pipe diameter but not less than 1 in. or more than 4 in. Markers shall include the name of the utility and a description of the contents as shown in the Contract Documents or as directed.

Submit a sample of the proposed markers.

470.03 CONSTRUCTION. Place identification markers within the first and last 50 ft of the structure, and at intervals not to exceed 100 ft.

Ensure that the surface to receive the marker is properly cleaned and prepared prior to the application. Orient the markings for best visibility.

470.04 MEASUREMENT AND PAYMENT. The application of utility markers on structures will not be measured but the cost will be incidental to the pertinent items.

SECTIONS 471 Through 498 – RESERVED

SECTION 499 – WORKING DRAWINGS

499.01 DESCRIPTION. Schedule and distribute working drawings, which are described in Section GP-1.05 and specified in Section TC-4.01. Working drawings shall exhibit good drafting practices and represent the original work of the Contractor, fabricator, or supplier. Duplicated portions of the Plans will not be accepted. When requested by the County or consultant, submit calculations or other information deemed necessary to backup working

drawings. Calculations and other backup material shall be signed and sealed by a Professional Engineer registered in the State of Maryland.

499.02 MATERIALS. Not applicable.

499.03 CONSTRUCTION.

499.03.01 Schedule. As a first order of work, prepare and submit a schedule for the submission of the working drawings as specified in Sections 499.03.02 or 499.03.03. Coordinate the schedule with and in full accord with the Progress Schedule submitted to the procurement officer as specified in Section GP-8.04.

The schedule shall include each type of working drawings (e.g. form plans, structural steel, etc.), approximate number of drawings to be reviewed, estimated date of first submission, and estimated rate of submission of drawings (e.g. 5/wk). Where possible, submit the most crucial drawings first with sufficient time for review so as to minimize delays during construction.

499.03.02 Consultant Engineering Firm. When the Contract Documents specify that a consulting engineering firm is to review the working drawings for the structure, send all working drawings to that firm.

To expedite the checking and distribution of working drawings, fabricators or suppliers may send prints directly to the appropriate consulting engineering firm with copies of all correspondence to the Contractor and the Baltimore County Bureau of Engineering and Construction, Design Division, Structural Design Section. If the Contractor requests that all plans be routed through the Contractor's office, then the establishment of that procedure should be the first order of work so as to avoid possible misunderstandings as to the processing. Be advised that this plan of action will delay the turn around time and will not constitute grounds for complaint or a time extension.

The Contractor, fabricator, or supplier shall furnish to the consultant engineering firm 10 prints each of all working drawings, etc., for primary review.

Once primary review is complete, the Contractor, fabricator, or supplier shall furnish to the consultant engineering firm additional prints (number to be furnished by primary reviewer) for stamping and forwarding to the Baltimore County Bureau of Engineering and Construction, Design Division, Structural Design Section for distribution.

All working drawings for the structures will not be considered accepted until they bear the acceptance stamp of the consulting engineering firm.

499.03.03 Bureau of Engineering and Construction. When no consulting engineering firm is specified, send all working drawings for the structures to the Bureau Chief, Baltimore County Bureau of Engineering and Construction, Attn, Structural Design Section.

To expedite the checking and distribution of working drawings, fabricators or suppliers may send prints directly to the Bureau Chief, Baltimore County Bureau of Engineering and Construction with copies of all correspondence to the Contractor and the Bureau of Engineering and Construction, Division of Construction Contracts Administration. If the Contractor requests that all drawings be routed through the Contractor's office, then the establishment of that procedure should be the first order of work so as to avoid possible misunderstandings as to the processing. Be advised that this plan of action will delay the turn around time and will not constitute grounds for complaint or a time extension.

The Contractor, fabricator, or supplier shall furnish to the Bureau Chief, Baltimore County Bureau of Engineering and Construction 10 prints each of all working drawings, etc., for primary review.

Once primary review is complete the Contractor, fabricator, or supplier shall furnish to the Bureau Chief, Baltimore County Bureau of Engineering and Construction additional prints (number to be furnished by primary reviewer) for final review and distribution.

499.03.04 Revisions and Substitutions. All modifications, regardless of whether or not the Contract includes a consulting engineering firm, shall be sent to the Chief, Bureau of Engineering and Construction for acceptance. Any modifications implemented, without written acceptance from the Bureau Chief, Baltimore County Bureau of Engineering and Construction will be subject to the requirements of Section GP-5.02.

499.04 MEASUREMENT AND PAYMENT. This work will not be measured but the cost will be incidental to other pertinent items.

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