DIVISION 600

STRUCTURES AND CONCRETE

SECTION 601 — CONCRETE

601.01 DESCRIPTION. Use concrete consisting of a mixture of cement, fine aggregate, coarse aggregate, and water, with admixtures as specified, combined in the proportions and mixed to the consistency specified, when forming or casting to dimensions specified in the Plans or as the Engineer directs. Provide the materials, material proportions, equipment, and construction methods necessary to ensure that the concrete produced conforms to the Contract. Structural concrete is concrete for structures such as bridges, culverts, and retaining walls and other items detailed as structures in contract documents. Non-structural concrete is all other concrete.

601.02 MATERIALS AND EQUIPMENT.

601.02.01 Steel Reinforcement. Conform to Section 811.

601.02.02 Cement. Conform to Section 801. Use Type I cement. The Department will allow the use of Type IP(≤20), Type IS(≤30), Type IL(5-15), Type II, Type III, and Type V when the Engineer approves. The Engineer will condition his approval upon satisfactory means of storage and handling to ensure the ready identification of these cements when used in portions of the work. . If unsatisfactory test results are obtained using Type IP(≤20), Type IS(≤30), Type IL, Type II, or Type III, or Type V cement complete the work using Type I cement. Do not intermix cement types in any structural unit except when finishing with Type I. Discontinue the use of Type V cement used for the purpose of sulfate resistance if unsatisfactory results are obtained. Provide a new mix design addressing sulfate exposure shall be submitted for approval.

601.02.03 Admixtures. Conform to Section 802. Use air-entraining and water reducing admixtures in all classes of concrete. Water reducing admixtures are not required when slip forming is used for concrete placement. Use other admixtures when the Engineer directs or approves.

601.02.04 Water. Conform to Section 803.

601.02.05 Fine Aggregate. Conform to Section 804.

601.02.06 Coarse Aggregate. Conform to Section 805.

601.02.07 Joint Materials. Conform to Section 807.

601.02.08 Structural Steel. Conform to Section 812.

601.02.09 Miscellaneous Metals. Conform to Section 813.

601.02.10 Concrete Curing Materials. Conform to Section 823.

601.02.11 Masonry Coating. Conform to Section 828.

601.02.12 Mineral Admixtures. Conform to Section 844.

601.02.13 Forms. Provide forms that are mortar tight, true to the dimensions, lines, and grades of the structure, and of sufficient strength to prevent appreciable deflection during placing concrete.

A) Form Panels. Form panels are continuous sections of form facing material unbroken by joint marks, against which concrete is placed. For exposed surfaces, use form panels of plywood conforming to U.S. Product Standard PS-1 for

Exterior B-B (Concrete Form) Class I plywood or any material other than plywood that will produce an equivalent smooth uniform concrete surface.

B) Plywood Forms. Ensure that plywood forms are at least 3/4 inch thick.

C) Plastic Forms. Conform to the manufacturer's specifications.

D) Plastic Lined Forms. Conform to the manufacturer's specifications.

E) Metal Forms. Use metal forms of such thickness that the forms will remain true to shape. Do not use metal forms that do not present a smooth surface or line up properly.

F) Stay-In-Place Metal Forms. Conform to the following requirements:

1) Forms and Supports. Fabricate permanent steel bridge deck forms and supports from steel conforming to ASTM A 653, Grades A through E, and having a zinc coating class of G 165 according to ASTM A 924. Use forms having a minimum thickness of 22 gage.
2) Fastener Hardware. For miscellaneous fastener hardware (bolts, nuts, metal screws, and washers), provide common stock hardware items with a zinc coating equal to or better than that required by ASTM A 153.
3) Coarse Aggregate. Conform to the requirements of Section 805.04.01 for all coarse aggregate used in concrete for bridge decks and barrier walls when using permanent steel bridge deck forms.
4) Precast Beam Hardware. Provide all deck and overhang support hardware that is cast into precast beam tops with a zinc or epoxy coating of a commercial quality grade.
5) Anchor Legs. To anchor angle weld tabs, use straight anchor legs containing a hole having a 1 1/8-inch minimum diameter. If necessary, incline the anchor leg to vertical.
6) Tack Welding. Certified welders are not required for installation of stay-in-place metal forms.

G) Plank Forms. Use plank forms having a minimum nominal thickness of 1 1/2 inches.

H) Form Oil. Provide a commercial quality form oil or other equivalent coating that allows ready release of the forms and does not discolor the concrete or is detrimental to masonry coating.

I) Chamfer Strips. Only use chamfer strips that are no less than 3/4 by 3/4 inch.

601.02.14 Scales. For weighing water, aggregates, cement, and mineral admixtures, provide either beam, springless dial, or electronic load cell type scales, designed as an integral unit of the batching plant. When checked under static loads, maintain the accuracy of the scales to within 0.5 percent of the net load on the scales. The net load on the scales is the total weight of the actual test weights used in the accuracy determination. Use enough actual test weights to at least equal the weight necessary to check the cement scales to the net load required for a normal size batch. The Department will allow the use of aggregates in combination with test weights to obtain the accuracy determination of aggregate scales in the higher ranges.

Provide dial scales having a minimum of 1,000 graduations with a clear interval between graduation marks of 0.03 inch or more.

Provide beam scales having a graduation interval not greater than 0.1 percent of the scale capacity with a clear interval of 0.03 inch or more.

Provide scales that are sensitive enough to discern movement due to the addition to the scales of a weight equal to 0.1 percent of the scale capacity under load when the scales are not connected for automatic operation, or equal to 0.2 percent when the scales are connected for automatic operation.

Equip each beam scale with an auxiliary dial or "telltale" that will indicate to the operator that the required load in the hopper is being approached. The device shall show a minimum of 4 percent of the net rated capacity of the largest beam for underweight and 3 percent for overweight. Ensure that the indicator registers any movement of the beam.

Provide dial scales with suitable markers capable of being set to indicate the correct position of the dial indicator for predetermined loads. Enclose the dial in a glass-faced case for protection against dust.

Ensure that all weighing and indicating devices are in full view of and readable by the operator while charging the hopper, and provide the operator with convenient access to all controls.

Have all scales inspected and certified before use and whenever the Engineer may deem necessary to confirm the accuracy of the scales. Ensure that an inspection of the scales has been made within the preceding 6 months at any time a plant is supplying concrete to a Department construction project. Have a representative of a commercial scales company certified by the Division of Weights and Measures inspect and certify the scales. After the inspection and certification, only make adjustments or changes in the weighing mechanism at the direction of the Engineer. Keep all exposed fulcrums, clevises, and similar working parts of the scales clean at all times.

Furnish all weights and other equipment necessary for testing and calibrating the scales.

601.02.15 Batching Plant Equipment. Ensure that the plant conforms to all safety, health, and sanitation requirements specified in Subsection 107.01.01. Supply the batching plant with bins, weighing hoppers, and scales for the fine aggregate, each size of coarse aggregate, bulk cement, and mineral admixtures. The Department will allow weighing of cementitious material cumulatively. For the bulk cement, provide scales separate and distinct from those used for aggregate. Install and maintain the batching plant in a manner to provide accurate operations at all times. Only use weatherproof equipment for unloading cement, and protect the storage, weighing, and batching equipment for cement from the weather at all times.

Provide bins with separate compartments of sufficient capacity for each size of fine and coarse aggregate, and for bulk cement. Design each compartment to discharge efficiently and freely into the weighing hopper.

Provide a means of control so that when the quantity desired is being approached, the material may be added slowly and shut off with precision.

Use freely suspended weighing hoppers that do not affect the free movement of the weighing mechanism. Enclose the cement weigh hopper to prevent the loss of cement during weighing, and provide it with an approved device to transfer the cement to the batch trucks or the mixer. Construct all hoppers to eliminate leakage and the accumulation of tare materials, and to discharge completely. Provide any hopper that does not discharge satisfactorily with a vibrator having the frequency and power necessary to affect complete discharge.

601.02.16 Mixers.

A) Batch Mixer. Furnish a batch mixer of an approved size and type specified to positively ensure uniform distribution of materials throughout the mass, and to ensure discharge of the entire batch without segregation. Do not use any mixers having a rated capacity of less than one bag batch. Equip the mixer with adequate water storage and a device for accurately measuring and automatically controlling water discharge into each batch. Provide a mechanical device to control time of mixing for each batch and to automatically prevent discharge of the mixture until materials have been mixed for the specified time. Equip the mixer with a mechanical means for preventing addition of aggregates after mixing has started.

B) Continuous Mixer. Furnish a continuous mixer of an approved size and type specified to ensure uniform distribution of materials throughout the mass and to ensure discharge of the entire batch without segregation. Equip continuous type mixers to fix the proportions of admixture, cement, and fine and coarse aggregates by calibration according to KM 64-312 (ASTM C685). Provide devices to indicate the proportions of all components being incorporated into the mixture. Equip the water supply portion of the mixer with a readily accessible cumulative type meter which can be read to the nearest 0.1 gallon. Ensure that the meter is of

sufficient size to allow for easy reading. Calibrate the continuous type mixer to the satisfaction of the Engineer before starting work. Recalibrate the mixer thereafter at least once during each 50 cubic yards of production when yield checks indicate recalibration is necessary, and at any other times the Engineer deems necessary.

C) Truck Mixer. Furnish a truck mixer of an approved revolving drum or revolving blade type, constructed to produce a thoroughly mixed concrete mass with a uniform distribution of materials throughout. Keep the interior of the mixer drums free from hardened concrete.

Equip the truck mixer with a discharge mechanism which will ensure discharging of the mixed concrete without segregation. When the Engineer deems it necessary, provide baffle plates in the chute to avoid segregation in the concrete placed in the work. Make satisfactory repairs to any truck mixers that will not discharge concrete within the specified slump and air content ranges before using them.

Attach to each truck mixer a metal plate stating the manufacturer's capacities in terms of volume of mixed concrete for the various uses the equipment is applicable and the manufacturer's recommended speeds of rotation for mixing and agitation. For the mixer drum, apply the rates of rotation used for mixing and agitation as designated on the metal plate by the manufacturer of the equipment.

Do not allow the mixer drum to lose any water or concrete during charging, mixing, and agitation, or during transportation.

Equip the truck mixer with an automatic revolution counter that allows reading of the count at the plant and at the destination. Do not use trucks equipped with defective revolution counters. Keep the interior of the mixer drums free from hardened concrete. Equip tanks containing mixing water on all trucks with a device for accurately determining the quantity of water added at the job site.

Conduct annual tests to evaluate capability of the truck mixer to produce a uniform mixture according to KM 64-311. The Department will perform random checks of the tests.

D) Central Mixer.

1) Drum Type Mixer. Equip each drum type mixer with a batch counter and an approved timing device that automatically locks the discharge mechanism during the mixing period.
2) Pan Type Mixer. Equip each pan type mixer with a batch counter and an approved timing device that automatically locks the discharge mechanism during the mixing period.

601.02.17 Concrete Transfer Equipment. To transfer concrete from truck mixers or agitators, only use equipment of adequate design and dimension to deposit concrete of the specified slump at the point of placement.

601.02.18 Vibrators. Use a type and design approved by the Engineer that is capable of transmitting vibration to the concrete at frequencies to adequately consolidate the concrete and, when applicable, not damage the epoxy coating on reinforcing steel.

601.02.19 Tremies. Use tremies consisting of a tube having a diameter of 10 inches or more, constructed in sections having flanged couplings fitted with water tight gaskets.

601.02.20 Wire Brooms. Use Department approved wire brooms.

601.02.21 Slip Form Machine (Extrusion Machine). Use a self-propelled slip form machine designed to consolidate and finish the concrete in one pass without damaging or displacing any steel reinforcement, and that finishes the concrete to a smooth, uniformly textured surface conforming to the required cross section with a minimum of hand finishing.

601.02.22 Curing Compound Sprayer. To apply the membrane forming curing compound, use a sprayer consisting of a container having a capacity of no less than 5 gallons in which a consistent pressure can be maintained by mechanical means or by a suitable pumping arrangement in order to maintain a consistent pressure at the spray nozzle or nozzles, and to uniformly apply the membrane forming curing compound at the specified rate. Use nozzles designed to deliver a uniform, fine spray and that allow for easy cleaning. Provide a shield or apron to protect the spray from wind. Provide means for cleaning the nozzles as part of the spraying equipment.

601.03 CONSTRUCTION. Conduct a pre-pour meeting whenever the work will involve placing bridge slab concrete, concrete pumping, or trial batches. The Engineer will facilitate the meeting to discuss items such as timing of truck delivery, target air content and slump of delivered concrete, minimizing air content and slump loss through the pump, sampling location and procedures, and other items as appropriate. Attendance is required by the Contractor, concrete supplier, pump contractor (when pumping is involved), and jobsite inspector.

When the plans call for the bridge deck to be placed in phases and a change in sequence is desired, submit a request in writing to the Engineer. Include in the request the proposed sequence, supply rate of concrete delivery, retarder schedule, means of delivery (bucket/pump), and any other details which the Engineer may request. The Department will have the designer evaluate the requested change and determine feasibility. Make no changes without the Engineer's approval.

601.03.01 Care, Storage, and Handling of Aggregates, Cement, and Mineral Admixtures. Furnish, stock, and handle the fine and coarse aggregates at the job site or at the plant site to maintain uniformity of grading and free moisture contents at the time of batching. The Engineer may direct saturation to continue if necessary. Obtain the Engineer's permission prior to using materials stockpiled at areas remote from the plant site. The Engineer may revoke permission to use materials remote from the plant site any time it is apparent there is not uniformity of grading and free moisture content.

When storing in stockpiles, place each size aggregate in separate stockpiles sufficiently removed from each other to prevent the intermixing of material at edges of piles. Do not use materials which have become mixed with foreign matter, or fine and coarse aggregates which have become mixed with each other. Build stockpiles in layers not exceeding 3 feet in height. Complete each layer before beginning the next layer. Handle aggregates in a manner that ensures the uniformity of the moisture content for each pour. Do not batch directly from washing plants. When handling by hydraulic methods or when washing is involved, stockpile or use bins to drain all aggregates at least 12 hours before batching. Do not remove aggregates from stockpiles within one foot of the ground line until final cleanup of the work.

Protect stored cement from dampness at all times. For cement storage, use weatherproof buildings that have ample space for storing separate shipments readily identified and accessible for sampling. Remove the cement from storage in the order received, as practical, to avoid long storage periods.

Handle cement in a manner to prevent loss, wetting, or contamination.

When using bulk cement, maintain a clean and clear cement feed to the cement batching bin to maintain the correct batch weight at all times. Furnish to the Engineer daily records of the cement shipments to the job batch plant. The Engineer may not require daily records of cement shipments when using commercial concrete plants.

Do not allow the temperature of the cement at the time of its incorporation into the mixture to exceed 170 °F.

Store and handle fly ash and slag as specified for cement. Provide means, such as double wall separation, to prevent the intermixing of cement with fly ash or slag.

601.03.02 Concrete Producer Responsibilities. Obtain the concrete from producers that are in compliance with KM 64-323 and on the Department's List of Approved Materials. If a concrete plant becomes unqualified during a project and there are no other

qualified plants in the region, the Department will consider a request to provide a qualified personnel to witness and ensure the producer follows the required specifications. The Department will assess the Contractor a $100 per hour charge for this service.

Regardless of quantity, ensure that the all concrete producers comply with the following requirements:

A) General. Design concrete mixtures, and perform quality control and process control testing as needed.

B) Certified Personnel. Employ concrete technicians responsible for the design of the concrete mixtures and for performing quality control and process control testing as necessary. Ensure that the concrete technicians are certified as ACI Level I (Level I) and KCA Level II (Level II).

C) Quality Control. Take full responsibility for the batch weight calculations and quality control of concrete mixtures at the plant. Ensure that the Level II concrete technician is present when work is in progress and is responsible for inspecting trucks, batch weight calculations, monitoring batching, making mixture adjustments, reviewing the slump, air content, unit weight, temperature, and aggregate tests, all to provide conforming concrete to the project. A Level I concrete technician is responsible for testing production material for slump, entrained air, unit weight and temperature of the mixture. Ensure the technician performs all sampling and testing according to the appropriate Kentucky Methods.

Ensure that Level II concrete technicians cooperate with the Engineer in making minor adjustments to the mixture proportions within the limits of the specifications that may be desirable due to conditions at the job site.

D) Producer Testing. When producing for state work, have a Qualified Concrete Aggregate Technician or KYTC Qualified Aggregate Technician perform, at a minimum, weekly gradations and minus 200 wash tests and daily moisture contents of coarse and fine aggregate (Fine aggregates will not require a minus 200 wash test). Using the daily moisture contents, adjust the approved mix design accordingly prior to production. Ensure that the Level II concrete technician is present when work is in progress and is responsible for inspecting trucks, batch weight calculations, monitoring batching, making mixture adjustments, reviewing the slump, air content, unit weight, temperature, and aggregate tests, all to provide conforming concrete to the project.

E) Trip Tickets. Furnish a trip ticket containing the minimum information shown in the table below. Certify that the data on the ticket is correct and that the mixture conforms to the approved mix design. Ensure that the plant manager or a Level II concrete technician signs the ticket. The Department's jobsite inspector will complete all other necessary information on the back of the trip ticket. The trip ticket must be from the original concrete producer and only the original concrete producer is permitted to make mix adjustments.

Contract Id:	Proj. Number:	Date:	County:	
Truck No:	Producer Name:		SiteManager Sample Id:	
Qty(Yds^3):	Time Loaded (Non Agitated Concrete Only):			
Begin Mixing Time: _____ AM ____ PM ____ REV _____				
Set Retarder Used	Yes ___	Type____	No____	
Water Reducer Used	Yes ___	Type____	No____	
Water Underrun _____ Gal/Yd^3 _____ Total Gallons				
Design W/C:	Actual W/C:	Slump (inches)		
Batch Weight Information:				
Material:	Description:	Design Qty:	Required:	Batched: %Var: %Moisture: Actual:
Remarks:				
The data on this ticket is correct for the approved concrete mix design.				
Signature:			Date:	
	KRMCA Level II Technician or Plant Manager			

F) Records. Retain all concrete technician records, test results and batch tickets pertaining to concrete produced for a Department project for at least 3 years after formal acceptance of the project. Make all records available to the Engineer and the Contractor on the project for review upon request.

G) Mix Designs. Design the mixture for each class of concrete specified. Determine the proportions of materials to be used on an absolute volume basis. Establish quantities to yield as nearly practical, the design volume. Before producing any concrete for the project, submit a proposed mixture design to the Engineer and obtain the District Materials Engineer's or the Central Office Material's approval. Submit the mix design electronically using the Concrete Mix Design Spreadsheet located on the Division of Materials Website. Spreadsheets require the minimum system requirements: Microsoft Office 2003 Professional (full installation).

Consider any load of concrete delivered to the job site that fails to conform to specification requirements to be subject to rejection. The Engineer may allow the addition of water and admixtures at the job site. When the Engineer allows the addition of water or admixtures at the job site, take responsibility for the quantity to be added. Water may only be added to the load as a onetime addition prior to depositing any concrete into the structure or pavement. Do not allow the total water/cement ratio to exceed that listed in the Ingredient Proportions and Requirements for Various Classes of Concrete table. The Engineer may test remixed loads having additional water added to the mix at the job site. The Engineer will retest all loads when air entrainment admixtures are added at the jobsite. All acceptance testing will be performed after all permitted additions have been added and remixed.

1) New Mixture Designs. Base the proposed mix design on standard Department methods unless the District Materials Engineer or Central Office Materials approves otherwise. Include the following with the submitted design:

   a) The class of concrete and 28-day compressive strength.
   b) The source, specific gravity, percentage, and quantity of fine and coarse aggregate. The District Materials Engineer or Central Office Materials will provide an average value of the specific gravity and aggregate absorption.
   c) The cement producer, type, and pounds of cement per cubic yard.
   d) The mineral admixture supplier, type, class, percentage of cement reduction and replacement ratio, and total pounds per cubic yard.
   e) The source of water, predicted amount of total water per cubic yard, and the maximum allowable water per cubic yard.
   f) The brands and predicted dosages of admixtures per cubic yard.

If the concrete mixture is a class that the producer has not previously furnished to a Department project, have the producer provide trial batches of at least 4 cubic yards to demonstrate that the mixture will conform to the requirements for slump, air content, water/cement ratio, and compressive strength. Have the producer make the trial batches using the ingredients, proportions, and equipment (including batching, mixing and delivery time) to be used on this project. A Class A trial batch will qualify both Class A and Class P mixes. A Class M trial batch will also qualify as a Class P 24 mix. Have the producer make at least two trial batches conforming to all specified requirements. The two trial batches are to be conducted within a reasonable time frame which may be designated by the Engineer. Central Office Materials will observe all phases of the trial batches. Have the producer submit a report containing mix proportions and test results for slump, air content, water/cement ratio, unit weight, and compressive strength for each trial batch to the Engineer for Central Office Materials review and approval.

2) Approval. The District Materials Engineer or Central Office Materials will base approval of the mixture design on the following criteria:

   a) Provide concrete cylinders molded at the project site to verify that the specified compressive strength will be attained.
   b) The quantities of components given for a one cubic yard batch will, on the basis of absolute volumes, produce one cubic yard of concrete mix. Include the volume occupied by entrained air.
   c) The cement factor is at least the minimum specified in the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03.
   d) The water/cement ratio does not exceed the maximum specified in the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03.
   e) The aggregate sources, the cement supplier, the mineral admixture supplier or producer, and the admixture brands are on the Department's List of Approved Materials.
   f) The trial batches, when required, produce acceptable results. The Engineer or District Materials Engineer may request trial batches at any time before or during a project.

3) Changes in Approved Mixture Designs. Do not change the source of supply of the mixture ingredients without the District Materials Engineer's or Central Office Materials written permission. If it is necessary to change the source of aggregates, submit a new design reflecting the new source of aggregate to the Engineer. Upon the District Materials Engineer's or Central Office Materials written approval, the Department will allow the use of aggregate

from the new source.

601.03.03 Proportioning and Requirements.

A) Concrete.

INGREDIENT PROPORTIONS AND REQUIREMENTS FOR VARIOUS CLASSES OF CONCRETE

Class of Concrete	Approximate Percent Fine to Total Aggregate		Maximum Free Water by W/C Ratio[14] (lb/lb)	28-Day Compressive Strength [1] (psi)	Slump [4] (inches)	Minimum Cement Factor (lb/yd^3)	Air [11] Content (%)
	Gravel	Stone					
A[5]	36	40	0.49	3,500	2-5[7]	564	6 ± 2
A Mod	36	40	0.47	3,500	4-7	658	6 ± 2
AA[2]	36	40	0.42	4,000	2-5[12]	620	6 ± 2
B	40	44	0.66	2,500	3-5	451	6 ± 2
D[3]	35	39	0.44	4,000	3-5[6]	639	6 ± 2
D Mod[3]	35	39	0.42	5,000	3-5[6]	733	6 ± 2
M1[8] w/ Type 1 Cement or blended hydraulic cement	36	40	0.33	4,000[9]	7 max.	800	6 ± 2
M2[8] w/ Type III Cement	36	40	0.38	4,000[9]	7 max.	705	6 ± 2
P[5]	35	38	0.49	3,500	---[13]	564[10]	6 ± 2

[1] *The Department will determine non-payment, additional construction, or removal and replacement for concrete for which test cylinders indicate low compressive strength and any follow-up investigations indicate inadequate strength. The Department may require some classes to attain the required compressive strength in less than 28 days.*

[2] *When the ambient air temperature while placing slab concrete is 71 ℉ or more, add to the concrete a water-reducing and retarding admixture. The Engineer may require or allow, water-reducing and retarding admixture in slab concrete for ambient air temperatures of less than 71 ℉. Only use one type of admixture for concrete placed during any individual contiguous pour.*

[3] *The Department will require a compressive strength of 5,000 psi, or greater when specified in the Contract, at or before 28 days for prestressed members.*

[4] *The Engineer will allow slumps less than the minimum provided concrete is workable.*

[5] *The Department will allow the use of JPC pavement mixture for non-structural construction.*

[6] *At the option of the prestressed product fabricator, the Department will allow the slump of Class D or Class D Modified concrete to be increased to a maximum of 8 inches for all items, except products with voids. For products with voids, the slump may be increased to 7 inches. Provide a high range water reducer (Type F or G) in an amount not to exceed the following water/cement ratios:*

Summer mix designs - 0.39
Spring & Fall mix designs - 0.37

Winter mix designs - 0.34

(7) The Department may allow an increase of the slump of Class A concrete to a maximum of 7 inches provided that a high range water reducer (Type F or G) is used and maximum water/cement ratio of 0.46.

(8) Use a high range water reducer (Type F or G)

(9) The Department will require 3,000 psi compressive strength before opening to traffic and 4,000 psi at 28 days.

(10) 611 lb/yd^3 when using coarse aggregate sizes No. 8, 78, or 9-M.

(11) 7 ± 2% when using coarse aggregate sizes No. 8, 78, or 9-M.

(12) The Department may allow the slump of AA concrete to be increased up to a 7-inch maximum, provided the w/c ratio does not exceed 0.40 and a high range water reducer (Type F or G) is used. Trial Batches will be required if producer has not previously supplied.

(13) The Department does not have slump requirements for class P concrete mixes except for the edge slump requirements of Section 501.03.19.

B) Mortar, Grout, Flowable Fill, and Self-Consolidating Concrete. When required, ensure that the air content of mortar or grout is 8 percent ± 2 percent by volume. Do not allow the quantity of fly ash in mortar or grout to exceed 20 percent of the cement quantity.

1) Mortar. Proportion mortar mix with one part cement or cement with fly ash to 2 parts mortar sand, by volume. Add water in an amount not to exceed a water/cement ratio of 0.48.
2) Grout. Proportion grout with water and one part cement or cement with fly ash to 2 parts mortar sand, by volume. Adjust the water to produce a mixture of a consistency suitable for job conditions.
3) Non-Shrink Grout. Use the non-shrink grout on the Department's List of Approved Materials. Use an approved non-shrink, non-staining grout consisting of either a mixture of hydraulic cement, water, fine aggregate, and an approved non-ferrous expansive admixture, or a packaged commercial product conforming to ASTM C1107. To be placed on the Department's List of Approved Materials, non-shrink, non-staining grout, must conform to the following requirements:

    a) Use an initial set time of at least 45 minutes when tested according to ASTM C953. The Department will allow the use of a set-retarding admixture compatible with the expansive admixture.
    b) Use grout that has a minimum 7 day compressive strength of 4,500 psi when tested using applicable portions of ASTM C 109.
    c) Use grout that has a minimum durability factor of 85 percent and a maximum expansion of 0.06 percent when tested according to KM 64-626.
    d) Keep the water content of the grout as low as possible for proper grouting and do not exceed a water/cement ratio of 0.44. Do not exceed the manufacturer's recommendations for water added to commercial products.
    e) Ensure that the grout does not contain chlorides or nitrates in excess of 0.03%.
    f) Cure grout mixtures by covering with 2 layers of wet burlap or other approved covering so as to keep the grout continuously moist for at least 3 calendar days, except cure commercial mixtures as recommended by the manufacturer.
    g) Ensure that commercial products are non-ferrous and approximately match the color of hardened concrete.
    h) When preparing non-commercial grout mixture, submit a proposed mix

design and a sample of the expansive admixture to the Engineer for testing and approval before use.

i) When using packaged commercial grout, provide certified test results from the manufacturer showing the material conforms to ASTM C1107. When the Engineer requests, provide samples of the grout mixture for testing and approval.

4) Latex Grout. Use latex and cement mixture of a paste consistency.

5) Flowable Fill. Use flowable fill consisting of a mixture of cement, sand, fly ash, water, and other materials the Engineer approves. Contrary to Section 844, do not allow the loss on ignition for Class F fly ash to exceed 12 percent. Ensure that the concrete producer certifies mix proportions for flowable fill as follows:

a) Flowable Fill for Pipe Backfill. Proportion as follows, per cubic yard batch:

Cement	30 pounds
Fly Ash, Class F	300 pounds
Natural Sand (S.S.D.)	3,000 pounds
Water (Maximum)	550 pounds

b) Flowable Fill for Bridge End Bent Backfill. Proportion as follows, per cubic yard batch:

Cement	100 pounds
Fly Ash, Class F or Class C	300 pounds
Natural or Crushed Sand (S.S.D.)	2,950 pounds
Water (Maximum)	550 pounds

Alternate Mixtures for Flowable Fill. The Department may approve other mixtures. The mixtures may include other proportions of the above materials, Class C fly ash, chemical admixtures, or aggregate not conforming to the Standard Specifications. When deviating from the above specified proportions and materials, make and test a trial batch of at least 4 cubic yards to ensure that the mix will have flow and density characteristics suited for the intended use. Use the ingredients, proportions, and equipment intended for the project, including batching, mixing, and delivery.

The Department will observe all phases of the trial batching for approval. Ensure the proposed mixture is proportioned to obtain a minimum flow of 8 inches when tested with a 3 by 6 inch open ended cylinder modified flow test and meets applicable strength requirements. Ensure additional requirements, as stated below, for time of bleeding and time to achieve firmness are met when appropriate for application. Submit the proposed mixture proportions and appropriate test results to the Engineer for review and approval. When the mixture is proprietary, comply with Subsection 107.05.

The Department will cast, cure, and break test cylinders from the flowable fill trial batch according to ASTM D 4832 using 4x8 cylinders. Prior to completion of the 28 day curing period, transport the test cylinders to the MCL for compressive strength testing. Obtain an average compressive strength of 50 to 100 psi at 28 days for application as pipe backfill or minimum compressive strength of 250 psi at 28 days for application as bridge end bent backfill. For applications requiring early opening to traffic or placement of pavement as soon as possible, provide a mixture that conforms to the following general guidelines:

1) Mixture bleeds freely within 10 minutes.

2) Require the mixture to support a 150-pound person within 3 hours.

The Engineer will approve flowable fill, delivered to the project, based on certifications indicating proper proportions for the intended use.

6) Self Consolidating Concrete (SCC). Conform to KM 64-320 with application limited to precast plants.

C) Mixtures Using Type IP(≤20), IS(≤30), and IL Cement and Mineral Admixtures. The Engineer will not consider any Contract time extension requests for delays due to additional time necessary to attain specified strengths. Seasonal limitations on the use of Type IP cement and fly ash in bridge decks are specified in Subsection 601.03.09 D).

1) Type IP(≤20), IS(≤30), IL Cement. The Department will allow the use when substituted for Type I cement, pound for pound.

To produce the necessary workability, strength properties, and expected durability of the concrete, the Department will allow adjustment of the proportioning, air entraining agent, and finishing requirements; and acceptance procedures. Obtain the Engineer's approval for all such adjustments.

Conform to all strength requirements for loading structures or removing falsework before applying loads or removing falsework. If strength requirements are not met, increase the minimum times specified in the Required Time in Calendar Days before Removing Forms and Falsework table in Subsection 601.03.14 and the Required Time in Calendar Days before Applying Significant Loads on Concrete Structures table in Subsection 601.03.15 by 33 percent.

Ensure that the mixture contains the specified amount of entrained air.

2) Mineral Admixtures. The use of fly ash, slag cement, or micosilica in concrete is the Contractor's option. Reduction of the total cement content by a combination of mineral admixtures will be allowed, up to a maximum of 40 percent.

When the ability to use slag cement or microsilica has not been demonstrated have the concrete producer provide trial batches in accordance with Subsection 601.03.02 G) 1). Have the producer make the trial batches using the ingredients, proportions, and equipment (including batching, mixing and delivery time) to be used on the project. Furnish all required materials and samples at no cost to the Department.

a) Fly Ash. When added as a separate ingredient, the Department will allow the use of fly ash to reduce the quantity of cement, except do not use fly ash to reduce the quantity of Type IP cement. The Department will allow the use of Class F fly ash to reduce the quantity of cement up to a maximum of 20 percent of the minimum cement content. For each 1.0 pound of cement reduced, add at least 1.0 pound, but no more than 1.25 pounds, of Class F fly ash.

The Department will allow the use of Class C fly ash to reduce the quantity of cement up to a maximum of 30 percent of the minimum cement content. For each 1.0 pound of cement reduced, add 1.0 pound of Class C fly ash.

Incorporate and uniformly distribute the fly ash into the mixture using methods and equipment that the Engineer approves. The Department will allow weighing of fly ash cumulatively in the same weigh hopper with the cement, but weigh the cement first.

Conform to all strength requirements for loading structures or removing falsework before applying loads or removing falsework. If strength requirements are not met, increase the required times specified

in the Required Time in Calendar Days Before Removing Forms and Falsework table in Subsection 601.03.14 and the Required Time in Calendar Days Before Applying Significant Loads on Concrete Structures table in Subsection 601.03.15 by 33 percent.

To produce the necessary workability, strength properties, and expected durability of the concrete, the Department will allow adjustment of the proportioning, air entraining agent, finishing requirements, and acceptance procedures. Obtain the Engineer's approval for all such adjustments.

Calculate the maximum free water based on the total cementitious material including fly ash. Do not change any of the slump requirements.

Ensure that the mixture contains the specified amount of entrained air.

b) Slag Cement. When added as a separate ingredient, use Grade 120 or Grade 100 Slag to reduce the quantity of cement, except do not use slag cement to reduce the quantity of Type IS(≤30) cement. The Department will allow the use of slag cement to reduce the quantity of cement up to a maximum of 30 percent of the minimum cement content. For every 1.0 pound of cement reduced, add 1.0 pound of slag cement. The combined weight of the cement and slag cement will determine the minimum cement factor and water cement ratio. Due to the lower specific gravity of slag cement, the concrete volume will increase. Unless directed by the Engineer, adjust the increased volume by reducing an equal volume of the fine and coarse aggregate in the mixture.

Use Type I cement unless otherwise specified. Use Type II cement only if requested and approved in writing. When additional cements are approved, store and handle the cement so intermixing does not occur. Work done with each cement shall be readily identifiable. If test results are unsatisfactory, complete the work using Type I cement. Use only one brand of cement for each structure unless otherwise permitted by the Engineer.

Weigh the cement first when weighing slag cement cumulatively in the same weigh hopper. Incorporate the slag cement into the mixture by methods and equipment that ensure uniform distribution throughout the mixture.

c) Microsilica. When added as a separate ingredient, replace cement with microsilica as a percentage by weight specified elsewhere in the contract. When not specified elsewhere, replace 7 percent. The Department will allow the use of microsilica to reduce the quantity of cement up to a maximum of 10 percent of the minimum cement content. The combined weight of the cement and microsilica will determine the minimum cement factor and water cement ratio.

Use a high range water reducer conforming to ASTM C 494, Type F or Type G. Incorporate into the microsilica slurry or add at the time of batching for dry microsilica.

Use Type I cement unless otherwise specified. Use Type IS(<30) or Type II cement only if requested and approved in writing. When additional cement types are approved, store and handle the cement so intermixing does not occur. Work done with each cement shall be readily identifiable. If test results are unsatisfactory, complete the work using Type I cement. Use only one brand of cement for each structure unless otherwise permitted by the Engineer.

Weigh the cement first when weighing microsilica in the dry or pellet form cumulatively in the same hopper. When the microsilica is in a slurry form, verify the dispenser or other means of measurement to the Engineer's satisfaction. The percent of microsilica will be considered in the measurement determinations and in the proportioning calculations.

When the microsilica admixture is in a slurry form, continuously recirculate by pumping. Begin recirculation at least four hours before batching and continue until batching operations cease.

When using a truck mixer, limit the mixer charge to 3/4 of its rated capacity, unless the Engineer approves a larger size.

D) Department Tests. The Department will test the work at the minimum frequencies indicated in the Manual of Field Sampling and Testing Practices or as necessary to determine the quality. The Department will perform the tests according to procedures outlined by the applicable Kentucky Method. The Department will cast and test compressive strength specimens according to KM 64-305 and ASTM C 39, respectively. In cases of failures, the Department will evaluate cylinder results according to KM 64-314 to determine whether in-place investigation may be necessary.

E) Measuring. Conform to the individual ingredient material batching tolerances in Appendix A.

1) Cement. Measure cement by weight, considering one bag equal to 94 pounds, or weigh it in bulk on scales. When the weight of an entire shipment of cement in bags varies more than 2 percent from 94 pounds per bag, weigh the cement in bulk on scales. Do not produce batches from fractional bags, unless the entire quantity of cement is batched by weight as required for handling bulk cement.
2) Aggregates. Measure fine and coarse aggregates by weight, making corrections for moisture content. When the fine and coarse aggregates used contain more than the maximum free water stipulated in the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03, increase the cement content according to the concrete proportioning requirements, and ensure that the maximum water/cement ratio is not exceeded.
3) Water. Measure water either by weight or by volume. Use an approved visible measuring device for measuring water. Use only water meter systems and other approved volumetric systems that can accurately deliver into the mixer, to within ± 1 percent of the required amount of water per batch and are arranged to automatically stop flow of water when the required quantity has been delivered into the mixer. When the water measuring device fails to deliver the quantity of water discharged into the mixer within the limits specified, suspend operation of the mixer until making repairs and proper adjustments. Assume water weighs 8.34 pounds per gallon.

   Each time the scales are checked, check, or obtain an approved scale company to check, water meter systems for accuracy in the presence of the Engineer. Ensure that all calculations are included in the scale company's report.

   Withhold a portion of the water until the last part of the batching process to wash any cement that is sticking to the sides of the mixer into the mix.
4) Measuring Admixtures. Introduce liquid admixtures into the concrete batch along with, or as part of, the mixing water. Keep air-entraining admixtures completely separate from all other admixtures until introduction into the batch. Maintain and equip dispensing equipment to ensure no chlorides are introduced into any Department mix.

   Use approved dispensing equipment with a meter, gauge, or scale that can accurately be pre-set for the needed amount of admixture and can consistently deliver quantities of admixture to successive batches at any setting with satisfactory accuracy. The dispensing equipment must be visible to the batch operator. Ensure admixture dispensers are inspected, calibrated and certified every 6 months.

   The Department may allow admixtures to be added, to the truck, at the

project site provided the Engineer's approval is obtained first. Air detraining admixtures are not to be permitted

601.03.04 Classes and Primary Uses. Use the following classes of concrete in the types of construction designated.

A) Class A. All reinforced concrete abutments below top of caps including pedestals, retaining walls, box culverts, pipe culvert headwalls, nonstructural concrete, and all items for which the concrete class is not specified.
B) Class A Modified. All concrete deposited under water.
C) Class AA. All reinforced concrete in bridge substructures and superstructures above the tops of caps, excluding pedestals.
D) Class B. Gravity retaining walls, and all non-reinforced concrete deposited as fill for cavities or voids and mass footings.
E) Class D. Prestressed I beams, cast-in-place piles, and precast piles.
F) Class D Modified. Prestressed box, slab, and I-beams; and prestressed concrete piles.
G) Class M1. High early strength for bridge joint repair and full or partial depth bridge deck patching. (Type 1 cement or blended hydraulic cement)
H) Class M2. High early strength for bridge joint repair and full or partial depth bridge deck patching. (Type III cement)
I) Class P. JPC pavement.
J) Mortar. Concrete pipe joint seals, leveling drainage structure flowlines, and filling around inlets or outlets of drainage structures.
K) Flowable Fill. Backfill for pipe and bridge end bents
L) Grout. Patching, filling spalled areas, or other uses specified in the Contract.
M) Latex Grout. Bond coat between existing bridge surface and new overlays; and joint sealing for centerline and other construction joints and minor cracking on overlays.
N) Non-Shrink Grout. Bonding and sealing for post-tensioning, tie-back rods and bolts, and box beams.
O) Self-Consolidating Concrete (SCC). Precast Units.
P) Dry Cast. Precast units.

601.03.05 Admixtures. For all classes of concrete, add at least a water-reducing admixture. Water reducing admixtures are not required when slip forming is used for concrete placement. The Department will allow the use of other admixtures when specified or approved by Engineer. The Department will allow admixtures according to the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03. Follow the manufacturer's recommendations in determining the quantity of admixture to use.

Ensure that the concrete producer establishes the quantity of air-entraining admixture necessary to produce a mixture having the specified air content for the class of concrete being produced. Add air-entraining admixtures separately from other admixtures, and keep them separate until introducing them into the mixing water or concrete mixture. The Engineer will not require air-entraining of mortar or grouts, except when they are exposed to freeze-thaw conditions.

Ensure that any type of admixture is uniform in properties throughout its use in the work. Only dispense of admixtures in liquid form unless the Engineer approves prepackaged powdered water reducing admixtures. When using more than one admixture ensure that the admixtures are compatible. When using fly ash, ensure that the concrete producer uses fly ash compatible admixtures.

Clearly label admixture containers that indicate the exact brand name and type of admixture. Store products in containers with the correct label. Store admixtures where the liquid temperatures can be maintained between 32 and 110 °F.

When using water-reducing and retarding admixtures provide the Engineer with manufacturer's recommendations regarding the quantity of admixture used and expected

retardation period for the job mixture and conditions.

601.03.06 Slump. The Department will measure the slump of the concrete as described in KM 64-302. Do not exceed the water/cement ratio, including the free water on the aggregates, according to the Ingredient Proportions and Requirements for Various Classes of Concrete table in Subsection 601.03.03. In general, use a mixture which contains the minimum quantity of water required by these specifications, and ensure that concrete mixtures are such that:

1) mortar clings to the coarse aggregate;
2) concrete is not sufficiently fluid to segregate when transported to the place of deposit;
3) mortar shows no free water when removed from the mixer;
4) concrete, when transported in metal chutes at an angle of 30 degrees with the horizontal, slides rather than flows into place; and
5) upper layers of the hardened concrete show a cement film on the surface but are free from laitance.

601.03.07 Delivery. Mix the concrete in the quantities required for immediate use. Except for prestressed box beams, do not allow an interval greater than 20 minutes between delivery of batches placed contiguously in the work. When using concrete with a water reducing and retarding admixture, the Engineer will allow a 30-minute intervals between the delivery of batches, except for bridge deck slabs. For prestressed box beams, the Engineer will allow a 45-minute interval for delivery of batches between placement of the bottom slab and the remainder of the box beam when using concrete with a water reducing and retarding admixture.

After adding all water, cement, and aggregates to the mixer, deliver and place concrete in its final position within the time limits listed in the following table. Do not use concrete that has developed initial set, that has become segregated, or that has not been delivered within the time limits listed.

TIME OF DISCHARGE LIMITS [1] (minutes)					
Normal Concrete [2]			Retarded Concrete [3]		
Agitated [4]	Agitor [5]	Non-Agitated	Agitated [4]	Agitor [5]	Non-Agitated
60	45	30	90[6]	60	30

[1] *All times begin when cement first enters the mixer.*
[2] *Normal concrete is concrete without the addition of a water-reducing and retarding admixture.*
[3] *Retarded concrete is concrete to which a water-reducing and retarding admixture has been added at the Engineer's direction or approval.*
[4] *Agitated is defined as concrete that has been continuously agitated from the time of initial contact between cement and mixing water to the time of placement at the site of work.*
[5] *An agitor is a truck with paddles.*
[6] *120 minutes for Class B concrete placed in miscellaneous work such as fence post footings.*

601.03.08 Mixing Concrete.

A) General. The Department will allow mixing of concrete at the site of work or the use of ready-mixed methods. Ready-mixed concrete includes central-mixed and truck-mixed concrete. Site mixing includes batch mixing and continuous mixing. The Engineer may allow hand mixing.

B) Site Mixing. Thoroughly mix concrete in a batch mixer or continuous mixer.

Maintain the mixer, whether batch or continuous type, free of partially dried or hardened materials at all times. Consistently produce concrete to provide a uniform thoroughly blended mixture within the specified air content and slump limits.

1) Batch Mixing. Mix all concrete for a period of no less than 60 seconds after all materials, including water, are in the mixer. During the period of mixing, operate the drum at the manufacturer's recommended drum speed. When necessary, continue mixing until all aggregates are thoroughly coated with mortar.

   Remove the entire contents of the mixer from the drum before adding any materials for the succeeding batch. Deposit materials composing a batch simultaneously into the mixer. Do not operate any mixer above its rated capacity.

2) Continuous Mixing. The Department will allow the use of continuous type mixers for Class A or Class B concrete, except do not use them to place concrete in bridges or box culverts. Notify the Engineer of any proposed changes in the proportioning of any of the ingredients. Maintain the free-moisture content of the fine aggregate within the limits necessary to produce concrete conforming to these specifications.

   Perform slump tests on mixtures produced by continuous type mixers 4 to 5 minutes after depositing the concrete.

C) Ready-Mixed. When electing to use ready-mixed concrete, prevent delays in delivery and placing concrete. Provide a means of direct voice communication between the inspector at the job site and the inspector at the plant.

1) Truck Mixing. Accurately measure and control the entire quantity of mixing water to within ± 1 percent accuracy. Mix each batch no less than 70 revolutions at the plant site, at the rate of rotation the manufacturer specifies for a mixing speed. The Department will allow a reduction in mixing to 50 revolutions when the batch is charged so that all ingredients, including water, are uniformly blended during charging to produce a satisfactory mixture. In this case, mix the concrete an additional 10 revolutions at the specified mixing speed at the job site. When the Engineer allows additional water or admixtures at the job site, mix the concrete an additional 30 revolutions at the specified mixing speed after addition. Perform any additional mixing at a lower speed as the mixer manufacturer specifies for agitation, and continuously agitate until discharging the batch.

   Replace or repair any truck mixer that does not produce a uniform mixture.

2) Central Plant Mixing. When using a central-mixing plant, mix the concrete in an approved drum type mixer or pan type mixer. For drum type mixers having a rated capacity of 2 cubic yards or less, mix for a minimum of 60 seconds. For mixers having capacities greater than 2 cubic yards, mix for a minimum of 90 seconds. The Department will allow a reduction in the minimum mixing time for drum type mixers from 90 to 75 seconds when the concrete ingredients are uniformly blended during the charging of the mixer. In order to attain uniform blending, charge the batch so that the flows of

water, coarse aggregate, fine aggregate, and cement are started, continued, and ended simultaneously or nearly simultaneously.

For pan type mixers having a rated capacity of 3 cubic yards or less, mix for a minimum of 45 seconds. Increase the mixing time for pan type mixers having rated capacities greater than 3 cubic yards by 15 seconds for each 3 cubic yards, over that allowed for the 3-cubic yard mixer. Any fraction of 3 cubic yards is considered to be 3 cubic yards.

The Engineer may increase the minimum mixing time for any type of mixer if the mixer does not produce the desirable quality with respect to uniformity of mixture, slump, and air content, or upon proof by tests that concrete of an undesirable quality with regard to compressive strength would be prevented by additional mixing. Measure the mixing time from the time all cement and aggregates are charged into the mixer until the mixer is ready for discharging.

Deliver concrete for use at points other than the central plant site in approved truck mixers. Start agitating immediately after introducing the batch into the mixer and continue without interruption until discharging the batch. Completely discharge each batch before introducing the succeeding batch.

The Department will allow the delivery of central-mixed concrete without agitation to a structural unit having a volume not exceeding 10 cubic yards, provided the time of delivery does not exceed the 30-minute limit listed in the Time of Discharge Limits table in Subsection 601.03.07 and the interval between delivery of batches does not exceed 20 minutes.

601.03.09 Placing Concrete.

A) General. Deliver concrete to its final position of placement within the time required for delivery after mixing and within the required time interval between delivery of batches as specified for the method of mixing and handling employed. Moisten forms and reinforcement with water immediately before placing the concrete.

Ensure that all equipment used for handling or placing concrete accommodates concrete of the proportions and consistencies as specified. The Engineer will make no adjustments in mixture proportions to accommodate equipment incapable of handling concrete of specified proportions and consistencies.

Whenever possible, completely remove water from all foundation excavations before depositing concrete. When it is necessary to deposit concrete under water, place concrete according to the requirements specified.

Employ methods and manners of placing concrete that avoid segregation or separation of aggregates or displacement of reinforcement. The Department will allow the use of long chutes, troughs, belts, and pipes for conveying concrete from the mixing plant or point of delivery to the forms only with the Engineer's written permission. When the Engineer allows such conveyers and the quality of concrete or methods of placing or working it are not satisfactory, discontinue their use and re-equip his plant or conveyance to place concrete in a satisfactory manner. Arrange and use troughs, pipes, or chutes used as aids in placing concrete so that ingredients of the concrete are not separated. Where steep slopes are required, equip the chutes with baffle boards or provide the chutes in short lengths that change the direction of movement. Maintain all chutes, troughs, and pipes clean and free from coating of hardened concrete by thoroughly flushing with water after each run or when out of operation for more than 30 minutes. Discharge water used for flushing clear of in-place concrete. Use troughs, pipes, and chutes that are either metal or metal lined and extend as near as possible to the point of deposit. Do not use aluminum or aluminum alloy troughs, pipes, or chutes that have surface damage or for lengths greater than 20 feet.

Do not drop concrete in excess of 5 feet without using pipe or tremies, and do not deposit a large quantity at any point and run or work it along the forms. When pumping, equip the delivery pipe with a nozzle, having a restricting device at the discharge end. Maintain the discharge end of the pipe as close to the point of deposit as feasible. Place concrete to entirely fill but not bulge or distort the forms or to disturb their alignment. Fill each part of the forms by depositing concrete as near its final position as possible, to work the coarser aggregate back from the face, and to force concrete under and around reinforcing bars without displacing them. After concrete has taken its initial set, avoid jarring the forms or placing any strain on ends of projecting reinforcement.

Consolidate concrete in all bridges and box culverts with a mechanical vibrator operated within the mass of concrete. Consolidate concrete in all other concrete construction, exclusive of pavement, either by vibration as described herein or with approved spading tools. When vibrating concrete, the Engineer will require spading in addition to vibrating to prevent formation of honeycomb, voids, and air pockets against the forms, except for concrete placed in pavements, bridge slabs, footings, and culvert slabs.

Provide vibration of sufficient intensity and duration to cause flow or settlement of the concrete and complete consolidation, but ensure that vibration is not used to cause concrete to flow over long distances in the forms or is unduly prolonged to cause segregation or undesirable laitance at the surface of the lift being consolidated. Use plastic coated vibrators, when necessary, to prevent damage to the epoxy coating of the steel. Provide and use a sufficient number of mechanical vibrators to ensure that consolidation can be started immediately after concrete has been deposited in the forms. Do not attach the mechanical vibrator to the forms or reinforcing steel or apply to the surface of the concrete. Apply the vibrator to the concrete immediately after depositing the concrete and move it throughout the mass, thoroughly working the concrete around the reinforcement, embedded fixtures, and into angles and corners of the forms. Design forms to provide for requirements of vibration.

Place concrete in continuous horizontal layers not exceeding a thickness of one foot, unless otherwise specified for different types of structures. In any given layer, place and consolidate consecutive batches before the preceding batch has taken its initial set. Ensure that each layer of concrete retains a rough surface to secure efficient bonding with the next layer. Consolidate a succeeding layer placed before the underlying layer has set in a manner that will entirely break up and eliminate the tendency to produce a cold joint between layers.

Construct the bridge seats comprising the area of that portion of the pier or abutment tops receiving steel bridge bearings to an elevation of 1/8 inch greater than that specified in the Plans for an area in excess of the bearing area occupied by masonry bearing plates. Construct this excess material for the bearing area with mortar of the same proportions as that in the concrete and cast it monolithic with the pier or abutment. Prevent the coarse aggregate from being placed within 1/4 inch of finished elevation specified in the Plans. Immediately after depositing the mortar, strike the surface off by means of a wooden float. When the concrete has thoroughly hardened, finish it to the true, correct elevation specified in the Plans by tooling and polishing. Test the finished surface with a spirit level, and ensure that there is no variation in excess of 1/32 inch above or below a true level plane.

When temporarily discontinuing placing, clean the concrete, after it becomes firm enough to retain its form, of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, make construction joints according to Subsection 601.03.10.

Regulate the method and manner of placing concrete so as to place all construction joints across regions of low shearing stress and in locations that will be hidden from view the greatest possible extent. Use methods and sequences of placing concrete for various types of concrete bridge construction as specified for

the particular type of construction involved.

Deposit and consolidate concrete to form a compact, dense, and impervious mass of uniform texture having smooth faces on exposed surfaces. When any section of concrete is defective, remove and satisfactorily replace or repair it as directed.

B) Placing Concrete Under Water. Do not expose concrete to the action of water before setting, or deposit it in water, except upon the Engineer's written permission. Mix all concrete deposited under water in proportions specified for Class A Modified. Place concrete deposited under water in its final position by means of a tremie or by other approved methods. Do not disturb it after depositing. Provide a sufficient number of tremies or other approved devices to ensure proper distribution of concrete to all portions of the seal. Maintain calm water at the point of deposit. Do not place any concrete in flowing water. Ensure that all form work, such as interlocking sheeting, designed to retain concrete under water is water-tight.

Regulate the consistency of the concrete to prevent segregation of materials. Maintain the surface of the concrete as nearly horizontal as practical at all times. To ensure thorough bonding, place each succeeding layer before the preceding layer has taken its initial set.

Close the discharge end at the start of work to prevent water from entering the tube. Induce the flow of concrete by slightly raising the tremie, but always keeping the discharge end in the deposited concrete. Stop the flow by lowering the tremie. Provide a continuous flow and, unless unavoidable, do not interrupt it until completing the work.

The Department will allow dewatering when the concrete is sufficiently strong to withstand hydrostatic pressure, but in no case in less than 3 calendar days after placing, or such additional length of time as the Engineer may direct. Remove all laitance or other unsatisfactory material from the exposed surfaces by scraping, chipping, or other means which will not injure the concrete surface, as the Engineer directs.

When it is necessary to use a concrete seal in construction of a foundation, construct it as hereinafter described. A concrete seal in a foundation is that volume of concrete placed under water by means of a tremie or other approved means for sealing the entire bottom area of the excavated pit within the cofferdam against hydrostatic pressure, to dewater the excavation and construct the remainder of the foundation in dewatered forms. Use Class A Modified concrete for the seal, and in general make the thickness of the seal course 0.43 times the hydrostatic head exerting pressure on the bottom of the foundation, or of a thickness as specified in the Plans. Place the corners of the seal to an elevation lower than the remaining surface of the seal course for the purpose of dewatering. In such cases, do not exceed an elevation difference between the corners and the remaining surface of 6 inches.

C) Placing Flowable Fill. To place flowable fill requires a minimum trench width of 6 inches clearance on each side of the pipe. The Engineer will allow standing water to be in the trench when backfilling with flowable fill. Deep trenches may require bleeder trenches or placement in layers to drain excess water.

Because certain types of pipe may float, backfill in lifts or anchor the pipe when necessary. Backfilling in lifts is more applicable to long lines of pipe, allowing time for a substantial amount of the water to dissipate before applying the next lift. The Department will allow the use of adequately spaced anchors made of small lumber or metal straps to anchor the pipe. For larger diameter pipe, it may be possible to maintain a surge of flowable fill on top of the pipe to prevent floating. Floating usually does not occur after the level of the backfill is above the springline of the pipe. Ensure that the pipe remains in the correct horizontal position and elevation.

Place flowable fill by discharging directly from truck chutes into the trench or place by means of conveyors, buckets or pumps. When pumping, fill the voids

adequately with solid particles to provide cohesion during the transport through the pump line under pressure to prevent segregation and line blockage. Maintain continuous flow through the pump line to prevent segregation and line blockage.

Place the flowable fill from the top of the compacted bedding to the bottom of the pavement structure. Unless the Engineer directs otherwise, allow a minimum of 2 hours before adding and compacting any material above the flowable fill.

To expedite settling and hardening in cool weather, drain or pump the bleed water from the surface or overfill the trench to allow bleed water to flow out. When overfilling, remove all excess material after hardening.

The flowable fill will bleed water within 5 to 10 minutes after placement. The release of water by bleeding causes the solid particles to realign and become firm. A delay in bleeding indicates there are too many fines in the mixture or insufficient water. If the maximum water was added, reduce the fly ash quantity in increments of 50 pounds until the mixture bleeds freely. Add approximately 60 pounds of sand to replace each 50-pound increment of fly ash to maintain the original yield. When 2 increment reductions, 100 pounds total, do not promote free bleeding of the mixture, evaluate other possible remedies. The flowable fill is too dry when cracks develop as it flows into place.

D) Weather Limitations and Protection. Designate an employee for the Engineer to contact in case of unexpected situations. The Department reserves the right to discontinue concrete placement when the means of protection or method of placement does not produce satisfactory results.

Maintain the temperature of the mixture at or below 90 °F during placement. Unless the Engineer determines that safety concerns or other considerations prohibit a shutdown, cease concrete production when the mixture exceeds 90 °F until adequate methods are in place to reduce or maintain the mixture temperature. Ensure that the temperature of the concrete mixture immediately before placing in bridges or box culverts is between 50 and 90 °F. When the ambient air temperature is above 90°F, cool the temperature of the forms, reinforcing steel, steel beam flanges, and other surfaces that will come in contact with the mixture to below 90 °F by means of a water spray or other approved methods. Allow excess water to drain, or remove it from the forms before placing concrete. Do not place concrete in box culverts or bridges if the ambient temperature exceeds 100 °F.

Maintain a minimum surface concrete temperature of 45°F for 3 calendar days after placement and at a minimum surface concrete temperature of 40°F for an additional 4 calendar days, unless acceptable cylinder strength is achieved, as determined by the engineer.

Do not place concrete during times of the year that ambient temperatures may be expected to drop below the 45 °F or 40 °F limits, unless there are adequate provisions at the job site for maintaining concrete at the specified temperature. Do not place concrete in contact with any material coated with frost or having a temperature of 32°F or lower. Submit a written plan detailing the methods to be used for protecting concrete for the Engineer's review. When performing cold weather concrete work, provide and install recording thermometers or other approved temperature measuring devices.

In cold weather, heat all water and/or aggregate so the temperature of the mixed concrete is no less than 50 °F or more than 90°F at the time of placement. To avoid the possibility of flash set when water or aggregate is heated to above 100 °F, mix the water and aggregate before adding the cement, and do not exceed a temperature of 90 °F for the mixture of water and aggregate when adding the cement.

When using artificial heat, provide a means to maintain adequate moisture in the air within the enclosure. Maintain surfaces of all concrete in a moist condition as specified for curing during the entire curing period. When using artificial heat, do not exceed a temperature of 90 °F for concrete near the source of heat, and maintain the temperature of concrete remote from the source of heat higher than

the designated 45 °F or 40 °F for the time of curing after placement. When using stoves or salamanders, make adequate provisions for fire protection.

Assume all risk connected with placing concrete under these conditions, and even with the Engineer's permission to do the work, take responsibility for proper results. Should concrete placed under such conditions prove unsatisfactory, remove and replace it with satisfactory concrete.

Do not use fly ash or Type 1P cement in bridge decks, JPC pavement, JPC base, or JPC shoulders between November 1 and March 1 if the item is to be opened to public traffic and exposed to deicing salts. If the item will remain closed to public traffic until the following spring or later, the Department will allow the use of fly ash or Type 1P cement during this period.

601.03.10 Construction Joints.

A) General Requirements for Structures. When work of placing concrete is delayed until the concrete attains its initial set, deem the point of stopping to be a construction joint. Locate construction joints in the structure as specified in the Contract for the different types of structures; but, when the volume of concrete is too great to be placed without the use of additional construction joints, locate and construct the additional construction joints without impairing the strength or appearance of the structure as the Engineer approves. Avoid construction joints through paneled wingwalls or other surfaces to be treated architecturally. To avoid visible joints as far as possible upon exposed faces, finish the top surface of concrete adjacent to the forms by smoothing with a mason's plastering trowel. Where a featheredge might be produced at a construction joint, as in the sloped top surface of a wingwall, use an inset form work to produce a blocked out portion in the preceding layer that produces an edge thickness of 6 inches or more in the succeeding layer. Do not stop or temporarily discontinue work on any section or layer within 18 inches below the top of any face unless details of the work provide for a coping having a thickness less than 18 inches. When the details provide for a coping having a thickness less than 18 inches, the Engineer may allow placement of the construction joint at the underside of the coping.

Whenever construction joints are required and in the opinion of the Engineer an insufficient quantity of reinforcement is projecting to secure satisfactory bond, accomplish bonding as specified in B) below.

B) Bonding Construction Joints for Structures. In joining fresh concrete to concrete that has already set, or to preceding layers, thoroughly clean the surface of work already in place of all laitance, loose, and foreign material. Then, wash and scrub this surface with wire brooms and thoroughly drench with water until saturated. Keep the surface saturated until placing new concrete. Immediately before placing new concrete, draw all forms tight against concrete already in place.

After interrupting concrete placement and forming a construction joint, interlock with the succeeding concrete by forming suitable keys in the concrete. Form these keys by inserting and subsequently removing beveled wood strips. Thoroughly saturate the wood strips with water before inserting them. The Department may allow the use of steel dowels instead of keys. The Engineer will determine the size and placement of keys and dowels.

C) Non-Structural Concrete Items. When non-structural concrete items are constructed on top of rigid pavement, ensure that construction joints in the non-structural items coincide with the pavement joints. Install expansion joint material 1/2 inch thick and cut it to conform to the cross section of the non-structural item at all construction joints. When a construction joint is within 100 feet of a break in alignment or a drainage structure; treat the construction joint as a contraction joint.

601.03.11 Falsework. Design and construct falsework that provides the necessary rigidity, supports the loads imposed, and produces, in the finished structure, the lines and

grades specified in the Plans. Have a Registered Professional Engineer design all falsework that is not a Department standard design for structures with clear span lengths of 20 feet or more and all falsework where traffic openings are specified.

Furnish the Engineer detailed working drawings in triplicate and design calculations for falsework. Do not begin any falsework construction until the Engineer has reviewed the falsework drawings. Take full responsibility for any falsework constructed prior to the Engineer's review of falsework drawings. Do not place any concrete until the Engineer has completed the review of the falsework drawings. Provide time for the Engineer to complete this review that is proportionate to the complexity of the falsework design; however always provide at least 3 weeks. For falsework over railroads or navigable streams, the Engineer's review of the falsework drawings will be contingent upon the drawings being satisfactory to the railroad company involved, US Coast Guard, Army Corps of Engineers, or other agency having jurisdiction, as applicable.

The Department will allow the revision of falsework drawings at any time. When requesting a revision, allow sufficient time for the Engineer's review before starting construction on the revised portion.

When using footing type falsework foundations, decide the bearing value of the soil, and show the values assumed in the design of the falsework on the falsework drawings. Show assumed values for both wet and dry soil conditions.

Construct slab forms between girders with no allowance for settlement relative to the girders.

Ensure that the design load for falsework consists of the sum of dead and live vertical loads. Include the weight of concrete, reinforcing steel, forms, and falsework in the dead loads. Assume the weight of concrete, reinforcing steel, and forms to be no less than 160 pounds per cubic foot of concrete. In addition to the full dead load, assume a live load of 50 pounds per square foot for horizontal surfaces and finishing machine weight, if necessary, in the design of falsework and centering.

Design the falsework so that horizontal loads are resisted in any direction by diagonal bracing, blocking, ties, or other means the Engineer approves, to be no less than 2 percent of the total dead load.

Design falsework footings to carry the load imposed upon them without exceeding the estimated soil bearing values and all anticipated settlements. When post-tensioning the concrete, design the falsework to support any increased or readjusted loads caused by the post-tensioning.

Ensure that the design of all plywood form panels and studs supporting them is as specified for forms. Design all joists supporting slabs and overhangs as falsework.

When falsework is over or adjacent to roadways or railways, install all details of the falsework system which contribute to horizontal stability and resistance to impact at the time each element of the falsework is erected and leave them in place until removing the falsework.

Construct falsework to reasonably conform to falsework drawings. Use materials in the falsework construction of the quality necessary to sustain stresses required by the falsework design. Use workmanship in falsework construction of such quality that the falsework will support the loads imposed without excessive settlement or deformation. Use suitable jacks or oak wedges in connection with falsework to set the forms to the required grade and to take up any excessive settlement in the falsework, either before or while placing concrete.

If unanticipated events occur, including undue settlements, which in the opinion of the Engineer would prevent obtaining a structure conforming to the Contract, discontinue placing concrete and provide corrective measures satisfactory to the Engineer. In the event satisfactory measures are not provided before initial set of the concrete in the affected area, discontinue placing concrete at a location the Engineer determines. Remove all unacceptable concrete.

Do not place temporary supports or shoring under prestressed concrete or structural steel girders when paving bridge slabs or when taking top of beam elevations.

When placing falsework installations over or adjacent to an open public road, include design considerations and protection to ensure that the falsework system is not disturbed by

errant highway vehicles or from vibration forces caused by passing vehicles. Include provisions to protect traffic from falling objects.

601.03.12 Forming.

A) Forms for Structures. Clean the inside surfaces of forms of all dirt, mortar, and foreign material. Thoroughly coat forms which will later be removed with form oil before use.

Do not deposit concrete in forms until completing all work connected with constructing the forms, placing all materials required to be embedded in the concrete for the unit to be poured, and the Engineer has inspected forms and materials.

Control the rate of depositing concrete in forms to prevent over stressing the forms due to fluid pressure.

Provide forms for all concrete surfaces not completely enclosed or hidden below the permanent ground surface that conform to the requirements herein for forms for exposed surfaces. The Engineer will consider interior surfaces of underground drainage structures the same as to be completely enclosed surfaces.

Prior to using the forming system for exposed surfaces and when the Engineer requests, furnish the Engineer the form design and materials data so the Engineer may verify compliance with this section.

Design and construct forms for exposed concrete surfaces so the formed surfaces of concrete do not deflect excessively in any direction between studs, joists, form stiffeners, form fasteners, or wales. Place plywood with the face grain perpendicular to the studs or joists. If placement of the plywood with the grain parallel to the studs or joists is desired, furnish the Engineer calculations showing that excessive deflection or stresses will not occur. Provide a clear span between supporting studs or joists that is no more than 20 times the thickness of the form facing and that does not deflect more than 1/360 of the clear span. Should any form or forming system, even though previously reviewed before use, produce a surface with excessive bulges, discontinue its use until making modifications satisfactory to the Engineer.

Form all exposed surfaces of each element in a concrete structure with the same forming material or with materials which produce similar surface textures, color, and appearance.

Face forms for exposed surfaces with form panels. Only use form panels in good condition free of defects, such as scars, dents, or delaminations, for exposed surfaces.

In general, furnish and place form panels for exposed surfaces in uniform widths of 3 feet or more and in uniform lengths of 5 feet or more, except where the dimensions of the member formed are less than these dimensions. Arrange panels in symmetrical patterns conforming to the general lines of the structure. Precisely align form panels on each side of the panel joint using supports or fasteners common to both panels, to obtain a continuous, unbroken concrete plane surface.

Construct forms for exposed surfaces with 3/4 inch chamfer strips attached to prevent mortar runs and to produce smooth, straight chamfers at all sharp edges of the concrete. Grinding of chamfers is not allowed as a primary construction method. Grinding is only acceptable as a means of correction or repair as approved by the engineer.

Use form fasteners consisting of form bolts, clamps, or other devices as necessary to prevent spreading of the forms during concrete placement. Do not use twisted wire loop ties to hold forms in position.

The Department will allow casting of anchor devices into the concrete for later use in supporting forms or for lifting precast members when the Engineer allows. Do not use driven types of anchorages for fastening forms or form supports to concrete on bridge decks.

Construct all forms to allow removal without damaging the concrete. Frame forms for copings, offsets, railings, and all ornamental work so there will be no damage to or marring of the concrete when removing the forms.

Leave openings in forms at intervals no greater than 10 feet vertically. Ensure that the openings are adequate to allow free access to the forms for the purpose of inspection, working, and vibrating the concrete.

Set and maintain all forms true to lines and grades designated until the concrete has hardened. After placing concrete, remove the forms according to Subsection 601.03.14.

For narrow walls where access to the bottom of forms is not readily attainable otherwise, leave the lower form boards loose so they may be removed to remove all chips, dirt, sawdust, or other extraneous material from inside the forms immediately before placing concrete.

Construct metal ties or anchorages within the forms to allow their removal to a depth of at least one inch from the face without injury to the concrete. Design all fittings or metal ties such that upon their removal the cavities that remain will be the smallest possible size. Regardless of their position in the completed construction, ram and fill cavities with mortar, and ensure that the surface is sound, smooth, even, and uniform in color.

When using ordinary tie wires within the forms for areas where concrete will be exposed and will receive surface finish, cut back all wires at least 1/4 inch from the face of the concrete with chisels or nippers. Fill the resulting cavities with mortar, and ensure that the surface is sound, smooth, even, and uniform in color. Use nippers for cutting wires in fresh concrete. Cut the wires that are not included within the areas where the concrete will receive surface finish flush with the concrete surface. The Engineer will not require grouting unless concrete is damaged in cutting wires.

Maintain forms that are intended for reuse in good condition to ensure accuracy of shape, strength, rigidity, mortar tightness, and surface smoothness. Do not use forms that are unsatisfactory in any respect in the opinion of the Engineer and remove them immediately from the job site.

Use forms for circular section concrete columns that are plastic, plastic lined, metal, or other approved material in order to provide a smooth and true surface free from fins, joints, and other irregularities.

Apply the above wooden form specifications relative to design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, reuse, and oiling to metal forms, also. Countersink all bolt heads. Design clamps, pins, or other connecting devices to hold the forms rigidly together and to allow removal without injury to the concrete. Keep metal forms free from rust, grease, or other foreign matter that may discolor the concrete.

B) Forms for Non-Structural Construction. Provide forms used for non-structural construction, free from warps, of sufficient strength to resist warping during construction, and of a height approximately equal to the depth of the section to be constructed. Thoroughly clean, oil well, and securely stake, brace, and hold forms to the required line and grade before depositing any concrete. Use approved flexible forms for construction of circular sections where the radius is 100 feet or less.

C) Slip Forming for Non-Structural Construction. The Department will allow the use of slip form or extruding machines for non-structural concrete items whose design is compatible with the slip form or extrusion process. For concrete placed by the slip form or extrusion process, the Engineer may waive the minimum slump requirements for the concrete being placed. Control the slump so that during each continuous run the maximum range of slump between the various batches or loads does not exceed one inch.

Produce items by the slip form or extrusion process that are comparable in quality to those produced by use of side form methods. When work is not satisfactory, the Engineer may require the use of side forms instead of the slip form

or extrusion process, as well as corrective work.

D) Slip Forming for Bridge Barrier Wall. The Department will allow slip form construction of bridge barrier wall when the Engineer approves test sections. Test sections will be the first 25 feet in length and may be poured on the structure with the Engineer's prior approval. If test sections are unacceptable, the Contractor will remove the entire test section at no expense to the Department. Core or slice the test section as the Engineer directs. The Engineer will review the cores or slices to ensure concrete consolidation around the horizontal steel reinforcement. When concrete is not consolidated around the steel or the quality is not comparable to the side form methods, the Engineer may require the use of side forms and corrective work. The Engineer may waive the minimum slump requirements. Control the slump so that during each continuous run, the maximum range of slump between the various batches of loads does not exceed one inch. Conform to the alignment tolerance requirements of Subsection 601.03.18. Construct joints and bevels according to the Plans. Construct barrier wall to the dimensions specified on the Plans.

601.03.13 Camber. Set falsework and forms to provide structural camber indicated or as directed.

601.03.14 Removal of Falsework and Forms. In determination of time for removal of falsework and forms, consider the location and character of the structure, weather, and other conditions influencing hardening of the concrete and materials used in the mixture.

Do not remove falsework centering and falsework supporting any concrete work or loosen any wedges without obtaining the Engineer's permission. Even with the Engineer's permission, take full responsibility for the safety of the work.

The Department will allow the removal of forms for ornamental work, railing, parapets, and vertical surfaces that do not carry loads after 18 hours, unless otherwise directed or approved. Column forms may be removed after 18 hours, provided no significant structural loads will be placed before concrete design strength is reached.

1) The Department will allow the removal of supporting forms and falsework for structural units subjected to bending stresses, 3 days after placing the last concrete in the unit upon conformance to the following conditions:

   a) Advise the Engineer in writing at least 24 hours in advance of placing concrete that early removal is necessary or desirable, and request that additional cylinders for the required testing be made.
   b) Submit, for approval, a written request for the intended use of any special procedures or modifications to the mixture such as increased cement content, use of Type III cement, use of high range water reducing admixture. If supplying a high range water reducing admixture, subject to the Engineer's approval, the Department will allow the use of a higher than specified slump.
   c) Ensure that results of the compressive strength tests demonstrate a minimum of 80% the required 28-day compressive strength for the class of concrete specified. The Engineer will sample for compressive strength at the minimum frequencies indicated in the Manual of Field Sampling and Testing Practices. The Department will cast and test compressive strength cylinders according to KM 64-305 and ASTM C 39, respectively. Cure cylinders to be tested for early removal of forms and falsework as nearly as possible in the identical manner that the concrete in the structural unit is cured. The Engineer will allow early removal of forms and falsework when all of the cylinders achieve the specified minimum compressive strength.

      Upon conforming to the above conditions, the Department will allow the removal of supporting forms and falsework for structural units subjected to bending stresses to begin 3 days after placing the last concrete in the unit.

2) If early release cylinders are not requested or have failed strength requirements, do not remove the falsework, centering, and forms supporting any girder, slab, beam, arch, or member subject to direct bending stress, or forms inside concrete barrels, until the minimum curing time has elapsed as shown in the following table. The Engineer will take air temperature readings at approximately 7:30 AM and 3:00 PM each day during the curing period and determine the average temperature from those readings. The curing time will start after placing the last concrete in the member considered.

The Engineer will add one day to the following calendar days shown in the table for each day the average ambient air temperature falls below 40 °F.

REQUIRED TIME IN CALENDAR DAYS BEFORE REMOVING FORMS AND FALSEWORK[1]

Item	Average Ambient Temperature During Curing Period		
	41 to 54 °F	55 to 69 °F	70 °F or more
Box Culverts, spans 10 feet or less	18	11	7
Box Culverts, spans 10 to 20 feet inclusive	18	12	8
Slab and Girder Spans, 10 feet or less, including Slab Spans between Steel Girders	18	11	7
Slab and Girder Spans, 10 to 20 feet inclusive, including Slab Spans between Steel Girders	18	12	8
Slab and Girder Spans, over 20 feet, including Slab Spans between Steel Girders	21	15	12
Caps of Concrete Pile Bents, Open Column Abutments, and Piers	18	11	7
Caps of Piers with Copings extending 3 feet or less beyond Web Walls	7	5	3
Curbs or Slabs Overhanging 2 feet or less, and Rails in Open Handrails	7	5	3
Falsework under Web Walls	7	5	3
Curbs or Slabs Overhanging more than 2 feet	18	11	7
Walls, Columns, and Vertical Sides of Beams and Girders	18 hours min. as the Engineer directs		

[1]*For mixtures using Type IP cement or fly ash, see Subsection 601.03.03*

3) Remove falsework and centering in such a manner and sequence that allows concrete to uniformly and gradually take the stresses due to its own weight.

Remove forms without defacing the structure. Always remove forms from the sides of columns and piers before removing falsework or centering beneath

girders, beams, or other members that they will support, so the Engineer may inspect the quality of concrete.

The Engineer will not grant any extension of time to complete work due to falsework remaining in place during curing.

4) Box culvert top slab forms may be removed earlier than 3 days. Submit special mix design and early release cylinder plan to the Engineer for approval if removal of forms earlier than 3 days is desired.

601.03.15 Opening to Traffic. Conform to the following requirements for the time of opening a completed structure to traffic or application of significant loads. The Engineer will consider construction equipment passing over a structure to be traffic.

1) The Engineer will allow early opening to traffic or application of significant loads under the same criteria as early removal for forms and falsework with the following additional requirements:

   a) Ensure that results of the compressive strength tests demonstrate a minimum of 100% the required 28 days compressive strength, for the class of concrete specified.
   b) When possible, continue to cure concrete for the time specified in the following table even when the specified strength requirements have been met.

2) If early release cylinders are not requested or have failed strength requirements, do not open the structure to traffic or subject it to significant loads until the minimum time has elapsed as specified in the Required Time in Calendar Days Before Removing Forms and Falsework table in Subsection 601.03.14 and the Required Time in Calendar Days Before Applying Significant Loads on Concrete Structures table in this subsection. The curing time will start after placing the last concrete in the structure, with the exception of handrails not designed as load supporting members. The Engineer will add one day to the following calendar days shown in the table for each day the average ambient air temperature falls below 40 °F.

   The Engineer will take air temperature readings at approximately 7:30 AM and 3:00 PM each day during the curing period and determine the average temperature from those readings.

REQUIRED TIME IN CALENDAR DAYS BEFORE APPLYING SIGNIFICANT LOADS ON CONCRETE STRUCTURES			
Item	Average Ambient Temperature During Curing Period		
	40 to 54 °F	55 to 69 °F	70 °F or more
Box Culverts, spans 10 feet or less	21	13	10
Box Culverts, 10 to 20 feet inclusive	22	14	11
Slab and Girder Spans, 10 feet or less, including Slab Spans between Steel Girders	21	13	10
Slab and Girder Spans, 10 to 20 feet inclusive, including Slab Spans Steel Girders	22	14	11
Slab and Girder Spans, over 20 feet, including Slab Spans between Steel Girders	23	18	14
Overhanging Slabs, age before barrier walls are placed[2][3]	23	18	14
Caps on Concrete Pile Bents, Open Column Abutments, and Piers			
Concentrated Loads, as produced by steel superstructures or precast concrete	18	11	7
Distributed Loads, as produced by poured-in-place concrete deck girder superstructures	3	2	1[2]
Class "D" Piles, Moved or Driven[1]	28	21	21
Class "D" (HES) Piles, Moved or Driven[1]	7	5	3
Class "D" Modified Piles, Moved or Driven[1]	14	10	7
Bridge Barrier Wall[4]	23	18	14
Backfill against Abutments or Retaining Walls	14	10	7
Pole and Sign Base Foundations			
Setting the poles or truss legs	14	10	7
Tensioning of Messenger Cables or installation of overhead trusswork.	28	21	21

[1] *See Subsection 604.03.*
[2] *No strength requirements apply.*
[3] *The Engineer will not apply time limits when falsework is designed to support barrier wall.*
[4] *Opening to traffic is considered applying a significant load*

601.03.16 Joints.

A) Expansion and Contraction Joints for Structures. Construct expansion joints to allow absolute freedom of movement. After completing all work, use a fine

chisel to carefully remove all loose or thin shells or mortar likely to spall under movement from expansion joints.

Provide and place expansion joints at locations specified in the Plans and Standard Drawings as follows:

1) Friction or Sliding Joints. Friction or sliding joints may be either metal, neoprene, rubber, or premolded filler type as specified.
2) Open Joints. Place at locations designated and form by insertion and subsequent removal of a template of timber, metal, or other suitable and approved material. Use a method of insertion and removal of joint templates that avoids the possibility of chipping or breaking the edges and construct the templates so removal is readily accomplished without injury to the work. Do not extend reinforcement across an open joint unless specified in the Plans. Carefully set structural steel angles, channels, plates, or other shapes used in connection with open joints to conform to the crown and grade of the bridge deck. Construct the joint with a uniform opening and to dimensions specified in the Plans.
3) Special Types. Use special types other than those listed when specified in the Plans or when the Engineer so orders in writing. Furnish special details for such joints.

B) Expansion Joints for Non-Structural Items. Install expansion joints at all breaks in alignment and at all locations where one concrete construction abuts another concrete or other type construction. Install expansion joints at each 1,000 feet of continuous construction. The Engineer will not require steel reinforcement in expansion joints.

When another concrete item crosses an expansion joint in JPC pavements, construct the expansion joint for the structural or non-structural concrete item one inch wide and construct all other expansion joints 1/2 inch wide. The Engineer will not require expansion joints in paved ditches except at locations where the paved ditch abuts another structure. Cut the one-inch thick expansion joint material to conform to the cross section of the concrete.

C) Contraction Joints for Non-Structural Concrete Items. Either form 1/8-inch wide contraction joints for non-structural concrete items or construct them according to requirements of this subsection at intervals not to exceed 30 feet, except when items are constructed on or adjacent to a rigid pavement or shoulder. For these exceptions, make the joint spacing coincide with that of the pavement or shoulder. Space contraction joints for sidewalks as specified in Section 505. The Engineer will not require the sealing of contraction joints in non-structural items.

The Engineer will not require contraction joints for paved ditches. Construct sawed contraction joints to a minimum depth of 2 inches, except that the Engineer will allow one inch of depth for header curbs and integral curbs.

601.03.17 Curing Concrete. Cure reinforced concrete bridge slabs according to Subsection 609.03. Wet cure all surfaces that are to receive a masonry coating finish, unless using combination material. When using combination material, cure as specified in B) below. Either wet cure all other concrete, except pipe culvert headwalls, as specified in A) below or cure it by application of membrane forming compound as specified in B) below. The Engineer will not require curing for cast-in-place pipe culvert headwalls.

At any time the Engineer determines concrete on the project is not being properly cured, the Engineer may suspend all or any concreting operations on the project.

At any time during the curing period when the atmospheric temperature is 45 °F or less, protect the concrete to satisfy the temperature requirements according to Subsection 601.03.09 D).

A) Wet Curing. Cure concrete for a period of at least 7 calendar days, beginning immediately after placement and finishing, by frequently applying water to all

surfaces to keep them continuously damp during the full 7-calendar day curing period or until the required strength is attained. Protect exposed concrete surfaces from drying by application of a double thickness of wet burlap or similar approved material and keep the burlap or other approved material continuously wet for a period of 7 or more calendar days. Soak new burlap in water for at least 12 hours before the first use.

When the structure or any portion thereof is enclosed and artificial heat is provided for protection, the Engineer will not waive the moist curing requirement. When using steamlines for heating, leave the pipe loose so sufficient steam escapes into the housing to maintain a moist atmosphere at all times. When using stoves or salamanders, maintain vessels containing water on each stove or salamander to maintain a moist atmosphere at all times. The Department will allow the curing of flat horizontal surfaces with curing blankets.

B) Membrane Curing. Do not dilute or alter the membrane forming curing compound. Thoroughly agitate the compound immediately before using it. When the compound is too viscous to apply, warm it in a water bath to approximately 100 °F before applying.

Uniformly apply the compound to a surface by use of an approved pressure sprayer. The Department will allow the placement of curing compound in one application. When placing in one application, achieve uniform and satisfactory coverage. If the Engineer directs that 2 applications are required because one application is not satisfactory, then make each application at the rate of one gallon per 300 or less square feet. Start the first application as soon as practical after the final finish and as the Engineer directs, and start the second application after finishing the first application. Use a total actual application rate of at least one gallon per 150 square feet or less actual coverage.

Do not apply curing compound to construction joints, reinforcing steel, or surfaces to receive a masonry coating, except:

1) The Department will allow the use of materials conforming to the water retention requirements of AASHTO M 148 for liquid membrane forming curing compound, and also conforming to Section 828 for masonry coating, on areas designated to receive masonry coating. Combination materials will be so designated on the List of Approved Materials for Masonry Coating Materials
2) When using combination materials, follow wet curing procedures until completing all patching or other surface corrections and applying the compound. Keep the surface covered with wet burlap or other approved material and alternately expose small sections for surface corrections, to avoid drying. Conform to surface preparation requirements for masonry coating in all respects.

   When inadvertently applying curing compound or masonry coating to surfaces upon which the compound is not allowed for use, remove it by sandblasting or high-pressure water cleaning with or without abrasives added to water stream. Some compounds may require chemical removal. When chemical cleaners are used, neutralize compounds and fully rinse surface with clean water. Do not damage finished concrete. Correct any damage at no cost to the Department. Allow surface to dry before proceeding.

   Protect the curing compound and maintain it in an acceptable condition for a period of at least 7 calendar days. Moisten and respray curing compound on surfaces on which the curing compound is damaged before the end of the 7-calendar day curing period. Cover surfaces upon which curing compound has been applied and that will be used as work surfaces or otherwise subject to damage to the curing compound with planks, boards, or other protective material to protect the curing compound from damage.

C) Curing Blankets. Only use curing blankets for curing bridge deck slabs and other

flat horizontal surfaces.

Keep the concrete continuously damp for the period of time specified for the item being constructed, beginning immediately after placing and finishing. As soon as possible, without damaging the concrete surface, moisten the concrete by applying water, and immediately cover the surface with the curing blankets.

Place the blankets so that adjoining blankets overlap at least 18 inches. Weight all laps and outside edges to prevent displacement of the blankets before completing curing. Ensure intimate contact between the blankets and the concrete surface.

If the blankets are disturbed before the curing time expires, immediately replace them. Apply water at any time drying of the concrete is evident.

Immediately repair torn places in the blankets by cementing an additional thickness of the same material over the torn area. At the end of each curing period, inspect the blankets; repair all tears or holes before reusing the blankets.

601.03.18 Surface Finish. Apply the following surface finishes to various parts of concrete structures:

1) Ordinary Surface Finish,
2) Masonry Coating Finish, or
3) Floated Surface Finish.

Apply ordinary surface finish to all concrete surfaces not required to have masonry coating finish or a floated surface finish. Consider ordinary surface finish as a final finish on all surfaces not required to have masonry coating.

Ensure that exposed finished concrete surfaces do not vary more than 1/4 inch in 10 feet as measured from a straightedge.

A) Ordinary Surface Finish. Immediately following removal of forms, remove all fins and irregular projections from all surfaces except those not to be exposed in the completed work. On all surfaces, that have cavities and depressions resulting from removal of form ties, and all other holes, honeycomb spots, broken corners or edges, and other defects, thoroughly clean the defects, saturate them with water, and carefully point them. Use a mortar of the same cement and fine aggregates mixed in the same proportions as used in the class of concrete being finished. Do not use a mortar that is more than 30 minutes old, and cure the mortar patches as specified for the structures. After the mortar has thoroughly hardened, finish it to obtain a uniform and smooth surface that is the same color and texture as in the surrounding concrete. When required, chip out honeycomb areas before pointing. Carefully tool all open and filled contraction and expansion joints in the completed work and keep them free of all mortar and concrete. Expose the joint filler for its full length with clean true edges.

Obtain smooth and even surfaces of uniform color and texture without unsightly bulges, patched areas, depressions, and other imperfections.

The Engineer will consider individual surfaces satisfactory and in compliance with requirements for ordinary surface finish when the surfaces have been formed and finished as specified and the Engineer has approved the resultant surface as to uniformity, color, texture, and smoothness.

The Engineer will consider each face of a column, wing, girder, or parapet separately in determining if the finish is satisfactory.

Protect all exposed surfaces from subsequent construction operations and from drip and disfigurement. Clean and finish any surface disfigured as a result of construction or other operations as the Engineer may require to give a satisfactory surface finish.

B) Masonry Coating Finish. After the Engineer has inspected and accepted the concrete surfaces of bridges and median barriers as having a satisfactory ordinary surface finish, clean the concrete surfaces specified hereinafter of all dust, foreign

matter, and form oil, and apply a Department approved masonry coating finish. Coat the following surfaces, including all beveled edges:

1) Bridge End Bents, Abutments, Retaining Walls, and Headwalls for box or long span underpasses - every exposed surface including wingwalls, above a point 6 inches below ground or fill line.
2) Bridge Pier Caps - the tops (including exposed surfaces of pads, pedestals, and keys), sides and ends. Do not apply the coating to bearing areas.
3) Bridge Superstructure - the tops, inside and outside faces, and ends of all barrier walls, parapets, curbs, and plinths that will be exposed. Do not apply the coating to the riding surface of the bridge deck.
4) Median Barriers - all exposed surfaces of concrete median barriers and concrete terminal sections appurtenant to the barriers.
5) Exposed Surfaces of Substructure and the Superstructure of Highway, Railway, and Pedestrian Bridges Over a Highway - all surfaces identified in 1), 2), and 3) above and the underneath surfaces of slab overhangs that are outside of exterior girders and the exterior side and bottom of exterior beams, girders and box beams and all exposed surfaces of piers, abutments and walls that are within 200 feet of a public road or street. Extend the masonry coating from a point 6 inches below ground line to the top of the exposed surface.

Thoroughly clean all surfaces to receive a masonry coating and keep them free of oil, form oil, grease, dust, dirt, mud, curing compound, release agents, loose patching mortar, or any other substance that may prevent bonding. Before applying the masonry coating material, fill all air holes flush with the surface with the masonry coating material or an approved mortar to provide a uniform surface. Surfaces that will receive Masonry Coating Finish must have a roughened surface that meets manufacturer's recommendations for product performance.

Check all surfaces to receive a masonry coating for the presence of dust by wiping a dark cloth across the surface of the concrete. If a white powder can be seen on the dark cloth, clean the concrete by wire brushing, grinding, or water blasting and then allow it to thoroughly dry before applying the masonry coating. The Engineer will recheck the surface for the presence of dust after cleaning.

Check all surfaces to receive a masonry coating for the presence of oily conditions by sprinkling or fogging water on the surface of the concrete. If the water stands in droplets without spreading out immediately, this indicates the surface is contaminated with an oily substance, and the Engineer will require cleaning using a detergent and water followed by thorough rinsing with water. The Engineer will recheck the surface for the presence of oily conditions after cleaning.

Thoroughly dry all surfaces to receive a masonry coating before applying the coating, unless the coating manufacturer specifically recommends the surface to be wet. The Department's List of Approved Materials contains each manufacturer's recommendation. The Engineer will not consider surfaces to be dry unless an absorbent paper pressed tightly against the surface does not show any trace of moisture.

Suspend coating application any time the ambient temperature or the temperature of the concrete does not comply with the coating manufacturer's recommendations.

Prior to application of the materials, furnish the Engineer with copies of the coating material manufacturer's brochures or booklets. Apply masonry coating materials in strict conformity with the manufacturer's written instructions and apply the material at a uniform rate of at least 50 ± 10 square feet per gallon.

Satisfactorily repair or remove any portions of the coating that are not clean, uniform in color, texture, thickness, tightly bonded, or that are damaged before final acceptance of the project and replace them with an acceptable finish and

coating.

Provide a neat uniform appearance, and prevent the coating from being dripped, sprayed, or otherwise deposited upon concrete or steel surfaces not designated to receive the coating. Remove any objectionable deposits or material and repair the surfaces to the Engineer's satisfaction.

C) Floated Surface Finish. Finish horizontal surfaces not subject to wear, and those that do not receive the Masonry Coating Finish, such as back walls, and headwalls, by placing an excess of materials in the form and removing or striking off such excess with a wooden template, forcing coarse aggregate below the mortar surface. Do not use mortar topping for surfaces falling under this classification. After striking-off the concrete as described, thoroughly work the surface and float it by hand with a wooden float leaving a fine grained, smooth-sanded surface.

Finish concrete bridge floors as specified in Section 609.

Finish sidewalks on structures as specified in Section 505.

601.03.19 Construction Date and Identification. On all concrete bridges and box culverts, stencil the year the Contract was executed and the structure drawing number on the concrete at the locations designated. Make the figures on the stencil according to details specified in the Plans. For bridges having a clear span of 20 feet or more, stencil the year the Contract was executed and load capacity of the structure on the outside face of the plinth or barrier wall as shown on the Standard Drawing or as directed. On all box culverts, place stenciled figures giving the year in which the Contract is executed on the inlet end of the culvert on the outside face and center of the parapet or headwall. Do not use permanent plates or markers of any kind, other than those shown, on any structure. On all bridges, imprint the name(s) of the prime contractor, and the subcontractor when applicable, in the concrete at the location shown or designated. Furnish stencils, all equipment, tools, labor, materials, and other incidentals necessary.

601.04 MEASUREMENT.

601.04.01 Concrete. The Department will measure the quantity in cubic yards according to the dimensions specified in the Plans. The Department will not measure the volume of concrete displaced by pile heads (except when using concrete piles) for payment and will consider it incidental to this item of work. The Department will measure the volume of concrete displaced by concrete pile heads in cubic yards. The Department will not measure forming, including permanent steel forms, for payment and will consider it incidental to this item of work.

601.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

601.04.03 Masonry Coating. The Department will measure the quantity in square yards.

601.04.04 Mass Concrete. The Department will measure the quantity in cubic yards actually placed.

601.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08100, 08102-08106, 02555	Concrete, Class	Cubic Yard
08150	Steel Reinforcement	See Subsection 602.05
02998	Masonry Coating	Square Yard
10040	Mass Concrete[1]	Cubic Yard

[1] *The Department will pay for Mass Concrete at a unit price of 2 times the delivered cost of the concrete. When mixing concrete on site, the Department will pay for Mass Concrete at one-half the contract unit price for that class concrete.*

The Department will consider payment as full compensation for all work required under this section.

Appendix A Construction Tolerances

Concrete for structures and pavements; accuracy of individual ingredient materials for each batch.
± 2% for aggregates.
± 1% for water.
± 1% for cement in batches of 4 cubic yards or greater.
± 1% for total cementitious materials in batches of 4 cubic yards or greater.
0% to + 4% for cement in batches less than 4 cubic yards.
0% to + 4% for total cementitious materials in batches less than 4 cubic yards.
± 3% if total admixture dosage required ≥ 34oz.
± 1 oz. if total admixture dosage < 34oz.

SECTION 602 - STEEL REINFORCEMENT

602.01 DESCRIPTION. Furnish and place steel for reinforcement of concrete. Furnish bars, spirals, welded wire fabric, bar mat, or other specified reinforcement, of the quality, type, size, and quantity designated by the Contract.

602.02 MATERIALS.

602.02.01 Steel Reinforcement. Conform to Section 811.

602.02.02 Epoxy Coating Material. Conform to Section 811.

602.02.03 Welded Steel Wire Reinforcement (WWR). Conform to Section 811.

602.03 CONSTRUCTION.

602.03.01 Protection of Material. Handle and store steel reinforcement to prevent bending, excessive rusting, or contamination with objectionable substances.

602.03.02 Straightening. Before placing in the work, straighten reinforcement bent during shipment or handling without injuring the steel. Do not heat the steel, or use steel with sharp kinks.

602.03.03 Bending. Bend reinforcement cold to the dimensions and shapes specified in the Plans and to within tolerances designated in the CRSI Manual of Standard Practice. In bending, do not injure the steel. Bend bars in the shop before shipment, not in the field.

602.03.04 Placing and Fastening. Accurately place all steel reinforcement as shown, and firmly hold in position while placing and during hardening of concrete. Hold in position to within a tolerance of ± 1/2 inch, and place to within a tolerance of ± 1/4 inch of specified clearance from the face of concrete, except for bridge deck reinforcement steel. Place steel reinforcement for bridge slabs to within the tolerances specified in Subsection 609.03.03. Dimensions shown from the face of concrete to bars are clear distances. Bar spacings are from center to center of bars. Tie bars at all intersections, except where spacing is less than one foot in both directions, then tie alternate intersections. Always pass vertical stirrups around the main tension members and securely attach them to the members.

Use Engineer approved supports to maintain distances from forms and to accurately position reinforcement as necessary. Use precast blocks composed of mortar or Engineer approved supports for holding reinforcement from contact with the forms. Ensure that the tips of metal chair supports in contact with the surface of the concrete are plastic coated steel. When using plastic coated steel supports, provide a minimum of 1/8 inch thickness of the plastic material between the metal tips and the exposed surface of the concrete. The Engineer will accept metal supports as specified for epoxy coated bars. Securely tie down the steel placed in reinforced concrete slabs to prevent any possibility of steel rising above the specified elevation during placing, vibrating, and finishing the concrete as required by Subsection 609.03. Ensure that metal supports have a shape that will be easily enveloped by the concrete.

Separate the top and bottom mats of bars with precast mortar blocks, Engineer approved supports or by other equally suitable devices. Do not use pebbles, pieces of broken stone or brick, metal pipe, and wooden blocks as separators. Securely place reinforcement in any member, and then obtain the Engineer's approval before placing concrete. The Engineer may reject concrete placed in violation of this provision.

When using epoxy or non-epoxy adhesive or grout to install steel reinforcing bars into existing concrete, provide an approved Type IV epoxy resin system conforming to Section 826 or if included in the proposal, the Special Note for Non-Epoxy Adhesives. Drill and install reinforcing to the embedment depth shown in the plans. Install epoxy or non-epoxy adhesive in accordance with the manufacturer's recommendations including

hole size, drilling equipment and method, hole cleaning equipment and method, mixing and dispensing epoxy, and reinforcement insertion. Provide an embedment depth capable of developing the yield strength of the reinforcing bar based on the manufacturer's literature for the epoxy material used if no resistance or embedment depth is shown in the plans. Do not alter the manufacturer's mixing nozzle or dispenser. Post-installed reinforcement must be clean and free from grease, oil, or other foreign material. Furnish the adhesive system manufacturer's written recommendations for installation, cleaning, and use for approval. Demonstrate hole cleaning method to the Engineer for approval and continue the approved process for all post-installed reinforcement. Contact the Engineer 7 days in advance of the installation date to set up a testing schedule. After installation of the first 50 reinforcing bars, the Department will randomly select 5 and proof load the installed bars to 100% of the bars yield strength with zero slippage unless otherwise shown in the plans or approved by the Engineer. If any of the bars fail in bond, either revise the installation procedure, if applicable, or provide another adhesive that is capable of passing this test. The Engineer may require additional job site testing or may waive testing with the written approval of the Director, Division of Construction. .

602.03.05 Special Requirements for the Installation of Epoxy Coated Bars. Either coat all tie wires, clips, chairs, bar supports, and other metallic materials used for the installation of the epoxy coated reinforcing bars with fusion bonded epoxy resin or with an approved vinyl type material, or make them of an approved non-metallic material.

Use an epoxy material that provides a uniform continuous coating having a film thickness of 12 ± 7 mils. Use vinyl-type material that is pliable and provides a uniform continuous coating having a thickness of 30 ± 10 mils. Test installation devices coated with either material according to KM 64-106.

Allow the Engineer to check the installation devices for flaking, chipping, or any other defects during the pre-pour inspection of the epoxy coated reinforcing bars, and repair or replace the devices as the Engineer deems necessary.

Coat tie wires with a flexible plastic or vinyl material to a thickness of 12 ± 7 mils. The Engineer will test the coating according to KM 64-106.

Provide all systems for handling coated bars with padded contact areas for the bars whenever possible. Pad all bundling bands, and lift all bundles with a strong back, multiple supports, or a platform bridge so as to prevent bar-to-bar abrasion from sags in the bar bundle. Use nylon slings for direct epoxy bar contact. Use loading and unloading procedures and equipment that does not damage the coating.

Unload and store the epoxy coated steel bars on the project site in a manner to avoid damage or contamination. Avoid extended outdoor storage of coated bars of over 2 months. If expecting the outdoor storage to exceed 2 months, cover the bars for protection against the elements and to prevent condensation from forming on the bars. Install the bars in the bridge deck according to applicable requirements of Section 609, except as provided in this section and as the Engineer deems necessary in order to protect and preserve the epoxy coating.

Repair all cuts, nicks, and abrasions that exceed 0.25 percent of the surface area and the bar end with the epoxy repair material supplied by the powdered epoxy resin manufacturer. If the total surface area covered with patching material exceeds 2 percent in a one foot section, sheared ends not included, remove and replace them with acceptable bars. Also, repair any damaged metallic accessories with a suitable material.

Make every reasonable effort to repair all damaged areas of the reinforcing steel and accessories before any rusting occurs. If infrequent and small damaged areas do rust, thoroughly remove the rust by sandblasting or other Engineer approved methods before repairing the areas. Ensure that the coated bars, when incorporated into the work, are reasonably free from dirt, paint, oil, grease, or other foreign substance, and, when deemed necessary, clean the bars to the satisfaction of the Engineer.

Place concrete in the deck using methods and equipment that will not damage the coated materials.

Since the epoxy coating is flammable, do not expose the coated bars to any fire or flame. Do not cut coated bars by burning.

602.03.06 Splicing. Do not splice any reinforcement that is not of the type and at the locations specified in the Plans without the Engineer's written permission. The Department will allow the use of lapped splices, welded splices, mechanical couplers, or other positive connection splices specified in the Plans or designated by Engineer. Do not weld rail steel bar reinforcement used for bridges, cast-in-place culverts, and cast-in-place walls.

Make all splices added in the field and not specified in the Plans as far from the point of maximum tensile stress in the member as practical, and stagger splice points 3 feet or more in adjacent bars, when possible. Do not use any splices which reduce the clear distance between the splice and the closest bar to less than the minimum clear distance required by the design specifications. Do not use mechanical couplers having a diameter of greater than 125 percent of the nominal diameter of the reinforcing bar in the top bars in beams, slabs, or girders in which the concrete under the top bars is 12 inches or more in depth.

Make all splices with clean, sound materials properly affixed to the members being spliced and free of any substances that would weaken or contaminate the splice or concrete surrounding the splice.

Provide lapped splices that have a length no less than that specified in the Plans. When using lapped splices in areas not specified in the Plans, conform to the AASHTO LRFD Bridge Design Specifications and obtain the Engineer's approval. Splice bars by rigidly clamping or to otherwise wire together in a manner the Engineer approves. Make splices for spirals, where necessary, with a minimum lap of 1.5 turns of spiral.

When welding splices, conform to the AWS Reinforcing Steel Welding Code. Butt together and weld bars to develop, in tension, at least 125 percent of the specified yield strength of the bars. Do not use welded splices unless specified in the Plans or as the Engineer approves.

Use mechanical couplers primarily for bars required for compression only. Use only mechanical couplers or bars designed to carry critical tension or compression that are equivalent in strength to approved welded splices (125 percent of the specified bar yield strength).

When the Engineer allows welded splices or mechanical couplers, prepare 2 test specimens of the spliced reinforcement for submittal to the Division of Materials for testing before incorporating the splices into the work, and submit one additional test specimen for each 100 splices made. Ensure that only personnel who are qualified in conformance with the AWS Reinforcing Steel Welding Code make the welded splices.

602.03.07 Welded Steel Wire Reinforcement(WWR). Overlap sheets of WWR by 40 or more times the nominal diameter of the longitudinal wires to maintain a uniform strength, and securely fasten the sheets at the ends and edges.

602.04 MEASUREMENT.

602.04.01 Steel Reinforcement. The Department will measure the quantity, including bars used to replace test specimens, by the pound in the final work based on the theoretical number of pounds. The Department will not measure clips, wire, chairs, or other material used for fastening, supporting, or positioning reinforcement in place for payment and will consider them incidental to this item of work. The Department will not measure welded splicing for payment and will consider it incidental to this item of work.

The Department will base quantities of materials furnished and placed on the calculated weights of the reinforcing steel actually placed. The Department will calculate the weights based upon the following table:

ASTM STANDARD REINFORCING BARS				
Bar Size English and (metric)	Nominal Mass pounds per foot	Nominal Dimensions - Round Sections		
		Diameter inches	Cross Section Area, sq. inches	Perimeter inches
#3 (10)	0.376	0.375	0.11	1.178
#4 (13)	0.668	0.500	0.20	1.571
#5 (16)	1.043	0.625	0.31	1.963
#6 (19)	1.502	0.750	0.44	2.356
#7 (22)	2.044	0.875	0.60	2.749
#8 (25)	2.670	1.000	0.79	3.142
#9 (29)	3.400	1.128	1.00	3.544
#10 (32)	4.303	1.270	1.27	3.990
#11 (36)	5.313	1.410	1.56	4.430
#14 (43)	7.650	1.693	2.25	5.320
#18 (57)	13.600	2.257	4.00	7.090

602.04.02 Steel Reinforcement, Epoxy Coated. The Department will measure the quantity according to Subsection 602.04.01. The Department will not measure the epoxy coating or its application for payment and will consider it incidental to this item of work.

602.04.03 Mechanical Couplers. The Department will measure the quantity by each individual unit installed in the completed structure. Test specimens submitted as per Section 602.03.06 will not be counted as a unit installed in the completed structure.

602.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08150	Steel Reinforcement	Pound
08151	Steel Reinforcement, Epoxy Coated	Pound
08130-08139	Mechanical Reinforced Couplers, Size	Each
08140, 08141	Mechanical Reinforced Couplers Epoxy Coated, Size	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 603 — FOUNDATION PREPARATION AND BACKFILL

603.01 DESCRIPTION. Excavate and backfill or dispose of all materials required for the construction of bridges, box culverts, and other structures for which excavation is not otherwise provided.

603.02 MATERIALS AND EQUIPMENT. Use fabric wrapped backfill drains conforming to Section 845.

603.03 CONSTRUCTION. Remove and dispose of all materials excavated for the construction of the foundations for all structures, including the removal of existing structures. Place backfill to the original ground level and perform final cleaning up.

603.03.01 Classification. Perform structure excavation necessary for all bridge foundations and culverts, except pipe culverts, as Structure Excavation Solid Rock or Structure Excavation Common. Perform structure excavation necessary in the construction of cribwalls and retaining walls as Structure Excavation Unclassified.

A) Structure Excavation Solid Rock. The Department considers all of the following Structure Excavation Solid Rock:

1) All rock in solid beds, detached masses, or ledge formations which cannot be removed without blasting or quarrying. Hoe-rams and jackhammers may be required for solid rock removal.
2) Detached rocks or boulders having a volume of 0.5 cubic yards or more each.
3) Shale, slate, or coal which cannot be removed without blasting or quarrying.
4) Rock layers interspersed with strata of earth, or all conglomerate boulder formations, when rock strata or boulders constitute 60 percent or more of the volume to be removed.

B) Structure Excavation Common. The Department considers Structure Excavation Common as all material not classified as Solid Rock Structure Excavation.

C) Structure Excavation Unclassified. The Department considers Structure Excavation Unclassified as all excavation regardless of the materials encountered.

603.03.02 Channel Preservation. When any excavation or dredging is done at the site of the structure, do not excavate outside of caissons, cofferdams, steel piling, or sheeting, and do not disturb the natural stream bed adjacent to the structure without the Engineer's written permission.

603.03.03 Footing Excavation. Notify the Engineer at least 48 hours in advance of beginning structure excavation.

Excavate the foundation pits to allow placing of the full width and length of footings specified in the Plans with full horizontal beds. Do not use rounded or undercut corners and edges of footings. Ensure that all rock and other hard foundation material is free from all loose material, cleaned, and cut to a firm surface, either level, stepped, or roughened, as directed. Clean all seams and fill with concrete, mortar, crushed stone, or sand. When masonry is to rest on an excavated surface other than durable rock or durable shale (SDI equal to or greater than 95 according to KM 64-513), do not disturb the bottom of the excavation, and do not make the final removal of the foundation material to grade until just before the masonry is to be placed. When unsuitable foundation material is encountered, excavate and replace with acceptable material as the Engineer directs. Maintain the excavation free of standing water, insofar as is practical.

When the Plans require the foundation for a bridge or culvert to be solid rock or shale, drill into the foundation material to confirm its suitability. The contractor shall drill test

holes ≥5 feet deep for every 50 linear feet of footing as a test for suitable solid rock. For culverts with parallel footings under the walls or with an extra-wide footing, the contractor shall drill more than one line of holes. In this case, the contractor shall stagger the holes between footings on 25-foot centers.

603.03.04 Backfilling. Use only approved materials that will provide a dense well-compacted backfill. Ensure that the backfill material is free of frozen lumps, vegetation, debris, and rock fragments larger than 4 inches in any dimension. Before starting backfill, clear the excavated pits of all form material and rubbish, and, when practical dewater the pits.

Place and compact backfill material in uniform horizontal lifts not exceeding one foot for stone and 6 inches for soil and rock/soil combination material. For backfill that will be beneath, or within a proposed embankment, backfill according to Subsection 206.03.03.

When backfilling piers constructed in a stream bed or flood plain, the Department will allow material removed from the excavation as backfill material provided no large rock or broken concrete fragments are placed in contact with the structure, and provided no logs, stumps or rubbish are used. Backfill below normal low water elevation will not require compaction.

Shape the backfilled areas lying outside the limits of roadway embankment to a uniform finish.

As a precaution against introducing unbalanced stresses in structural walls or columns, place and compact the backfill to the same elevation on both sides of culverts, wingwalls, piers, and abutments before proceeding to the next layer.

For structures over which rock fills will be constructed, first cover the structures to a minimum depth of 2 feet with materials placed and compacted as required for backfill.

Obtain the Engineer's permission before backfilling against any concrete masonry structure.

603.03.05 Drainage. At locations where depth to weep hole flowline is 30 feet or less, drain backfill by installing a fabric-wrapped drain.

Center a fabric-wrapped drain over the inlet end of each weep hole as per the drain manufacturer recommendations. Use a glue recommended by the drain manufacturer. Ensure that glue is not placed over the portion of the drain covering the weep hole. Place drains vertically at each weep hole.

When using Type 1 drains, the 'weak' or 'cleat' side shall face the structure, unless otherwise noted in the manufacturer's recommendations and the appropriate product accessories are used.

Extend the drain from top of footing or from 6 inches below the inlet end of weep holes to 6 inches below subgrade elevation or, in the case of box culverts, to the top of the top slab. Avoid damaging or compressing the drain during backfilling.

When splices are required, provide a 6-inch lap of fabric to be glued to the adjacent piece so the spliced drain is completely covered by fabric.

Provide flaps or separate pieces of fabric to cover the top and bottom of the drain, and overlap the fabric on all sides of the drain at least 6 inches.

At the weep hole, if necessary, puncture the plastic core to provide free drainage from the drain to the weep hole. If puncturing of the core is necessary do not puncture the geotextile fabric on the outside face of the drain. Place a piece of plastic, at least 8 inches by 8 inches by 3/16 inches on the outside face of the drain over the weep hole, as reinforcement.

When depth to weep hole flow line is greater than 30 feet, cover the inlet ends of weep holes with at least 2 cubic feet of No. 57 coarse aggregate wrapped with geotextile fabric type IV. Place the aggregate to allow free drainage but at the same time prevent the fill from washing. From approximately 6 inches below the bottom of the inlet ends of the weep holes, place a column of clean crushed stone or gravel, wrapped with geotextile fabric type IV, at least one square foot, up against the back of the wall to the upper limits of the backfill. All geotextile fabric used to wrap this aggregate is incidental to placement. At the time of placing the remainder of embankment adjacent to the structure, continue placing the column

of stone up to subgrade elevation, or, in the case of box culverts, to the top of the top slab.

603.03.06 Cofferdams. For foundation construction, drive sheet piles for cofferdams to an elevation well below the bottom of the footings. Brace walls to ensure against collapse. Provide interior dimensions that allow sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside the forms. Right, reset, or enlarge cofferdams that are tilted or moved laterally during the process of sinking to provide the necessary clearance. Construct cofferdams sufficiently watertight to prevent water from coming in contact with fresh concrete. Do not allow bracing to extend into the substructure masonry unless the Engineer permits in writing. Submit drawings that are stamped by a Professional Engineer licensed in the Commonwealth of Kentucky. Include in the drawings all necessary details and design calculations. The type and clearance of cofferdams, details that affect the character of the finished work and the safety of the installation are subject to Department approval. The Department will review design details of cofferdams, bracing, shoring, or other work.

Remove all cofferdams, including all sheeting and bracing, after completion of the substructure without disturbing or causing damage to the finished masonry.

603.03.07 Foundation Seals. When conditions are encountered which, in the judgment of the Engineer, render it impracticable to remove water from the cofferdam before placing masonry, the Engineer may require construction of a concrete foundation seal according to Subsection 601.03.09 B).

Do not dewater cofferdam until the concrete seal has set sufficiently to withstand the hydrostatic pressure and in no case less than 72 hours after placement.

The Engineer may require longer than 72 hours.

603.04 MEASUREMENT. The Department will not measure the removal of existing structures, or portions thereof, in structure excavation when listed in the Contract as a bid item.

The Department will measure removing masonry necessary in the building of extensions to or the rebuilding of an existing structure according to Section 203.

The Department will consider removal of existing pipe incidental to structure excavation and will deduct the interior volume of the pipe from the structure excavation quantity.

When the Plans require the foundation to be solid rock or shale, drilling to confirm suitability is incidental to the structure excavation.

603.04.01 All Structures. When it is necessary to backfill in excess of the material excavated, the Department will measure the quantity of the additional material necessary for such backfill in cubic yards in its original position under Embankment or Roadway Excavation, unless it is paid for as Extra Work.

The Department will not measure dewatering excavated pits and placing and compacting backfill for payment and will consider them incidental to the structure excavation bid items.

When not listed as a bid item, the Department will not measure furnishing and placing fabric wrapped drains or coarse aggregate at weep holes for payment and will consider them incidental to the structure excavation bid items.

When it is necessary to construct any footing more than 2.5 feet below the elevation specified in the Plans for structures, except pipe culverts, sewers, and underdrains, the Department will pay for all excavation below plan elevation as Extra Work.

The Department will not measure excavation or backfill in excess of the limits described in this section for payment.

603.04.02 Bridges, Culverts, and Retaining Walls. The Department will measure the quantity of all excavation in its original position as that actually excavated within the limits bounded by vertical planes 18 inches outside the footings and parallel thereto except as follows. The Department will measure between the original ground surface and the

bottom of the excavated pit, except in cuts where the finished cross section will govern, and except when structures are removed, the bottom of the excavation for removal shall govern. The Department will not include in the quantity the volume of the waterway of existing culverts and bridges, the volume of materials removed as Remove Existing Structure, nor materials removed as incidental. The Department will not measure structure excavation for pipe culverts and pipe culvert headwalls, sewer pipe, or combination sewer and storm pipe.

Where tie beams, struts, web walls, overhangs, or similar construction are required on the substructure above the bottom of the footings and extend beyond the area bounded by vertical planes 18 inches outside the footings, the Department will measure the excavation, except that the Department will measure the area bounded by vertical planes 18 inches outside the footings and 18 inches outside the neat lines of the tie beams, struts, web walls, and other similar construction. The Department will measure between the original ground surface and a plane 18 inches below the bottom of the tie beams, struts, web walls, and other similar construction.

The Department will not measure excavation necessary to construct concrete encasement for an individual steel pile for payment and will consider it incidental to the pile. The Department will not measure Structure Excavation in the construction of timber bents or backing planks, or for excavation incidental to splicing piling for payment.

603.04.03 Foundation Preparation. When listed as a bid item, the Department will measure all work performed as part of Foundation Preparation as a lump sum for each structure. The Department will not measure cofferdams, shoring, dewatering, common excavation, or backfill for payment, and will consider them incidental to this bid item. The Department will measure Structure Excavation Solid Rock and removal of unsuitable foundation material and refill separately for payment. The Cabinet will pay Structure Excavation Common when conditions are such that excavation is required two (2) feet beyond bottom of foundation elevations.

603.04.04 Structure Excavation Common. When Foundation Preparation is not listed as a bid item, the Department will measure the quantity, in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.05 Structure Excavation Solid Rock. The Department will measure the quantity in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.06 Structure Excavation Unclassified. The Department will measure the quantity in cubic yards. The Department will not measure any material removed or excavated before the Engineer takes measurements.

603.04.07 Foundation Undercut. When Foundation Preparation is not a bid item and the Engineer directs that unsuitable foundation material is to be excavated and replaced, the Department will measure the quantity of excavation as Structure Excavation Common, Structure Excavation Solid Rock, or Structure Excavation Unclassified in cubic yards, as applicable, which will be complete compensation for all excavation, disposal, backfill, and all other incidentals necessary to prepare a suitable foundation.

When Foundation Preparation is a bid item, the Department will pay for Foundation Undercut as Extra Work.

603.04.08 Cofferdams. The Department will not measure the quantity unless it is listed as a separate bid item and will consider it incidental to the bid item Structure Excavation or Foundation Preparation.

603.04.09 Foundation Seals. The Department will not measure the quantity unless it is listed as a separate bid item or the work is directed by the Engineer.

603.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08002	Structure Excavation Solid Rock	Cubic Yard
08001	Structure Excavation Common	Cubic Yard
02203	Structure Excavation Unclassified	Cubic Yard
02210	Borrow Excavation	See Section 205.05
02200	Roadway Excavation	See Section 204.05
08003	Foundation Preparation	Lump Sum

The Department will consider payment as full compensation for all work required under this section.

SECTION 604 BEARING PILES

604.01 DESCRIPTION. Furnish and drive, or HP shape structural steel or steel pipe bearing piles.

604.02 MATERIALS AND EQUIPMENT.

604.02.01 Concrete. Conform to Section 601..

604.02.02 Structural Steel. Conform to Section 812.

604.02.03 Welded Steel Pipe Piles. Conform to ASTM A 252, Grade 3.

604.02.04 Miscellaneous Metals. Conform to Section 813.

604.02.05 Polypropylene Sleeves. Conform to the manufacturer's recommendations.

604.02.06 Pile Points. Conform to AASHTO M 103, Grade 65/35 or ASTM A 148. Furnish pile points from a supplier on the Department's List of Approved Materials.

604.02.07 Pile Shoes. Provide pile shoes and closure plates of the type and dimensions specified when designated on the contract documents. Provide pile shoes for H-piles and open end pipe piles fabricated from cast steel conforming to ASTM A148/A148M (Grade 90-60).

604.02.08 Closure Plates. Provide end closure plates for closed end pipe piles made of ASTM A36/A36M steel or better. Provide the closure plate diameter and thickness designated in the plans.

604.02.09 Equipment for Driving.

A) Hammers. Drive piles with diesel, air, steam, hydraulic or vibratory hammers.

Provide open end (single acting) diesel hammers equipped with a device such as rings on the ram to permit the Engineer to visually determine hammer stroke at all times during pile driving operations. Also provide the Engineer a chart from the hammer manufacturer equating stroke and blows per minute for the open end diesel hammer to be used. For open end diesel hammers, provide and maintain in working order for the Engineer's use, an approved device to automatically determine and display ram stroke.

Operate and maintain air/steam hammers within the manufacturer's specified ranges. Furnish plant and equipment for air/steam hammers with sufficient capacity to maintain the volume and pressure specified by the manufacturer under working conditions. Provide a hose connecting the compressor or boiler with the hammer that is at least the minimum size recommended by the hammer manufacturer. Provide plant and equipment that are equipped with accurate pressure gauges which are easily accessible to the Engineer. Provide striking parts of air/steam hammers which are not less than one third the weight of the helmet and pile being driven, and in no case weigh less than 2750 pounds. If a wave equation analysis is used for hammer acceptance the minimum ram weight requirements do not apply.

Provide hydraulic hammers equipped with a system for measuring and immediately displaying the kinetic energy or ram impact velocity in the field. Maintain the system in good working order and operational at all times piles are driven.

Vibratory hammers, when approved by the Engineer for installing

production piles, may be used to advance a pile. Use an impact hammer to verify the nominal resistance or refusal criteria, as applicable.

When the Engineer judges that the size of the hammer is unsatisfactory due to the required nominal resistance not being reached or excessive blow counts, correct or replace it to produce satisfactory results. Provide the Engineer with the manufacturer's specifications regarding hammers upon request.

B) Leads. Use leads to support piles in line and position while being driven. Provide pile driver leads constructed in a manner that affords freedom of movement of the hammer while maintaining alignment of the hammer and the pile to insure concentric impact for each blow.

Leads may be either fixed or swinging type. Adequately embed swinging leads in the ground or constrain the pile in a structural frame such as a template to maintain alignment and location tolerances. Fit swinging leads with a pile gate at the bottom of the leads unless used with a template. Provide leads with a sufficient length to make the use of a follower unnecessary. Design leads used for driving batter piles to permit and maintain proper alignment of the batter pile. A horizontal brace may be required between the crane and base of leads to maintain alignment and location tolerances in some batter pile installation conditions. If necessary to maintain tolerance, hold leads in position with guys, stiff braces, templates or other Engineer approved means for supporting the pile during driving.

C) Followers. Use followers only when approved in writing by the Engineer, or when specifically stated in the contract documents. When submitting a proposal to use a follower, include a wave equation analysis to evaluate the suitability of the proposed driving system. When driving steel piles, provide a steel follower with a cross section that has an impedance between 50 percent and 200 percent of the pile impedance. If using followers, drive one long pile from every group of 10 without a follower, and use this pile to evaluate the nominal resistance of the group.

Hold and maintain the follower and pile in equal and proper alignment during driving. Provide a follower consisting of material and with dimensions to permit the piles to be driven to the required penetration depth. Design the follower with guides adapted to the leads that maintain the hammer, follower and pile in alignment during driving. Equip the lower end of the follower with a helmet or follower-pile connection suitable for the pile type being driven.

Verify the final position and alignment of the first two piles installed with followers in each substructure unit in accordance with the location and alignment tolerances in Section 604.03.08 before additional piles are installed.

D) Jets. Use jetting only if approved in writing by the Engineer or when specifically stated in the contract documents. When jetting is used, submit details of the proposed jetting and pile driving plan. Where practical, jet all piles in a pile group to the required penetration depth before beginning pile driving. When large pile groups or pile spacing and batter make this impractical and dynamic testing is being conducted, perform restrike tests on a select number of previously driven piles to check nominal resistance after jetting operations are completed; the Gates formula is only valid for the end of driving (EOD) condition.

604.03 CONSTRUCTION.

604.03.01 General.

A) Steel Pipe Piles. Use welded steel pipe piles of the design, thickness, and dimensions specified in the plans. Backfill pipes with sand, gravel, and/or concrete as specified in the contract documents. Unless otherwise specified, use fine aggregate meeting the requirements of Section 804, coarse aggregate No. 5 or

finer meeting the requirements of Section 805, or Class A concrete meeting the requirements of Section 601.

B) Steel H Piles. Use HP shape piles as shown in the plans.

604.03.02 Limitations of Use. Penetrate 10 feet or more into original ground and 10 feet or more below stream bed, or to rock. In all cases, develop the required nominal resistance value or refusal criteria with the pile penetration.

For foundation work, do not penetrate a very soft upper stratum overlying a hard stratum unless the piles penetrate the hard material a sufficient distance to rigidly fix the ends.

604.03.03 Storage and Handling. Store and handle piles in a manner that avoids injury to the piles.

604.03.04 Preparation for Driving.

A) Excavation. Do not drive piles until after completing excavation, except for test piles driven to bedrock and for piles that extend above the ground in the completed structure. Sufficiently excavate the area in the vicinity of the test piles before driving them to ensure that the test piles are driven only through material that will not be excavated later in constructing the footing. Ensure that the Department allows driving test piles before excavating for the entire footing. Remove all material forced up between the piles to the correct elevation before placing concrete for the foundation.

B) Caps. Cut the heads of steel piles squarely. Provide a driving cap or head that has been properly grooved or made in some manner to fit and hold firmly the head of the pile being driven so that the axis of the pile is in line with the axis of the hammer.

Protect tops of steel pipe piles with driving heads, mandrels, or other devices properly sized for the hammer according to the hammer manufacturer's recommendations to properly distribute the hammer blow and to prevent damage to the pipe pile during driving.

C) Pile Points. For steel piles, provide cast steel points when specified or directed in order to obtain penetration. Use pile points of the type specified in the Contract or by the Engineer. Weld pile points to the pile with a minimum 5/16 inch groove weld along the full outside width of each flange on the pile. Install pile points in the shop or in the field and perform all welding according to Sub-Section 607.03.07 using KYTC or AWS certified welders. Furnish a mill test report according to Subsection 607.03.13 C). Furnish the Engineer with the manufacturer's specifications.

D) Extensions, Build-Ups, and Splices. The Engineer may allow extensions, splices, or build ups when necessary as outlined below. Perform all welding according to Subsection 607.03.07 using KYTC or AWS certified welders.

1) Steel Pipe Piles. Make extensions, splices, or build-ups on steel pipe piles as specified in the Plans or as directed.
2) Steel H Piles. Make extensions or splices according to the standard drawings. Never begin driving with a spliced pile. When splicing is necessary, use a length that will minimize the number of splices required to meet he applicable driving criteria.

604.03.05 Methods of Driving and Placing. With the Engineer's written permission, water jet or pre-drill and drive the piles with an impact hammer to secure the last few feet of penetration. Do not jet piles unless the Engineer approves. Unless otherwise specified in the Plans or directed, prepare jetted or pre-drilled holes in compacted fills as necessary to secure the required penetration. Pre-drill holes to a maximum diameter equal to the least cross sectional dimension of the piles driven. Fill all voids that occur around a driven pile

with free flowing sand.

Do not drive piles in the vicinity of recently placed concrete until the concrete is sufficiently cured to prevent damage, in the judgment of the Engineer.

Drive pipe piles using steel heads having a projecting ring fitting inside the pipe pile. Provide a 1/4 inch clearance between the ring and the pipe pile. The Department will allow the use of other types of driving heads if the Engineer approves. The Department will not require painting the steel pipes. Remove and replace improperly driven, broken, or otherwise defective pipe piles, or otherwise correct them to the Engineer's satisfaction by driving an additional pile. The Engineer will inspect all driven pipe piles. When the Engineer approves the driven pipe piles, cut them off to a horizontal plane at the required elevation.

Before placing concrete, remove all water or debris from the pipe pile. Place concrete in an approved manner that will ensure against segregation. Do not place concrete until completely driving all piles within a radius of 16 feet of the pipe pile to be filled or until completely driving all the pipe piles for any one bent or pier foundation unit. Continuously place the concrete in each pile, and exercise proper care to fill every part of the pipe pile and to ensure a dense, homogeneous mixture.

Ensure that the finished tops of piles are at the elevation specified in the Contract or directed by the Engineer and that they project no less than 6 inches into pier footings and no less than 3 feet into end bents.

604.03.06 Test Piles. Drive test piles of a length and at the location designated on the plans or determined by the Engineer. Plan test pile lengths are typically greater than the length assumed in the design in order to provide for any variation in subsurface conditions.

Test Piles are for the Engineer's use in determining capability of the Contractor's equipment and adequacy of design. The Engineer will determine when the applicable refusal criteria or nominal resistance value has been obtained. The Contractor is responsible for determining pile lengths that may be necessary to meet applicable driving criteria. Do not make a claim against the Department for costs of construction delays, or any materials, labor, or equipment that may be necessary due to the Contractor's failure to furnish piles of a length sufficient to meet applicable driving criteria or for variations in length due to subsurface conditions that may be encountered.

Drive production piles using the pile hammer model, size and fuel setting used to drive the test piles. Use the same type of piles in the remainder of the group as the type tested for the group. Unless otherwise noted in the contract documents, accurately locate all test piles so they may be used in the finished structure.

Soundings, boring logs, soil profiles, or other subsurface data included in the Contract documents are used by the Department for foundation design and making preliminary estimates of quantities. The contractor must develop their own interpretation of the subsurface data to evaluate equipment, materials, or labor necessary for driving piles as required by the contract.

604.03.07 EVALUATION OF NOMINAL RESISTANCE. The Engineer will evaluate when each pile in the structure has obtained an adequate nominal resistance. Determine the pile lengths necessary to obtain the required nominal resistance. The Engineer will evaluate the nominal resistance of piles in axial compression based on one of the methods listed below.

A) Static, Dynamic and/or Other Type(s) of Load Testing. When specified in the Contract or required by the Engineer, the Department will determine the size, number, and nominal resistance of piles by loading tests. Perform load testing according to the plans or proposal notes which are elsewhere in the contract documents.

B) Modified Gates Dynamic Formula for Friction Piles. The Engineer will evaluate the nominal resistance using the Modified Gates dynamic formula unless the contract documents contain a provision to use another method to establish driving criteria. The Modified Gates formula is valid for a nominal resistance no greater than 300 tons. It is valid only for the end of driving (EOD)

condition and may not be applied on restrike. Formula results are not applicable when the pile head is crushed or damaged, or when a follower is used. Drive piles to a penetration depth necessary to obtain the required nominal resistance according to the Modified Gates formula with specified units as follows:

$$R_{ndr} = 0.875\sqrt{WH}\ \log_{10}(10N_{in}) - 50$$

Where:

R_{ndr} = nominal driving resistance (tons)

W = ram weight (lbs.)

H = average hammer stroke during set observation (ft.)

N_{in} = number of hammer blows per inch (blows/in.)

The number of hammer blows per foot of pile penetration required to obtain the nominal resistance is calculated as follows:

$$N_{ft} = 12\ (10^{x})$$

In which:

$$x = \left[\frac{R_{ndr} + 50}{0.875\sqrt{WH}}\right] - 1$$

Where:

N_{ft} = number of hammer blows per foot (blows/ft.)

The Modified Gates Formula can also be expressed as:

$$R_{ndr} = 0.875\sqrt{WH}\ \log_{10}\left(\frac{100}{S_{10}}\right) - 50$$

Where:

S_{10} = the total set in the last 10 blows (inches)

The total set in the last 10 blows (inches) required to obtain the nominal resistance is calculated as follows:

$$S_{10} = (10^{y})$$

In which:

$$y = 2 - \left[\frac{R_{ndr} + 50}{0.875\sqrt{WH}}\right]$$

The Department will use the preceding formulas only when:

1) they are applied at the end of driving condition and not on restrike,
2) the hammer has a free fall,
3) the head of the pile is not crushed or damaged,

4) the penetration is reasonably quick and uniform,
5) there is no observed appreciable bounce after the blow, and
6) a follower is not used.

C) Practical Refusal for Point Bearing Piles. Drive point bearing piles to practical refusal as defined in the table below. Immediately cease driving operations if the pile visibly yields or becomes damaged during driving. If hard driving is encountered because of dense strata or an obstruction, such as a boulder before the pile is advanced to the depth anticipated, the Engineer will determine if more blows than specified for practical refusal are required to further advance the pile. Drive additional production and test piles if directed by the Engineer.

Case	Rock Type	Maximum Set
I	Hard Bedrock	¼ inch in 5 consecutive blows and ¼ inch for 5 additional consecutive blows
II	Soft Bedrock	½ inch in 10 consecutive blows and ½ inch for 10 additional consecutive blows
III	Very Soft and Weathered Bedrock	1 inch in 20 consecutive blows and 1 inch for 20 additional consecutive blows
Apply the Case Number identified in the plans or as directed by the Engineer.		

604.03.08 Allowable Variation in Driving. Use templates when specified or directed.

A) Exposed Piles. The Engineer will not accept exposed piles in the finished structure when:

1) during driving, the pile varies more than 1/4 inch per foot from vertical or the batter position specified in the Plans;
2) the driven pile varies more than 4 inches from plan position at the pile cut-off elevation; or
3) the driven pile varies more than 2 inches from a stringline stretched between exterior piles in the exposed portion of the pile bent or group.

B) Unexposed Piles. The Engineer will not accept unexposed piles in the finished structure when:

1) during driving, the pile varies more than 1/4 inch per foot from vertical or the batter position specified in the Plans; or
2) the driven pile varies more than 6 inches from plan position at the pile cut-off elevation.

For either case, the Engineer will reference the plan position of the pile cut-off elevation to determine the variation of 1/4 inch per foot. For all piling that is unacceptable because of variations, remove and replace or redrive them in an acceptable position or correct them in a manner the Engineer directs. Furnish and place all additional concrete and steel reinforcement required to meet plan clearance and dimensions in footings, caps, or bridge seats due to variations in driving, even when variations are within allowable tolerances.

604.03.09 Design Modifications. When it is not possible to meet the applicable driving criteria required by the Plans, the Department will redesign the structure based on the test piles or pile load tests. The redesign will be at Department expense and time will not accrue during redesign.

604.03.10 Ordering Piles. Order piles of the number and lengths necessary to complete the work.

604.03.11 Pile Protection. When specified in the Contract, provide protection from negative skin friction as the Contract specifies.

604.03.12 Unused Pile Lengths. Take ownership of unused lengths of piles and pile cutoffs, and remove such lengths and cutoffs from the project.

604.04 MEASUREMENT.

604.04.01 Piles. The Department will measure the quantity in linear feet for the total lengths of the various types and sizes. Splices are incidental to this item of work.

The Department will not measure unused lengths of piles or pile cutoffs for payment.

The Department will not measure corrective work or re-driven piles.

The Department will not measure any additional concrete or steel reinforcement required to meet plan clearance and dimensions in footings, caps, or bridge seats due to variations in driving, even when variations are within allowable tolerances.

604.04.02 Pile Points. When included as a bid item, the Department will measure the quantity by each individual unit.

604.04.03 Test Piles. For test piles actually used as a pile in the structure, the Department will measure the quantity according to Subsection 604.04.01 except that the

minimum measured length for test piles will be the length specified in the Plans or directed by the Engineer. The Department will not measure unsatisfactory test piles that are not used as a pile in the structure.

Length of test piles specified in the Plans are approximate only. The Department will not measure necessary splices for payment and will consider them incidental to this item of work.

604.04.04 Load Tests. When required, the Department will measure and pay for load tests as defined elsewhere in the Contract Documents. The Department will not measure for payment load tests made at the option of the Contractor.

604.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08042-08056	Piles Steel HP, Size	Linear Foot
23546EC, 23826EC	Pipe Pile, Size	Linear Foot
08093-08095	Pile Points	Each
08033	Test Piles	Linear Foot

The Department will consider payment as full compensation for all work required under this section.

SECTION 605 — PRESTRESSED AND PRECAST CONCRETE PRODUCTS

605.01 DESCRIPTION. Construct precast prestressed concrete members.

Provide complete members, including all steel and other materials. Members include I-beams, box beams, barrier walls, deck units (box beams and slab), box culverts, and piling and other structural items.

Fabricate according to the Department's Precast and Prestressed Concrete Products Inspector's Manual.

605.02 MATERIALS AND EQUIPMENT.

605.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

605.02.02 Steel Reinforcement. Conform to Section 811.

605.02.03 Prestressing Strands. Conform to Section 811.

605.02.04 Non-Shrink Grout. Conform to Subsection 601.03.

605.02.05 Forms. Conform to Subsection 601.02. Only use metal forms for prestressed sections, except that wooden bulkheads are acceptable. Ensure that all forms are accessible for vibrating, tamping, and consolidating the concrete.

605.02.06 Styrofoam. Use material the Engineer approves.

605.02.07 Cardboard. Use material the Engineer approves.

605.02.08 Batching Plant Equipment. Conform to Subsection 601.02.

605.02.09 Plant Certification. Ensure that all prestressed and precast concrete products supplied to Department of Highways' projects are manufactured in a Certified Plant.

A) Requirements. For a plant to become a Certified Plant, ensure that the producer has the following:

1) A production facility and other necessary equipment that conform to the Contract requirements.
2) A quality control program conforming to Division 100 of the Department's Precast and Prestressed Concrete Products Inspectors Manual.
3) An acceptable record of production of quality products.
4) Concrete technicians responsible for design of the concrete mixture and for performing quality control and process control testing, as required in Subsection 605.02.09 and Division 300 of the Department's Precast and Prestressed Concrete Products Inspectors Manual. Ensure that the concrete technicians are certified as ACI Level I and KCA Level II as awarded by the KCA.

   A Level I concrete technician is responsible for quality control tests such as air content, slump, and molding cylinders. A Level II concrete technician is responsible for supervising this testing.

   The Engineer may require retesting or re-certification as deemed necessary.

B) Application for Certification. Each year, ensure that the plant submits a written application for plant certification before January 1 to the Division of Materials. Ensure that the plant submits an application for re-certification when transferring

plant ownership.

Ensure that the plant includes the following items with the application:

1) Company name, physical plant address, the principle officers of the company, plant manager, production superintendent, and quality control supervisor.
2) The names and certification levels of the concrete technicians responsible for design of the concrete mixture and for performing the required quality control and process control testing.

The Department will place any plant that has not previously manufactured products for the Department on a one-year probationary period before qualifying it as a Certified Plant.

C) Additional Prestressed Concrete Certification. Ensure that all prestressed concrete members supplied to the Department are manufactured in a plant that is certified under the appropriate Prestressed Concrete Institute quality control program and is designated as a PCI Certified Plant.

605.02.10 Concrete Production. During production of concrete products, ensure that the producer conforms to all requirements of the Contract, and ensure that the concrete technicians perform all quality control and process control testing required by the Precast/Prestressed Concrete Manual and any applicable KM.

The Inspector will perform the inspection duties established by the Department for the item being produced, including but not limited to the duties in the Department's Precast and Prestressed Concrete Products Inspectors Manual. If, at any time, the producer is not abiding by the certification requirements, the Inspector will reject or accept those products not manufactured according to the Contract requirements as specified in Subsection 105.04.

When production problems occur which may affect the structural integrity, such as holes in webs and flanges, cracks, reinforcement displacement, submit proposed corrective procedures to the Engineer. The Department will evaluate the product and determine if it will be rejected or if corrective actions are reasonable.

If a plant consistently produces products not conforming to the requirements as set forth in this agreement, the Department will revoke its certification, and the plant may not longer produce products for Department projects until the plant corrects all deficiencies and regains certification.

605.03 CONSTRUCTION. For prestressed concrete deck units, use Class D Modified concrete of either Type I or Type III cement, except do not allow the cement factor to exceed 800 pounds per cubic yard. Ensure all non-composite box beam concrete contains an approved corrosion inhibitor from the List of Approved Materials. Construct prestressed members other than concrete deck units of Class D concrete that uses either Type I or Type III cement, except do not allow the cement content to exceed 800 pounds per cubic yard.

When the ambient temperature is 71 °F or higher, add a water reducing and retarding admixture to the concrete mixture for prestressed concrete products. The Engineer may direct or allow the use of water reducing and retarding or water-reducing admixture.

605.03.01 Mixing and Batching. Conform to Subsection 601.03.

605.03.02 Forming. Construct formwork according to Subsection 601.03.

When the ambient temperature is above 80 °F, fog spray forms exposed to direct sunlight with water in order to cool the forms before placing the concrete mixture. When the ambient temperature is below 41 °F, heat forms left unprotected from the weather with steam or other Engineer approved methods, unless the temperature of the concrete mixture to be placed is maintained at 60 °F or greater.

Fabricate voids of styrofoam or from cardboard that has been treated with a waterproofing agent. Glue and band all voids made by stacking more than one piece of material to prevent separation during concreting operations. The Engineer will regard any evidence of separation as cause for rejection.

605.03.03 Casting. Accurately place all steel, when required, as shown or directed. Dimensions shown from the face of concrete to steel are clear distances. Spacings are from center to center of steel. Place and securely tie all steel reinforcement before placing concrete, unless the Engineer requires or allows otherwise.

For concrete batching equipment and procedures, conform to Section 601. Do not begin concreting operations when the wind chill factor at the site is consistently 0 °F or less.

Place concrete continuously in each section, vibrating internally or externally or both to consolidate the concrete. Do not vibrate Self-Consolidating Concrete (SCC). Overfill the forms, screed off the surplus concrete, and finish the top surfaces to a uniform, even texture comparable to the finish produced by the forms.

Give the top surfaces to be bonded to other concrete a rough finish. Initially, float finish the surfaces. Perform further finishing before the concrete takes its initial set, by scoring the tops of the members transversely at approximately 3-inch centers with a pointed tool. Remove any laitance present during the finishing operations.

Vibrate in a manner that avoids displacement of any steel or enclosures and segregation of the concrete. Properly embed steel and enclosures in the concrete.

The Department will allow casting of members at the job site or at any location away from the job site. The Engineer will inspect members at the site of the casting, but will make final acceptance according to Subsection 105.12.

Determine the compressive strength of the concrete from cylinders cast from concrete placed in the members and cured in the same manner as the concrete represented by the cylinders. Cast and test cylinders according to KM 64-305 and ASTM C 39, respectively.

Imprint the name or trademark of the fabricator of I beams, box beams, or deck units in the concrete near the abutment end of the right fascia beam or deck unit, on the beginning end of each bridge. Cast the name or trademark into the concrete according to Subsection 601.03.19 for the plate used to imprint the construction date.

The Department will inspect, sample, and test precast units to determine their acceptability. The fabricator is responsible for providing quality control personnel as necessary to ensure the work performed complies with all requirements of the Contract.

Ensure that fabricators of prestressed concrete members furnish, as part of their quality control equipment, a pachometer for determining the depth of concrete cover over steel reinforcement. Furnish a meter that is acceptable to the Engineer. Make the pachometer available for use by both the fabricator's quality control personnel and by the Inspectors.

605.03.04 Tack Welding. The Department does not allow tack welding.

605.03.05 Special Requirements for Prestress Plants.

A) Hot Weather Production. In addition to the requirements of Subsection 605.03, ensure that the producer applies the following requirements to outdoor prestress operations:

1) When the ambient temperature is above 80 °F sprinkle or fog spray coarse aggregates.
2) Discontinue concreting operations when ambient temperatures are between 90 and 100 °F if the producer cannot effectively maintain form and concrete temperatures below 90 °F.
3) Discontinue concreting operations when ambient temperatures are above 100 °F.

B) Drawings. Have the producer submit drawings conforming to applicable requirements of Subsection 607.03 for prestressed girders. Include with the shop drawings a detailed drawing, including the total number of stirrups, for each different mark number and a diagram of the detensioning procedure. The Department will not require reproducible drawings. Obtain the Department's completed drawing review prior to releasing fabrication.

C) Safety Measures. Ensure that the producer takes effective safety measures to prevent injuries to personnel due to the breakage of strands or failure of anchorage devices during the tensioning operations. Ensure that the producer provides adequate protection that allows the Inspector to perform his normal duties. The Inspector will report any safety precautions deemed inadequate to the Division of Materials. The Inspector will abide by the safety rules established by the producer, provided that they do not interfere with his normal duties.

D) Prestressing. Ensure that the producer performs prestressing by pretensioning and provides a skilled technician knowledgeable of the pretensioning system used. Ensure that the producer conforms to the following:

1) Uses approved jacking equipment to perform prestressing.
2) When using hydraulic jacks, equips them with calibrated pressure gages. Calibrates the combination of jack and gage to an accuracy of ± 2 percent, and furnishes a graph or table showing the calibration to the Engineer. If using other types of jacks, furnishes calibrated proving rings or other devices to accurately determine jacking forces.
3) Accurately holds prestressing elements in position to stress by jacks.
4) Applies an initial force to each strand in beams or girders such as to develop a stress of 189,000 psi or such other stress as specified in the Plans.
5) Maintains a record of the jacking force and elongations produced thereby.
6) If desired, cast several units for precast sections in one continuous line, but stress them one at a time.
7) Does not transfer prestressing forces to any member or release end anchors before the concrete has attained a minimum compressive strength of 4,000 psi, as determined by tests of standard cylinders cured identically as the member. The Department may require a higher strength.
8) Removes forms and detensions prestressed members immediately after discontinuing steam curing or heat curing while the concrete is still warm and moist, when using either of these methods for curing.
9) Cuts or releases the elements in an order that minimizes the lateral eccentricity of the prestressing.
10) The Engineer will reject beams or girders having honeycomb of such extent to affect their strength or resistance to deterioration.
11) Makes an allowance of 0.0005 times the length for shortening of beams and girders as a result of shrinkage and elastic change.

E) Curing. Cure according to Subsection 605.03.06 except the producer may discontinue curing after the concrete reaches the detensioning strength.

F) Removal From Forms. The producer may remove and store precast, prestressed members from the casting beds after the prestress force has been applied, provided the Engineer approves arrangements for curing and protecting. Ensure that the producer conforms to the following:

1) Fills all air voids in the inclined surfaces of all I beams with grout.
2) Ensures that strand hold-down devices that remain in place are either a minimum of 1/2 inch from the surface of the concrete or are galvanized.
3) Patches all cavities.
4) The producer may use other type devices when the Engineer approves them. Complete all finishing operations on prestressed bridge beams within 48 hours of detensioning, except masonry coating, curbs, and damage repair as the Engineer directs.

605.03.06 Curing. Cure members either by water curing according to Subsection 601.03.17 or by rapid curing with low pressure steam or radiant heat.

Perform low pressure steam curing or radiant heat curing under an enclosure capable of adequately containing the live steam or radiant heat. Use enclosures that allow free

circulation of steam or heat about the sides, ends, and tops of members and are constructed to contain the live steam with a minimum moisture loss. The Department will allow the use of tarpaulins or similar flexible covers that remain in good repair. Secure the tarpaulins in a manner that prevents the loss of significant steam and moisture. Allow concrete to attain its initial set before applying the steam or heat. After placing the concrete, allow an initial set period of not less than 2 hours before applying the steam or heat. When using water reducing and retarding admixtures, increase the initial set period to 4 hours. The Department will allow determination of the time of initial set using ASTM C 403 and waive the time limits specified herein when the initial set has been reached as determined by the referenced test. Prevent surface drying during the period between placing the concrete and applying the steam or heat by covering the members after casting or by keeping the exposed surfaces wet with a fog spray or a double layer of wet burlap. During the waiting period, do not allow the temperature within the curing chamber to fall below 50 °F. Use live steam or radiant heat to maintain the curing chamber at the proper minimum temperature.

During the initial application of live steam or radiant heat, allow the ambient temperature within the curing enclosure to increase at an average rate not exceeding 40 °F per hour until reaching the curing temperature within the enclosure. Do not allow the maximum curing temperature within the enclosure to exceed 160 °F.

Apply live steam on the concrete forms in a manner that does not cause localized high temperatures.

Apply radiant heat using pipes circulating steam, hot oil, or hot water. Perform radiant heat curing under a suitable enclosure to contain the heat, and minimize moisture loss by covering all exposed concrete surfaces with a plastic sheeting. Provide a method of maintaining moisture satisfactory to the Engineer.

Water cure precast, non-prestressed, non-post-tensioned items for 3 days or rapid cure them with steam or heat overnight. The Department will allow curing to cease when the acceptance strength is reached as shown by test cylinders.

605.03.07 Removal of Forms and Surface Finish. The Department will allow the removal of side forms at any time when no distortion, slump, or misalignment of the concrete will result. Ensure that all surfaces are free from rough, open, or honeycombed areas, and appreciable depressions or projections. Finish or chamfer edges as directed. When removing the forms, avoid spalling or otherwise damaging the concrete. Finish members that will be exposed in the finished work according to Subsection 601.03.18. Finish dry cast products according to the Precast/Prestressed Concrete Manual. Repair vents opened to relieve air pressure in box beams during curing using non-shrink grout.

605.03.08 Dimensional Tolerances. Ensure that the producer furnishes members within the tolerances of the following tables. The Engineer will condition final acceptance upon satisfactory placement of the units in the structure.

I-BEAMS, BOX BEAMS WITH CAST-IN-PLACE SLAB, AND PRECAST BARRIER UNITS	
Depth (flanges, web, and fillets)	± 1/4 inch
Depth (overall)	+ 1/2 inch to – 1/4 inch
Width (flanges and fillets)	+ 3/8 inch to – 1/4 inch
Width (web)	+ 3/8 inch to – 1/4 inch
Length of Beam	± 1/8 inch per 10 feet or 3/4 inch, whichever is greater
Exposed Beam Ends (deviation from square or designated skew)	Horizontal ± 1/4 inch; Vertical ± 1/8 inch per foot of beam height
Side Inserts (spacing between centers of inserts and from the centers of inserts to the ends of the beams)	± 1/2 inch
Bearing Plate (spacing between the centers of bearing plates)	± 1/8 inch per 10 feet or 1/2 inch, whichever is greater
Bearing Plate (spacing from the centers of bearing plates to the ends of the beams)	± 1/4 inch
Bearing Plate or Bearing Area (deviation from a level plane)	± 1/8 inch
Stirrup Bars (projection above top of beam when design projection is more than 3 inches)	± 3/4 inch
Stirrup Bars (projection above top of beam when design projection is 3 inches or less)	± 1/2 inch
Stirrup Bars (long, spacing, anchorage zone)	± 1/2 inch
Stirrup Bars (long, spacing)	± 1 inch
End Stirrup Bars	Not more than 2 inches from the end of the beam
Horizontal Alignment (deviation from a straight line parallel to the centerline of beam)	1/8 inch per 10 feet
Camber of precast barrier units	± 1/4 inch per 10 feet
Camber differential between adjacent beams	1/8 inch per 10 feet of span to 1 inch max.
Center of gravity of strand group	± 1/4 inch
Strand positioning	± 1/4 inch
Center of gravity of depressed stand group at the end of beam	± 1/2 inch
Position of hold-down points for depressed stands-longitudinal	± 6 inches
Position of handling devices-longitudinal	± 6 inches
Position of material for debonding of strands	± 1 inch

DECK UNITS (Box Beams and Slabs)	
Depth (top slab, box beam)	± 1/2 inch
Depth (bottom slab, box beam)	± 1/2 inch
Depth (overall)	± 1/4 inch
Width (web, box beam)	± 3/8 inch
Width (overall)	± 1/4 inch
Length	± 1/8 inch per 10 feet or 3/4 inch, whichever is greater
Void position-longitudinal (flat slab)	± 1/2 inch from end of void to center tie hole; ± 1 inch adjacent to end block
Void position-transverse and vertical (flat slab)	± 1/2 inch
Square ends (deviation from square)	± 1/4 inch
Skew ends (deviation from designated skew) Skew angle equal to or less than 30° Skew angle greater than 30°	± 1/2 inch
Bearing plate or bearing area plane (deviation from level plane) (Bearing plate or bearing area plane must be an evenly distributed 80 percent of true plane, when tested with a straightedge.)	± 1/8 inch
Horizontal alignment (deviation from a line parallel to the centerline of member)	1/4 inch, up to 40 feet length; 3/8 inch, over 40 feet and up to 60 feet in length; 1/2 inch, over 60 feet in length
Dowel tubes (spacing between the centers of tubes and from the centers of tubes to the ends and sides of the member)	± 1/2 inch
Tie rod tubes (spacing between the centers of tubes and from the centers of tubes to the ends of the member)	± 1/2 inch
Tie rod tubes (spacing between the centers of tubes to the bottom of the beam)	± 1/2 inch
Total width of deck	Theoretical width + 1/2 inch per joint
Camber differential between adjacent units	± 1/4 inch per 10 feet, 3/4 inch max.
Camber differential between high and low members in the same span	1 inch max.
Side inserts positioning	± 1/2 inch
Stirrup bar positioning	± 1 inch
Stirrup bar (long, spacing, anchorage zone)	± 1/2 inch
Strand positioning	± 1/4 inch
Handling device positioning	± 6 inches
Center of gravity of stand group	± 1/4 inch
Curbs placed separately on prestressed box beams (Applies to any portion 10 feet in length over the entire length of the beam)	± 1/4 inch per 10 feet
Position of material for debonding of strands	± 1 inch

PILING	
Width or diameter	- 1/4 + 3/8 inch
Head out of square	1/8 inch per 12 inches of width
Length of pile	± 1 1/2 inch
Horizontal alignment (deviation from a straight line parallel to the centerline of the pile)	1/8 inch per 10 feet
Void position-longitudinal	± 2 inches
Void position-transverse	± 1/2 inch
Void position-vertical	± 1/2 inch
Stirrup bars or spiral position	± 1 inch
Tendon positioning	± 1/4 inch
Center of gravity of strand group	± 1/4 inch
Handling device positioning	± 6 inches

605.03.09 Transportation, Storage, Handling, and Erection. Transport precast girders in an upright position, and keep the points of support and directions of the reactions with respect to the girder approximately the same during transportation and storage as when the girder is in its final position.

Prevent cracking or damage during storage, hoisting, and handling of precast units. Replace units damaged by improper storing or handling. Do not ship precast units to the Project prior to attaining the specified acceptance strength.

During erection of members, keep the bridge seats and tops of bearing devices free of foreign materials. While shifting members, lift members completely away from bearings.

Temporarily brace and tie each prestressed concrete I-beam, after erection, in a manner that will prevent sliding, tipping, or other movement that may result from high winds, creeping down grade, or other causes, until casting the diaphragms. Erect and brace at least 2 adjacent members in any one span before suspending operations for any one day.

Begin erecting deck units at the location designated or approved by the Engineer and proceed, one member at a time, across the roadway. After placing and fastening the units by transverse tie assemblies, fill longitudinal keys between the units with non-shrink grout and seal as specified in the Plans. Cure the non-shrink grout keys with 2 layers of wet burlap, or other approved covering, placed on the slab. Keep the non-shrink grout continuously moist for 3 or more calendar days, except cure commercial mixtures according to the manufacturer's instructions.

Do not place equipment used to lift deck units into place on a portion of the bridge which has been erected without obtaining the Engineer's approval.

605.04 MEASUREMENT. The Department will not measure the work required to qualify the tack welders and tack welding procedures for payment and will consider it incidental to the pay item for prestressed or precast members, except the Department will test the specimens at no expense to the fabricator.

605.04.01 Precast I-Beams. The Department will measure the quantity in linear feet. The Department will not measure bearing devices for payment and will consider them incidental to this item of work.

605.04.02 Precast Panels. The Department will measure the quantity according to Subsection 613.04.

605.04.03 Precast Box Beams. The Department will measure the quantity in linear feet. The Department will not measure bearing devices for payment and will consider them incidental to this item of work.

605.04.04 Precast Concrete Median Barrier. The Department will measure the quantity according to Subsection 508.04.

605.04.05 Precast Piles. The Department will measure the quantity according to Subsection 604.04.

605.04.06 Prestressed Piles. The Department will measure the quantity according to Subsection 604.04.

605.04.07 Masonry Coating. The Department will measure the quantity according to Subsection 601.04.

605.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08631-08634, 08639	Precast PC I-Beam, Type	Linear Foot
08635-08638	Precast PC I-Beam Modified, Size	Linear Foot
08628	Precast PC Panels	See Subsection 613.05
08651-08672	Precast PC Box Beam, Designation	Linear Foot
01953, 01955, 01967, 01988, 01989, 01992, 01999	Concrete Median Barrier, Type	Linear Foot
08060-08066	Piles-Precast Concrete, Size	See Subsection 604.05
08080, 08082, 08086, 08096	Piles-Prestressed Concrete, Size	See Subsection 604.05
02998	Masonry Coating	See Subsection 601.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 606 BRIDGE RESTORATION AND WATERPROOFING WITH CONCRETE OVERLAYS

606.01 DESCRIPTION. This work shall consist of bridge deck restoration and waterproofing with latex concrete overlays.

606.02 MATERIALS AND EQUIPMENT.

606.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

606.02.02 Latex Admixture. Conform to Subsection 841.

606.02.03 Epoxy for Epoxy-Sand Slurry. Conform to Section 826.

606.02.04 Sand for Epoxy-Sand Slurry. Conform to Subsection 804.

606.02.05 Mortar Sand. Conform to Subsection 804 (for Grout-Bond Coat).

606.02.06 Latex Grout. Conform to Section 601.02.

606.02.07 Joint Materials. Conform to Section 807.

A) Filler. Use preformed expansion joint filler, Type II (cork).
B) Sealers. Use rapid cure silicone with closed-cell polyethylene foam back-up rod compatible with silicone sealant.

606.02.08 Concrete Curing Material. Conform to Section 823.

606.02.09 Structural Steel. Conform to Subsection 812 (for expansion dams and joint build up).

606.02.10 Equipment. Conform to Subsection 601.02 with the following exceptions and additions:

A) Mechanical Scarifiers or Grinders. Furnish mechanical scarifiers or grinders designed specifically for scarifying bridge decks that the Engineer approves. Ensure that the scarifier or grinder is capable of producing a surface matching the existing slab cross section and that each pass of the machine matches the previous pass in elevation.
B) Hammers. Provide Power driven Hammers lighter than nominal 45 lb. class.
C) Sawing Equipment. Sawing equipment shall be a concrete saw capable of sawing concrete to the specified depth.
D) Hydraulic Impact/Skid Steer Type Equipment with a maximum rated striking Energy of 360 ft-lbs are permitted only in areas of concrete removal more than 6 inches away from boundaries of surface areas to remain in service. The Contractor is to provide data information to the engineer on the equipment they wish to utilize to ensure compliance with this note.
E) Mixers. In addition to the requirements of Subsection 601.02, furnish continuous mixers having a latex admixture supply portion equipped with a cumulative-type meter that can be read to the nearest 0.1 gallon. Furnish continuous mixers having a water supply portion equipped with a flow meter or other suitable device for calibrating the water supply, and a cumulative type water meter that can be read to the nearest 0.1 gallon. Ensure that the latex and water meters are readily accessible, accurate to within ± one percent, and legible.
F) Hand Tools. In addition to the requirements of Subsection 601.02, furnish sufficient hand tools for placement of stiff, plastic concrete capable of working the

concrete down to approximately the correct elevation for striking off with a screed.

G) Finishing Machine. Conform to the requirements of Subsection 609.02.09.

H) Brooms. Furnish brooms having bristles of sufficient stiffness to treat the surface after finishing.

I) Air Compressors. Furnish air compressors equipped with separators and traps.

606.02.11 Coarse Aggregate. Conform to Section 805, size No. 8 or 9-M.

606.03 CONSTRUCTION.

606.03.01 Scheduling. Notify the Engineer at least 12 hours before placing concrete for the overlay. The Department will not grant a time extension for delay in placing concrete resulting from the Engineer receiving less than the 12-hour notice.

606.03.02 Weather Limitations. Construct the overlay during the night time hours when the ambient temperature will remain below 85 °F, the wind velocity is low, and hot conditions or rain are not expected. During hot weather, place the concrete when the ambient temperature falls to 85 °F or below. Complete placement of concrete before the ambient air temperature reaches 85 °F. Do not place concrete when the ambient temperature away from artificial heat is less that 45 °F and falling, except when using Type III cement. Keep all concrete at a temperature above 45 °F for at least 96 hours after placing. Make provisions for the uniform distribution of heat, and do not allow any area of the concrete surface to be heated to a temperature above 85 °F. To accomplish uniform distribution of heat during cold weather, provide housing, heating, or insulation methods that the Engineer approves. Do not place concrete during rain or drizzle. If it begins to rain or drizzle during placement, cease placement and finish and protect the material already in place.

606.03.03 Removal of Concrete, Restoration of Reinforcement and Cleaning. Treat the entire area of the deck between the curbs (roadway) and the ends of the structure (100 percent of the deck area) by machine preparation consisting of removal of concrete to a depth of at least 1/4 inch below the existing concrete surface. Machine prepare with mechanical scarifiers or grinders. If satisfactory results are not achieved, the Engineer may direct that the work be performed with other equipment. The Department will not require machine preparation on endwalls.

Remove epoxy, asphalt, foreign surfaces, and unsound patches in a manner approved by the Engineer. Sound concrete patches, regardless of the of the concrete material used, are to be left in place as determined by the Engineer. Do not use equipment that may cause damage to the underlying concrete.

Remove all other concrete that the Engineer deems unsound. Remove concrete within areas where the depth of removal exceeds 1/4 inch with hammers or other small equipment. Steel reinforcement damaged by the contractor shall be replaced to the size, type, and lap lengths determined by the Engineer. Remove concrete to a depth of 3/4 inch below any reinforcing bar which is more than 50 percent exposed or that appears not to be bonded to the existing concrete. Protect any underlying sound concrete and steel reinforcement. Ensure that the periphery of routed areas is as nearly vertical as possible. If the removal of unsound concrete extends through two thirds of the concrete slab or more, remove and replace the remaining sound concrete for full depth patching. Ensure that all exposed steel reinforcement is tied according to Subsection 602.03.04.

Remove all inferior concrete in the deteriorated and spalled areas near joints and all joint filler. Reform the joints to exact width and true alignment according to Subsection 609.03.04 for open joints except when a timber template is used, cover it with polyethylene sheeting.

Blast clean all exposed steel reinforcement and structural steel according to Subsection 606.03.04 to remove scale, rust, grease, oil and other material that would prevent adhesion of the concrete. Before placing concrete, replace or supplement deteriorated or damaged reinforcement as the Engineer directs. Remove all dust and chips of asphalt materials, concrete, or other debris and clean the entire area with compressed air. Ensure that the

compressed air is free of detrimental quantities of water, oil, grease, or any other injurious substances. Do not allow leakage of oil, grease, gasoline, or other substances from the compressor or other equipment on the deck. Suspend protective sheeting such as plastic or tarpaulins under all equipment that leaks.

Surface preparation, partial depth, and/or full depth removal of unsound concrete may be accomplished using hydrodemolition. Prior to any hydrodemolition operation, submit a hydrodemolition plan, in writing, for approval by the Engineer. In the hydrodemolition plan state water source, type of machine, water pressure settings and methods to collect and strain waste water and protect the public, structural steel paint, and structural steel. Calibrate the hydrodemolition machine to remove only unsound concrete. Test the machine on an area of concrete as directed by the Engineer.

Use clean water with a rust inhibitor. Collect and strain all waste water from the hydrodemolition operation. The Contractor, at a minimum, shall block all drains on the deck and install aggregate dams, or other Department approved devices, as necessary to strain runoff. The deck shall be used as a settlement basin within itself unless the Engineer or requirements of any associated regulatory agencies state otherwise.

After hydrodemolition operation, sound deck to ensure that all unsound concrete has been removed. Final sounding shall consist of as many successive resoundings as required to ensure that all unsatisfactory concrete has been removed. Additional removal shall be performed with 45 pound maximum weight hammers.

When Hydrodemolition is used, cleaning shall be performed with a vacuum system capable of removing wet debris and water all in the same pass. The vacuum equipment shall be capable of washing the deck with pressurized water prior to the vacuum operation to dislodge all debris and slurry from the deck surface. Cleaning shall be done in a timely manner, before debris and water is allowed to dry on the deck surface.

Full Depth repair shall be paid per cubic yard of concrete used and may not be done in the same operation as the deck overlay.

The Contractor shall comply with all federal, state, regional, and local government agencies that have requirements regarding the control of fugitive dust generated by concrete removal and blasting operations.

606.03.04 Blast Cleaning. Blast clean the entire area of the deck surface and vertical faces of curbs, barrier walls, and plinths up to a height of one inch above the top elevation of the overlay, and areas to receive epoxy-sand slurry to a bright, clean appearance that is free from curing compound, laitance, dust, dirt, oil, grease, asphalt material, paint, and all foreign matter. Perform blast cleaning of an area of the deck within the 24-hour period preceding placement of the overlay on the area. If the project is done under traffic, perform all blast cleaning within 12 hours prior to placement of the overlay. Perform blast cleaning according to the regulations specified in Subsection 107.01.04.

Protect the blast cleaned areas with white plastic before placement of the overlay. Blast clean contaminated areas and areas exposed more than 24 hours (12 hours when under traffic) again as the Engineer directs. Remove or roll the white plastic between the mixer truck rear wheels and the overlay placement.

Hydro blasting may be used in lieu blast cleaning. Use hand held high pressure wands with potable water. Water blast the entire area of the deck. Prevent steel reinforcement from rusting.

606.03.05 Full Depth Patching. Fill full depth holes with Class M1 or M2 Concrete. Immediately before placing concrete, dampen and surface dry the contact surface. Then apply a grout-bond coat by vigorously scrubbing or brushing into the vertical surface of full depth routed areas. Proportion the grout mixture according to Subsection 601.03 using Type I cement. Carefully place the Class M1 or M2 concrete and tamp or vibrate into place. Rough-finish the full depth patched areas to an elevation corresponding to the scarified grade and cure for a period of no less than 7 calendar days, or until the overlay is placed, by means of a double layer of wetted burlap or similar material. If the full depth patch area is

encompassed by an area of partial depth patching, finish the full depth concrete patch to an elevation corresponding to the bottom of the partial depth routed areas instead of the elevation of the scarified deck.

After the concrete has hardened sufficiently to maintain the proper shape, remove all joint templates. Avoid chipping or breaking down the edges of the repaired joint. Remove all forming material before completion of the project.

Provide temporary support for existing concrete handrails while removing and replacing full depth concrete. Submit the proposed method of supporting the handrails to the Engineer for approval before beginning work.

Blast clean the surfaces of all patched areas and remove sand before constructing the overlay. Complete all full depth patching in each lane before beginning overlay operations on that lane.

Place latex concrete overlays only when full depth patches have been placed for 24 hours or longer. Do not allow construction equipment on the full depth patches until they have attained a compressive strength of 4,000 psi.

606.03.06 Partial-Depth Patching. The Department may allow monolithic placement of the partial depth patches with the overlay.

606.03.07 Prohibited Field Welding. Do not perform welding on load carrying members of the bridge without the Engineer's written consent, and then only in the manner and at the locations designated.

606.03.08 Mixing and Placing. Mix concrete at the site by either batch or continuous mixers as the Engineer approves. Mix and deliver according to Subsections 601.03.07 and 601.03.08 except discharge within 20 minutes.

Submit to the Engineer for approval proposed methods for anchoring the finishing machine supporting rails to the deck.

Hold the formation of longitudinal joints and transverse joints to a minimum. When constructing longitudinal or transverse joints, thoroughly blast clean and coat with grout-bond coat material before placing plastic concrete against the hardened sides of the joints. Form longitudinal joints using a longitudinal header secured to the deck, 1/4 inch less in thickness than the overlay. Locate longitudinal joints along lane lines. After removal of the header, saw the overlay longitudinally 3 inches or more inside the formed edge and remove the portion of the overlay outside the saw cut before placing the adjacent portion of the overlay. The Department may allow alternate methods of constructing joints on latex overlays.

Produce the mixture at a uniform rate and perform finishing immediately after mixing.

606.03.09 Brooming. Immediately after finishing, broom the surface of the overlay transversely across the bridge deck from curb to curb. Texture the surface according to Subsection 609.03.10 immediately after finishing on new structure overlays, when specified in the Contract, and on Federal Aid projects.

606.03.10 Epoxy-Sand Slurry. After the overlay has been completed and cured, apply a thin coat (approximately 1/16 inch) of an epoxy-sand slurry to the 12 inches of the overlay adjacent to the curbs, concrete barrier walls, or other vertical walls. Extend the epoxy-sand slurry up the faces of the curbs and walls or other vertical walls and extend the epoxy-sand slurry up the faces and tops of the curbs and plinth according to the Standard Drawings. Thoroughly blast clean to a bright appearance and dry the areas to receive the epoxy-sand slurry before applying the slurry. Apply the slurry only after the deck has been dry for 24 hours. Place strips of masking tape along the joints to prevent the slurry from entering the joints and to ensure a straight line of slurry. Proportion the slurry as follows:

One Gallon of Component A
One Gallon of Component B
2 Gallons of dry, silica sand

The Engineer may allow minor adjustments in the quantity of sand in order to produce a more workable mixture. Thoroughly mix the ingredient materials for 3 to 5 minutes. Then spread the slurry and use a squeegee to completely fill the blast cleaned pitted areas, cracks, and rough surfaces. Finish the slurry to a thickness of no more than 1/16 inch. Sprinkle silica sand very lightly over the slurry to provide skid resistance.

The Department will allow placement of thoroughly mixed neat epoxy according to Subsection 510.03.

606.03.11 Cleaning and Sealing Joints. Rework each joint according to the Standard Drawings and as follows:

A) Joint Preparation. Remove any old sealant and joint filler. Use tools and techniques as approved by the Engineer.

When joint is dry, sandblast to remove all contaminants. Sandblast each joint a minimum of 2 passes, one for each face, with nozzle held at an angle to the joint face and within 1 to 2 inches of the pavement. After sandblasting, air blast each joint to remove sand and other contaminants. Air blast in only one direction to prevent recontamination of the joint. Compressed air used for air blasting will be at a pressure of at least 90 psi. The air compressor used will be equipped with traps capable of removing moisture, and oil from the air. Apply primer as recommended by the sealant's manufacturer.

B) Sealant Filler and Installation. Seal joints on same day that preparation occurs. When joints are prepared, but not sealed on the same day, sandblasting, removal of sand and debris, and primer application will be repeated as directed by the Engineer. Also any joint that has become contaminated will be recleaned as directed by the Engineer.

Prior to installation of sealant, each joint will be inspected by the Engineer for proper depth, width, alignment, and cleanliness. Install sealant at a minimum of 1/2 inch below the pavement face and in accordance with the manufacturers' recommendations.

606.03.12 Bridge End Transitions. Overlay the end sections of the bridge and finish as follows:

A) Rigid Approach. Set the finishing machine rails to provide a 50-foot transition on the ends of the bridge to match the finished grade of the overlay with the existing grade of the adjacent pavement. Remove the existing concrete as necessary to maintain the minimum specified thickness of the overlay.

B) Non-Rigid Approach or a Rigid Approach with Asphalt Overlay. The Department will not require a transition.

606.03.13 Expansion Dam Treatment. Treat the existing expansion dams according to the Standard Drawings. The Department will not require painting of structural steel.

606.03.14 Material Hauling. Haul all material for latex concrete overlays with vehicles which do not exceed the regulation for either the legal axle weights or axle spacing contained in 603 KAR 5-066. Prior to doing any overlay work on a structure, furnish to the Engineer a certified statement listing the empty weight of each hauling vehicle, axle weights when empty, axle weights when fully loaded, gross weight of each vehicle when loaded with a specific number of cubic yards, and the spacing of axles. The Engineer will use this information for the purpose of determining the allowable quantity of materials to be hauled. The Engineer will determine the allowable quantity of materials to be hauled based on the capacity and condition of the bridge after the removal of unsound concrete and prior to the placement of the overlay. Under no circumstances will the Department allow loads which exceed legal gross or axle load limits.

606.03.15 Damage to Structures. Take responsibility for all damage to the structure during construction until all work is completed, including the replacement of entire spans that fail as a result of this construction.

606.03.16 Unacceptable Work. When the Engineer deems necessary, the Department will core any areas of the overlay that display extensive cracking or other characteristics indicating the waterproofing effectiveness or expected life of the overlay may be reduced, or that the overlay may not be intimately bonded to the underlying deck.–Remove and replace with acceptable concrete all areas shown by the cores to either have cracks exceeding a depth of 1/4 inch or to not be intimately bonded to the underlying deck The Engineer may require removal and replacement without coring when significant cracking or lack of bond are apparent. Seal all cracks that are not significant enough to require removal of the overlay with a latex grout as the Engineer directs.

Correct all individual areas of hardened grooved concrete of 25 square feet or larger in which the texture is unsatisfactory using methods the Engineer approves.

606.03.17 Special Requirements for Latex Concrete Overlays.

A) Existing Bridges and New Structures.

1) Prewetting and Grout-Bond Coat. Thoroughly and continuously wet the blast cleaned areas to receive the overlay with water at least one hour before placing the overlay is started. Keep the areas wet and cooled with water until placing the overlay.

   Disperse or remove all accumulations of water before applying the grout-bond coat. Immediately ahead of placing the overlay mixture, thoroughly brush and scrub a thin coating of the latex concrete mixture to be used for the overlay onto the wetted surface as a grout-bond coat. Do not allow accumulations of coarser particles of the mixture which cannot be scrubbed into intimate contact with the surface.

   Apply the grout-bond coat only for a short distance in advance of placing the overlay. Do not allow the grout-bond coat to show any signs of drying before placing the overlay. Thoroughly recoat all areas showing signs of drying with fresh grout. Do not apply a grout-bond coat on bridge decks prepared by hydrodemolition.

2) Proportioning and Requirements. Proportion as follows:

   When adjusting, ensure the mixture contains no less than 658 pounds per cubic yard of cement nor less than 24.5 gallons per cubic yard of latex admixture.

Material	Quantity
Type I or Type III Cement	94 lbs
Latex Admixture	3.5 gal
Fine Aggregate	215 to 245 lbs[(1)]
Coarse Aggregate	165 to 195 lbs[(1)]
Water[(2)]	22 lbs[(1)]

[(1)] *Determine actual quantities and submit to the Engineer for approval.*

[(2)] *Includes free moisture on the fine and coarse aggregates.*

Furnish latex concrete with the following properties:

Property	Value
Slump[(1)]	4 – 6 in (KM 64-302)
Maximum Air Content	7% (KM 64-303)

Maximum W/C ratio[2]	0.40
7 - day compressive strength	3,000 psi

[1] *The Department will perform the slump test 4 to 5 minutes after discharging from continuous type mixers.*
[2] *Consider all the non-solids in the latex admixture as part of the total water.*

3) Placing, Consolidating, and Finishing the Overlay. Place the latex concrete overlay on the blast cleaned and prewetted deck immediately after applying the grout-bond coat. The Department will require a minimum latex concrete overlay thickness of one inch except on textured finishes. On textured finishes, the Department will require a minimum latex concrete overlay thickness of 1 1/4 inches. Ensure that the surface of the overlay conforms to the existing deck section while maintaining the minimum thickness. The Engineer will determine the deck section in the field, including the cross slope or crown. Pass the finishing machine over the existing deck prior to placing the overlay so that the Engineer can make measurements to ensure the proper cross slope and thickness.

   Construct a transverse construction joint whenever placing is interrupted for any reason for 20 minutes or longer.

   Ensure that the top surface of the overlay is uniform, smooth, and even-textured after finishing with a finishing machine. Thoroughly consolidate the concrete by vibration during the finishing operations. Ensure that the finished surface does not vary more than 1/8 inch in 10 feet as measured from a straightedge.

4) Curing. Immediately following the brooming operation or texturing, when texturing is required, cover the overlay with a thoroughly wetted layer of burlap immediately followed by a layer of polyethylene film 4 mils or more in thickness. Place sections or strips of burlap transversely, so that the overlay can be covered immediately after finishing or texturing. Leave the burlap and polyethylene film in place for at least 24 hours, and rewet the burlap if any signs of drying appear. Soak new burlap in water for at least 12 hours before the first use.

   After the 24-hour period has ended, remove the burlap and polyethylene and allow the overlay to air-cure. Continue the air-cure for an additional 48 hours when using Type I cement or an additional 24 hours when using Type III cement at an ambient air temperature of 50 °F or more.

   When the overlay has cured, give the tops of all longitudinal and transverse construction joints a thorough coating of grout of the same proportions as the latex concrete mixture used for the grout-bond coat material. Neatly and uniformly apply a 2-inch wide or wider coating to seal any minute cracks at these locations. Do not use epoxy-sand slurry to seal construction joints in lieu of grout.

   The Department will allow the overlay to be opened to traffic as soon as curing is completed, all full depth patches are at least 7 days old or have attained a compressive strength of 4,000 psi, all construction joints are sealed, and gutterline and curb slurry is applied.

B) Special Requirements for New Structures. Construct according to A) above with the following exceptions and additions:

1) The Department will not require machine preparation of the top 1/4 inch of the deck.
2) Construct an overlay having a thickness of 1 1/2 inch.
3) Texture the overlay surface according to Subsection 609.03.10.
4) Perform operations in the following sequence: blast clean the existing deck;

apply the grout-bond coat; mix, place, and consolidate the overlay mixture; finish; texture; cure; seal joints and cracks; then apply the epoxy-sand slurry.

5) Do not overlay the deck until it is at least 14 calendar days old.
6) When longitudinal construction joints are necessary, completely cure each section of the overlay before placing the adjacent section of the overlay.

606.04 MEASUREMENT.

606.04.01 Removal of Epoxy, Asphalt, and Foreign Overlay. When listed as a bid item, the Department will measure the quantity in square yards.

606.04.02 Machine Preparation of Existing Slab. The Department will measure the quantity in square yards. The Department will not deduct parts of the deck that are not concrete such as deck drains, castings, expansion dams, and patches of foreign material for payment.

606.04.03 Concrete, Class M for Full-Depth Patching. The Department will measure the quantity in cubic yards. The Department will not measure removal of epoxy, asphalt, or foreign overlays for payment, unless listed as a bid item, and will consider it incidental to this item of work.

606.04.04 Structural Steel. The Department will measure the quantity according to Subsection 607.04.

606.04.05 Blast Cleaning. The Department will measure the quantity in square yards. Before placement of the overlay the Department will measure the area of the deck and the vertical part of the curb which will be in direct contact with the overlay (distance equal to the thickness of the overlay) plus one inch for payment. After placement of the overlay and before placement of the epoxy-sand slurry, the Department will measure the 12-inch width of the overlay and the sides and tops of curbs that are to receive the epoxy-sand slurry for payment. The Department will not measure any repeated blast cleaning for payment and will consider it incidental to this item of work.

606.04.06 Latex Modified Concrete Overlay. The Department will measure the quantity in cubic yards using the theoretical volume as specified in the contract.

606.04.07 Latex Modified Concrete for Partial Depth Patching and variable thickness of Overlay. The Department will measure the quantity in cubic yards by deducting the theoretical volume of bridge deck overlay (LMC) from the total volume (as indicated by the batch quantity tickets) of Concrete required to obtain the finished grade shown on the Plans or established by the Engineer. The Department will measure the overlay partial depth patches and material used to patch spalled or deteriorated sections of curbs, sidewalks or plinths for payment. The Department will not measure the volume of material wasted or not incorporated in the work; grout used for the bond coat; crack sealing; or sand blast cleaning of reinforcing steel, longitudinal or transverse construction joints, areas of curbs, sidewalks, plinths, and other areas to be patched; or temporary supports for existing concrete handrails while removing and replacing full depth concrete for payment and will consider them incidental to this item of work.

606.04.08 Epoxy-Sand Slurry. The Department will measure the quantity in square yards. The Department will measure the entire area covered, including the 12-inch width of the overlay and the sides and tops of curbs, barrier walls, and plinths for payment.

606.04.09 Joint Sealing. The Department will measure the quantity in linear feet.

606.04.10 Hydrodemolition. When listed as a bid item, the Department will measure

the quantity in square yards. Otherwise, the Department will not measure Hyrodemolition for payment and will consider it incidental to the overlay.

606.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08510	Removal of Epoxy, Asphalt, or Foreign Overlay	Square Yard
08551	Machine Preparation of Slab	Square Yard
08526	Concrete, Class M for Full Depth Patching[(1)(3)]	Cubic Yard
08160	Structural Steel	See Subsection 607.05
08549	Blast Cleaning	Square Yard
08534	Concrete Overlay, Latex[(1)(2)(3)]	Cubic Yard
24094EC	Partial Depth Patching	Cubic Yard
08504	Epoxy-Sand Slurry	Square Yard
08540	Joint Sealing	Linear Foot
08550	Hydrodemolition	Square Yard

[(1)] The Department will establish an adjusted unit price according to the supplemental formulas established for excessive overruns and underruns in Subsection 104.02.02 when this pay item is a major item and either an overrun or an underrun of more than 25 percent occurs.

[(2)] The Department will adjust the Contract unit price of overlays on new structures by the Schedule for Adjusted Payment for Thickness Deficiency. The adjusted quantity is equal to the measured quantity of the pay item multiplied by the Contract unit price for the pay item and the Price Adjustment. As an option, remove and replace overlays with an average deficiency in thickness of no more than 1/2 inch with an overlay of the specified thickness at no cost to the Department. The Department will not make additional payment for average thicknesses of overlay in excess of the specified thickness.

Schedule for Adjusted Payment for Thickness Deficiency

Average Thickness Deficiency (inches)	Price Adjustment (Percent of Contract Unit Bid Price)
0	100.0
1/16	95.0
1/8	90.0
3/16	80.0
1/4	70.0
5/16	57.5
3/8	45.0
7/16	25.0
1/2	0.0
Greater than 1/2	[(a)]

[(a)] Remove and replace with an overlay of the specified thickness at no expense to the Department.

[(3)] When placing concrete on overlays is not begun within 2 hours after the scheduled time, the Department will deduct all engineering costs from the scheduled time until the time placing begins or is canceled from the Contract amount. The Department will not deduct engineering costs for uncontrollable circumstances such as inclement weather or equipment failure after placing begins.

The Department will consider payment as full compensation for all work required

under this section.

SECTION 607 — STRUCTURAL STEEL BRIDGES

607.01 DESCRIPTION. Build steel bridges, and perform other structural steel and miscellaneous metal construction.

The dimensions specified in the Plans are for a normal temperature of 60° F with dead load on the structure.

a) Primary Bridge Members include:
    a. Web and Flanges of plate, tub, and box girders
    b. Rolled Beams and cover plates
    c. Floor Beam webs and flanges
    d. Arch Ribs and arch ties beams or girders
    e. Truss Members
    f. Diaphragm members for tub girders
    g. Splice Plates for primary members
    h. Any other member designated as "primary" or "main" on the plans

b) Secondary Bridge Members include:
    a. Bracing (diaphragms, cross frames, and lateral bracing.

c) Miscellaneous Bridge Members
    a. All other miscellaneous bridge items not considered primary or secondary bridge members

607.02 MATERIALS AND EQUIPMENT.

607.02.01 Paint. Conform to Section 821.

607.02.02 Structural Steels. Conform to Section 812.

607.02.03 Miscellaneous Metals. Conform to Section 813 for pins and rollers; bearing and expansion plates (rockers and expansion dams); aluminum; high-strength steel bolts, nuts, and washers; and welding. Use flat and smooth circular washers and square or rectangular beveled washers.

Ensure that bolt dimensions conform to the heavy hexagon structural bolt requirements of ASME/ANSI 18.2.6 and Section 813.

Ensure that nut dimensions conform to the heavy hexagon nut requirements of ASME/ANSI B18.2.2 and Section 813.

Identify heavy hexagonal structural bolts, manufactured according to ASTM F3125 Grade A325, on the top of the head by 3 radial lines, the legend "A 325", and the manufacturer's mark.

Identify Grade 2H nuts on at least one face by the marking "2H" or "2HB", and Grade DH by the marking "DH". Ensure that all nuts bear the manufacturer's identification mark.

Heavy hexagonal structural bolts have shorter thread lengths than other standard bolts. Depending on the amount of bolt length added to adjust for incremental stock lengths, the full thread may extend into the grip as much as 3/8 inch for the following bolt sizes; 1/2 inch, 5/8 inch, 3/4 inch, 7/8 inch, 1 1/4 inch and 1 1/2 inch, and as much as 1/2 inch for the following bolt sizes; one inch, 1 1/8 inch, and 1 3/8 inch. The fabricator may include some of the thread run-out into the plane of the shear. When the thickness of an outside part adjacent to the nut is less than these values, the fabricator may use the next increment of bolt length together with a sufficient number of flat circular washers to ensure full seating of the nut.

607.02.04 Wrenches. Use manual or power torque wrenches. Use power wrenches of adequate capacity and of sufficient air supply to perform the required tightening of bolts in approximately 10 seconds.

607.02.05 Direct Tension Indicators. Use direct tension indicators conforming to ASTM F 959. Determine correct bolt tension by examining the gap between the washer and bolt head remaining after tightening.

Include with each shipment of direct tension indicators, reports of actual tests showing the bolt tension achieved when the indicators are loaded. Ensure that the bolt tension is ± 20 percent greater than the tension specified in the Bolt Tension table in Subsection 607.03.05. Furnish test reports for representative samples of each lot or heat and each size tension indicator in the shipment, and provide packaging that easily identifies individual lots or heats. The Department may perform any additional sampling or testing the Engineer deems necessary.

Mark the tension indicators with the correct grade (A 325 or A 490) to ensure ready verification on the job.

607.02.06 Tapes. Use only tapes that are correctly calibrated with NIST to ensure correct fit of the work.

607.03 CONSTRUCTION.

607.03.01 Shop Drawings and Welding Procedures. Submit detailed shop drawings and welding procedures with supporting procedure qualification records to the Division of Structural Design or their designated representative ("Reviewer"). The Department will furnish plans showing sufficient details for the Contractor to prepare detailed shop drawings. Include welding procedures and details, when required, as part of the shop drawings. The Department will not consider the shop drawing submittal process to be complete without the submittal of welding procedures.

Submit a shop drawing submittal schedule (Schedule) for review and approval no later than fifteen calendar days prior to the first submittal. List all anticipated shop drawing packages for the project by component and superstructure unit, span or pier, and show the estimated submittal dates for each package. Update the Schedule and resubmit to the Engineer, for review but not approval, on the first day of each calendar month until all required shop drawing submittals have been approved.

Submit shop drawings in substantial conformance with the latest Schedule submitted to the Engineer, and include all relevant drawings and construction procedures necessary for a thorough review. Allow sufficient lead time to permit a complete review.

Submit shop drawings in electronic format. Make all drawing submittals in a 22 inch by 36 inch Portable Document Format (PDF) that will produce clear prints and sharp lines on both 11 inch by 17 inch prints and 22 inch by 36 inch prints ("PDF Prints"). The Department reserves the right to require hard copy prints on a case-by-case basis.

Submission of two or three-dimensional computer modeling data will not by itself constitute a complete shop drawing submittal. The use of two- or three-dimensional computer modeling techniques to facilitate fabrication will not relieve the fabricator from providing detailed shop drawings of all bridge members and components for the Department's records.

Submit to the Reviewer PDF Print Files of the detailed shop drawings and welding procedures. Electronically stamp all shop drawings and procedures with the Contractor's stamp as an acknowledgment that the Contractor has reviewed the submittal for completeness and appropriateness. Each sheet will be electronically stamped by the Reviewer. The Reviewer will return one PDF file of reviewed shop drawings with all required corrections noted. When corrections and resubmittal are required, submit PDF Print Files of the corrected set of drawings. After the final review, when additional resubmittal is unnecessary, the Reviewer will forward the reviewed shop drawing PDF Print files with the Reviewer's Stamp indicating approval (or conditional approval) and any final comments to the DOSD Shop Plan Coordinator for distribution. Only plans submitted directly to the Shop Plan Coordinator by the Reviewer will be distributed, and only plans electronically stamped "distributed by the Division of Structural Design" are to be used for fabrication.

After fabrication is complete and the Engineer has approved the structural steel for shipment, furnish to the Engineer one electronic set of the as-built shop drawings, including the welding procedures, as PDF Prints.

Review cycles will begin the first Business Day after a submittal is received ("logged"), or the next Business Day after the submittal date indicated on the most recently submitted Schedule, whichever occurs later. Submittals received after 2:00 PM Eastern Time will be logged as the next Business Day following receipt of the submission. 'Business Days' are weekdays, Monday through Friday except official Department holidays.

The Reviewer will determine if all relevant drawings and construction procedures have been submitted. If a submission is incomplete or otherwise requires additional information or data to properly complete the review, the review cycle for the submission will be reset and the cycle will begin as specified in the previous paragraph once all required information is received (logged.)

Review cycle durations for shop drawing submittal packages deemed complete by the Reviewer are as follows:

- Allow at minimum 30 Business Days for review of shop drawing submissions of primary bridge members.
- Allow at minimum 15 Business Days for review of shop drawing submissions for the secondary bridge members.
- Allow at minimum 7 Business Days for review of other miscellaneous bridge members shop drawing packages.

No claims for delay will be considered for shop drawing reviews when the Engineer has indicated that relevant drawings or construction procedures are insufficient for a thorough review. No claims for delay will be considered for shop drawing reviews when information relevant to the submittal review is still in the process of being developed. Additional time to review requested changes to any relevant drawings and construction procedures will not be considered cause for delay claims.

Do not make changes to any drawing after the Engineer has reviewed it without the Engineer's written approval or written direction.

Only make substitutions of sections different from those shown on the drawings when the Engineer approves in writing.

Although the drawings may have been reviewed, take responsibility for the correctness of the drawings and for shop fits and field connections.

Take responsibility for any material ordered or work done before the Engineer reviews the drawings and welding procedures.

When the design drawings differ from the requirements of this section, the design drawings govern.

607.03.02 Fabricated Structural Steel

(a) Prequalification. Structural steel and aluminum fabricators performing work for the Department are required to prequalify according to the American Institute of Steel Construction's (AISC) Quality Certification Program and obtain approval from the Director of Construction. Plants and shops must be registered and certified under the AISC program with SBR: Certified Bridge Fabricator-Simple; IBR: Certified Bridge Fabricator-Intermediate; ABR: Certified Bridge Fabricator-Advanced; or CPT: Bridge Component Manufacturer, as applicable, and must

submit a valid certificate to the Division of Construction.

Only fabricators having ABR certification, including the Fracture Critical endorsement, may fabricate the following:

- Main members for arches, continuous span trusses, cable-stayed bridges, and suspension bridges.

Only fabricators having either IBR or ABR certification, including the Fracture Critical endorsement, may fabricate the following:

- Fracture critical members and attachments, except as specified above.

Only fabricators having either IBR or ABR certification may fabricate the following:

- Main bridge members, except for certain rolled beams
- Welded Plate Girders
- Welded floor beams
- Cross frames and diaphragms for curved bridges
- Bracing, portals, and stiffening members for arches, trusses, cable-stayed and suspension bridges
- Rolled beams with butt welds, or that are heat-curved,

heat-cambered, or cold cambered. Fabricators having either

SBR, IBR, or ABR certification may fabricate the following:

- Rolled beams with bearing stiffeners and diaphragm connection or cover plates[2]
- Cross frames and diaphragms for straight bridges
- Shop-fabricated material for reinforcing existing bridges[1]
- Lateral bracing except for arches, trusses, cable-stayed, and suspension bridges[1]

Note 1: Fabricate in an IBR or ABR certified plant if welding is required.

Note 2: SBR certified plants must qualify for initial approval from the Division of Construction to perform heat cambering or cold cambering on rolled beams.

Fabricators having SBR, IBR, ABR, or CPT certification may fabricate the following:

- Expansion dams
- Bridge drainage material
- Welded bearings
- Inspection walks

- Steel grid flooring
- Welded sound barrier supports
- Bridge railing
- Pedestrian railing
- Structure mounted guide rail
- Welded protective barrier
- Armored Edges

AISC certification is not required for the following:

- Castings, forgings, and machined parts not welded
- Non-metallic bearing
- Protective fence
- Material not requiring shop fabrication or shop welding, such as plates and shapes for strengthening existing bridges and manufactured items accepted by certification

Prequalification of 'machine shops' (who provide services and materials to approved fabricators) is not required. Machine shops may perform one or more of the following operations[3]:

- Cutting or shearing materials to finish size
- Grinding
- Drilling or punching
- Cold bending
- Machining
- Flattening

Note 3: Individual shop operations may be limited.
Machine shops cannot produce fracture critical members without project specific approval from the Division of Construction except if the material is being produced for and shipped to a fabricator having AISC IBR or ABR certification, including Fracture Critical endorsement.

A) Quality of Workmanship. Ensure that workmanship and finish are in accordance to the latest AISC Code of Standard Practice for Steel Buildings and Bridges at the time of letting.

B) Storage of Materials. Store structural material, either plain or fabricated, at the fabricating shop above ground upon platforms, skids, or other supports. Keep it free from dirt, grease, and other foreign matter and protect it from corrosion.

C) Straightening Materials. Before measuring or working rolled material, ensure that it is straight. When straightening is necessary, use methods that will not injure the metal. If sharp kinks and bends are evident, the Engineer will reject the material.

D) Finish. Blast clean all structural steel to SSPC SP5/NACE No. 1 white metal blast, prior to beginning any fabrication. Provide a neat finish to the work. Shear, flame cut, grind, and chip carefully and accurately. Remove all burrs resulting from reaming or drilling.

607.03.03 Bolt Holes. Either punch or drill all holes for connections.

A) Punched Work. Punch all holes full-size except:

1) When there are more than 5 thicknesses, or when any of the main material is thicker than 3/4 inch in structural carbon steel, 5/8 inch in high-strength low alloy steel, or 1/2 inch in quenched and tempered alloy steel, sub-punch all holes, and ream them after assembling according to the requirements of C) below.
2) When the metal is thicker than the size of the bolts, drill the holes according to the requirements of D) below.
3) Sub-punch and ream punched holes for stringer and floor beam field connections according to the requirements C) below, or sub-punch and ream to a metal template no less than one inch thick, without assembling.
4) Sub-punch and ream punched holes in field connections of main truss or arch members, skew portals, skew portal bracing plate, girder spans, continuous I-beam spans and rigid frames. Punch holes in connection plates or other parts of such members according to the requirements of C) below. Main truss members are the top and bottom chords, end posts, and web members forming the truss.

B) Punched Holes. Punch full-size holes 1/16 inch larger than the nominal diameter of the bolt except as noted below. Do not allow the diameter of the die to exceed the diameter of the punch by more than 3/32 inch. Ensure that holes are cut cleanly without torn or ragged edges.

Punch holes so that, after assembling the component parts of a member and before reaming, a cylindrical pin 1/8 inch smaller than the nominal diameter of the punched hole may be passed through at least 75 of any group of 100 contiguous holes, or in like proportion for any smaller group of holes. When 10 percent or more of any group of 100 or fewer holes will not pass a pin 3/16 inch smaller than the nominal diameter of the punched hole, the Engineer will reject the mispunched pieces. Ream any holes that must be enlarged to admit bolts. Holes in longitudinal main-carrying members, transverse floorbeams, and any components designated as Fracture Critical (FCMs) shall not be punched full size.

C) Sub-Punched and Reamed Holes. Punch sub-punched and reamed holes for bolts 3/16 inch smaller than the nominal diameter of the bolts. Ensure that the punch and die have the same relative sizes as specified for full size punched holes.

After assembling, ream sub-punched holes to a diameter of 1/16 inch larger than the nominal diameter of the bolt.

After assembling and firmly bolting pieces forming a built member perform reaming. Do not interchange reamed parts.

Ream holes with twist drills or with short taper reamers. Do not direct reamers by hand unless the Engineer approves. Use solvents, detergents, or other Engineer approved means before cleaning and painting, to thoroughly remove any oil or grease used as a reaming lubricant.

D) Drilled Holes. Ensure that drilled holes are 1/16 inch larger than the nominal diameter of the bolt. However, do not allow drilled holes for turned bolts to be more than 1/32 inch larger than the diameter of the finished bolt. Hold parts securely together while drilling assembled members.

Do not use numerical tape or electronic computer controlled drills unless the fabricator can provide a history showing defect free work of this type. This means that previous work was free of misdrilled holes caused by human errors or machine errors.

Drill holes according to the requirements of E) below. Submit to the Engineer for review with the shop drawings, the proposed procedure for drilling holes and assuring correct fit of members. When using numerical tape or electronic computer controlled drills, the Department will require shop assembly of at least 25 percent of the splices and at least 10 percent of floor beam and bracket main member connections as proof of accurate fit. In the event holes do not match as

prescribed for the assembled pieces, assemble and ream all splices to fit and use metal templates to ream all other floor beam connections.

E) Accuracy of Reamed and Drilled Holes. Ensure that reamed or drilled holes are cylindrical and perpendicular to the member. After reaming or drilling, do not allow 85 of any group of 100 contiguous holes, or in like proportion for any smaller group of holes, to show an offset greater than 1/32 inch between adjacent thicknesses of metal.

F) Edge Distance of Bolts. Maintain a minimum distance from the center of any bolt to an edge of a plate or steel member:
For 1 1/4 inch diameters, 1 5/8 inch.
For 1 1/8 inch diameters, 1 1/2 inch
For one inch diameters, 1 1/4 inch.
For 7/8 inch diameters, 1 1/8 inch.
For 3/4 inch diameters, 1 inch.
For 5/8 inch diameters, 7/8 inch.

Ensure that the maximum distance from any edge is 8 times the thickness of the thinnest outside plate, but does not exceed 5 inches. If the design drawings or the Engineer approves in writing, the Department will allow the use of oversize, short-slotted, and long-slotted holes according to the applicable structural steel design sections of the AASHTO LRFD Bridge Design Specifications.

607.03.04 Shop Assembly and Material Traceability. Conform to the requirements of A) through D) below when not using numerical tape or electronic controlled drills; conform to E) below for all structural steel fabrication.

A) Assembling Trusses and Other Supports. Assemble trusses, arches, skew portals, skew portal bracing, girder spans, continuous I-beam spans, and rigid frames in the shop, and adjust the parts to line, camber, and fit for drilling or reaming of field connections.

B) Assembling Members. Thoroughly clean surfaces of metal in contact before assembly. Before reaming, assemble, well pin, and firmly draw together the parts of a member with bolts. When necessary, take apart assembled pieces to remove burrs and shavings produced by the reaming operation. Ensure that members are free from twists, bends, and other deformation.

Progressively shop assemble each longitudinal girder unit in no less than 3 contiguous sections adjusted to line, elevation, camber, and fit for drilling or reaming. Add at least one section at the rear end of the assembly when removing any section from the advancing end to ensure that the assembled portion of the structure is never less than 3 contiguous sections.

With connected parts assembled, either drill or ream other major bolted connections to the longitudinal girders in the shop or drill or ream to a metal template without assembly. Keep girder sections assembled until match marked and the Engineer has inspected and approved them.

Do not apply the assembly requirement for drilling or punching to connections for cross frames, diaphragms, lateral bracing, expansion dams, and other minor members.

C) Drifting of Holes. Only allow drifting during assembly to the extent that it brings the parts into position, but does not enlarge holes or distort the metal. Ream all holes that must be enlarged. Do not allow reaming to exceed the allowable tolerances.

D) Match Marking and Identification. Match mark connecting parts assembled in the shop for the purpose of reaming holes in field connections, according to the diagram shown on reviewed shop drawings. Match mark with 3/8 inch steel, low stress riser dies.

E) Material Traceability. Ensure that the fabricator can demonstrate by a written procedure and by actual practice a method of material application and traceability,

visible (attached to each shipping piece) at least through the "fit up" operation, of all elements of a shipping piece. Ensure that the traceability method is capable of verifying proper material application as it relates to material specification designation; heat number and manufacturer; and material test reports for special requirements where required.

In addition, upon completion of fabrication, furnish the Department with a list of each component of each major load-carrying member and the heat number and manufacturer applicable to the material used for each, including sketches or diagrams when necessary. Provide this list as part of the final shop drawings.

607.03.05 Bolted Connections Using High-Strength Steel Bolts.

A) General. Use friction type joints for all connections made with high-strength steel bolts.

B) Bolt Length. To determine the required bolt length, add the grip, the adjustment for bolt size specified in the following table, 3/16 inch for each hardened flat washer, and 5/16 inch for each beveled washer. Grip is the total thickness of all connected materials, exclusive of washers. Then round up to the next 1/4 inch length.

BOLT SIZE ADJUSTMENT	
Nominal Bolt Size (inch)	Adjustment for Bolt Size (inch)
1/2	11/16
5/8	7/8
3/4	1
7/8	1 1/8
1	1 1/4
1 1/8	1 1/2
1 1/4	1 5/8
1 3/8	1 3/4
1 1/2	1 7/8

The adjustment in the above table allows for manufacturing tolerances and for the use of a heavy hexagon nut, and provides adequate "stick through" at the end of the bolt.

Provide adequate bolt length to allow for the exposure of at least 2 complete threads beyond the face of the nut after tightening.

C) Hardened Washer. Where necessary, clip washers on one side and no closer than 0.875 of the bolt diameter from the center of the washer.

Install bolts with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. The Department will allow the use of a flat washer when the abutting surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where outer faces of the bolted parts have a slope of more than 1:20 with respect to a plane normal to the bolt axis, use a smooth beveled washer to compensate for lack of parallelism.

Ensure that bolted parts fit solidly together when assembled and are not separated by gaskets or any other interposed compressible material. Keep all joint surfaces free of dirt, burrs, and other defects that would prevent solid seating of the parts. Maintain contact surfaces free of oil, excess primer, and any other foreign matter.

D) Bolt Tension. Tighten all bolts, with properly calibrated wrenches, to provide at least the required minimum bolt tension values shown in the following table on

completion of the joint.

BOLT TENSION		
Nominal Bolt Size (inch)	Minimum Bolt Tension ASTM F 3125 Bolts A325 (KIPS)	ASTM F3125 A 490 Bolts (KIPS)
½	12	15
5/8	19	24
¾	28	35
7/8	39	49
1	51	64
1 1/8	64	80
1 ¼	81	102
1 3/8	97	121
1 ½	118	148

E) Direct Tension Indicators. The Department requires tightening of all high-strength bolts in diameters of 1/2 inch through 1 1/2 inch inclusive, using direct tension indicators.

Before work begins, furnish the Engineer with the manufacturer's written installation instructions. Install direct tension indicators, and tighten the bolts according to these instructions.

Under normal conditions, install the tension indicator under the non-turned element of the fastening system. Obtain the Engineer's permission before installing tension indicators under the turned element. If the Engineer determines that it is necessary to install the tension indicator under the turned element, install additional hardened washers according to the manufacturer's instructions. Use bolt lengths sufficient to accommodate the tension indicators and any additional washers required.

Do not reuse tension indicators. If it becomes necessary to loosen a previously tensioned bolt, discard and replace the tension indicator. The fastener assembly may also need to be replaced.

Furnish a device capable of measuring actual bolt tension. Before work begins, tighten at least 3 typical bolts and direct tension indicators in the device to the correct bolt tension. Keep the tension device available thereafter for additional checks when the Engineer deems necessary.

The Engineer will inspect bolt installation by inserting a feeler gage into the opening between adjacent flattened protrusions. The Engineer will examine at least 10 percent, but no less than 2, of the bolts in each connection. The Engineer will consider the installation acceptable if the gage will not enter the opening. The Engineer will not consider a zero gap as cause for rejection. If the gap is not uniform around the bolt, the Engineer will base acceptance on the average gap. That is, the Engineer will check the gap at several points around the bolt and if the gage will not enter the gap on at least half the tries, the installation will be acceptable.

If the structure is to be painted, seal the gap behind the indicator completely with a compatible coating.

Furnish tension indicators in addition to washers.

F) Calibrated Wrenches. Set the calibrated wrenches used to provide the bolt tension specified in 607.03.05 Section D so as to induce a bolt tension at least 5 percent in excess of this value.

Calibrate the wrenches twice daily by tightening, in a device capable of indicating actual bolt tension, no less than 3 typical bolt assemblies from the lot to be installed. Adjust power wrenches to stall or cut-out at the selected tension.

When using manual torque wrenches, note the torque indication corresponding to the calibrating tension and use it in the installation of all bolts of the tested lot. When measuring torque, keep nuts in tightening motion. For short-grip bolts, the Department will allow calibration of wrenches by using direct-tension indicating washers with solid plates in a manner acceptable to the Engineer.

When using calibrated wrenches to install several bolts in a single joint, use the wrench to "touch up" bolts previously tightened, which may have been loosened by tightening of the subsequent bolts, until all are tightened to the prescribed amount.

When required, because of bolt entering and wrench operation clearances, tighten by turning the bolt while preventing the nut from rotating.

Furnish all tension machines and torque wrenches.

The Engineer will approve the procedure for calibration of wrenches.

Operate a manual torque wrench as the Engineer spot inspects installed bolts by observing the indicated torque. Use a torque wrench that has been calibrated as previously described in this subsection. When the Engineer is inspecting bolts, apply the inspecting wrench and its required torque to 10 percent of the bolts, but not less than 2 bolts, selected at random in a connection. The Engineer will accept the connection as properly tightened if the nut or bolt head does not turn when applying the required torque. When applying the required torque and a nut or bolt turns, the Engineer will test all bolts in the connection. Tighten all bolts whose nut or bolt head is turned by the required torque. The Engineer will re-inspect all connections whose nut or bolt head is turned by the required torque. Alternatively, the Department will allow retightening of all of the bolts in the connection and then resubmit the connection for the Engineer to inspect.

G) Storage. Store bolts and nuts in a dry location until use to protect them from contamination by foreign substances and the formation of rust. Only open shipping containers when needed for the work or for inspection purposes. Properly cover and store partially used containers to avoid contamination or exposure to moisture. Only install bolts and nuts that are clean and free of excessive rust. Do not consider a thin, tightly adhering rust as cause to require cleaning; however, apply an organic lubricant to the threads and bearing surface of all nuts to be used when either bolts or nuts show evidence of rust on the threads.

H) Turn-of-Nut. In lieu of using calibrated wrenches, the Department will allow the use of the turn-of-nut method to install bolts. During installation, regardless of the tightening method used, install bolts in all holes of the connection and bring them to a "snug tight" condition. Snug tight is the tightness that exists when the plies of the joint are in firm contact. Attain this condition either by a few impacts of an impact wrench or by the full effort of an ordinary spud wrench. When snug tightening, progress systematically from the most rigid part of the connection to the free edges, and then retighten the bolts of the connection in a similar systematic manner as necessary until all bolts are simultaneously snug tight and the connection is fully connected.

When using turn-of-nut tightening: Check a representative sample of not less than three bolt and nut assemblies of each diameter, length, and grade at the start of work in a device capable of indicating bolt tension. Use the test to demonstrate that the method for estimating the snug tight condition and controlling the turns from snug tight to be used by the bolting crew to develop a tension not less than 5 percent greater than the required tension specified in table above. After bringing to a "snug tight" condition, further tighten all bolts in the connection by the applicable amount of rotation specified in the following table. During the tightening operation, do not allow any rotation of the part not turned by the wrench. When tightening, progress systematically from the most rigid part of the joint to its free edges.

NUT ROTATION FROM SNUG TIGHT CONDITIONS[(1),(2),(3)]

Bolt Length (Under side of head to end of bolt.)	Disposition of Outer Faces of Bolted Parts		
	Both faces normal to bolt axis	One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)	Both faces sloped not more than 1:20 from normal to the 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

(1) Nut rotation is relative to bolt, regardless whether turning the element (nut or bolt). For installing bolts by half turn and less, the tolerance is ± 30°; for installing bolts by two-thirds turn and more, the tolerance is ±45°.

(2) Applicable only to connections in which all material within the turn grip of the bolt is steel.

(3) There is no research available to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, determine the required rotation by actual test in a suitable tension measuring device that simulates conditions of solidly fitted steel.

I) Rotational-Capacity Test. Perform the rotational-capacity test described in Section 813 on each rotational-capacity lot prior to the start of bolt installation. Use hardened steel washers for the test even if they are not required in the actual installation procedures.

Verify that a visible lubricant is on the threads of galvanized nuts. Ensure that black bolts are oily to the touch when delivered and installed.

Before installing, clean and relubricate weathered or rusted bolts or nuts not conforming to the requirements of the rotational-capacity test. Retreat recleaned or relubricated nut and washer assemblies to conform to rotational-capacity test requirements before installing.

Use bolt, nut and washer (when required) combinations from the same lot used for the rotational-capacity test.

607.03.06 Reuse of ASTM F3125 Grade A 325 Bolts. The Department will allow the use of non-galvanized ASTM F3125 Grade A 325 high-strength bolts one additional

time after initially tightening them to specification tension, provided a close visual inspection indicates no distress in the bolt. This allows non-galvanized ASTM F3125 Grade A 325 bolts to remain installed when tightened to specification tension twice, one time at original installation and one time at reuse. Do not consider touching up or retightening previously tightened bolts, which may have been loosened by the tightening of adjacent bolts, as reuse, providing the snugging up continues from the initial position. When removing and loosening a bolt after it has been tightened to specification tension twice, discard the bolt and substitute a new bolt. Reuse of galvanized ASTM F3125 Grade A 325 bolts is not allowed. Reuse of any type of ASTM F3125 Grade A 490 bolt is not allowed.

607.03.07 Welds. Perform all welding, when authorized, according to requirements specified in ANSI/AASHTO/AWS D1.5 Bridge Welding Code current edition with interims. Do not field weld, except as specified in the Plans, without the Engineer's written permission.

Ensure that in all cases, welders, welding operators, and tackers have been qualified by testing according to KM 64-110 and/or AWS within the previous 24 months of the time of actual weld performance.

Repair or replace welds shown by visual inspection or by nondestructive testing to be defective in accordance with the Bridge Welding Code. All repairs, replacements, and re-inspection costs shall be at the Contractor's sole expense.

607.03.08 Planing and Finishing.

A) Edge Planing. Plane to a depth of 1/4 inch all sheared edges of plates that are more than 5/8 inch thick and carry calculated stress. The Department will allow fillet re-entranting cuts before cutting.

B) Thermal Cutting. Use a mechanical guide to obtain a true profile. Hand-cut only when approved. Cutting (including burning and sawing), shearing, and machining shall be done in accordance with the requirements of the AASHTO/AWS D1.5 Bridge Welding Code and the following: Plane, mill, grind, or thermally cut the sheared edges of main load-carrying member plate components greater than 5/8" thick to a depth of ¼ inch.

Cut and fabricate the steel plates so that the primary direction of rolling is parallel to the direction of the member or component main stress. For flanges and webs, the direction of rolling is parallel to the flanges unless otherwise noted in the Contract Documents. Web splices may be rolled parallel to their length.

C) Heat Curving. The fabricator may either fabricate welded girders by flame cutting the flanges to the required curvature from rectangular plates before fitting and welding to the web, or fabricate welded girders or rolled beams by fabricating straight units and then, through the application of heat to the flange edges, induce the required curvature. Do not perform heat curving in beams or girders having a radius shorter than the minimum radius of curvature as determined by the procedures outlined in the current edition of the AASHTO LRFD Bridge Construction Specifications.

When the Contract requires heat curving rolled beams or welded girders, ensure that the work conforms to the following requirements.

Curve beams and girders by either continuous or V-type heating. For the continuous method, simultaneously heat a strip along the edge of the top and bottom flanges. Ensure that the strip is of sufficient width and temperature to obtain the required curvature. For the V-type heating, heat the top and bottom flanges in truncated triangular areas having their bases along the flange edge and spaced at regular intervals along each flange. Determine the spacing and temperature of the areas necessary to obtain the specified curvature. Apply heat along the top and bottom flanges at approximately the same rate.

For V-type heating, terminate the apex of each truncated triangular area applied to the inside of a flange surface just before reaching the juncture of the

web and the flange. To avoid unnecessary web distortion, carefully heat the inside flange surfaces (the surfaces that intersect the web) to avoid applying heat directly to the web. When the radius of curvature is 1,000 feet or more, extend the apex of each truncated triangular heating area applied to the outside of a flange surface to the juncture of the flange and web. When the radius of curvature is less than 1,000 feet, extend the apex of each truncated triangular heating area applied to the outside of a flange surface past the web for a distance equal to 1/8 of the flange width or 3 inches, whichever is less. Ensure that each truncated triangular area has an included angle of approximately 15 to 30 degrees; however, do not allow the length of the base of each triangle to exceed 10 inches. Obtain the Engineer's approval before making any variation in the patterns as prescribed in this subsection.

For both types of heating, heat the flange areas that will be on the inside of the horizontal curve. Concurrently heat both surfaces of flanges when the flange thickness is 1 1/4 inch or greater. Space the heating patterns uniformly along the full length of each flange to produce a uniform arc of a circular curve in the member. When heating causes a chording effect that the Engineer judges not aesthetically pleasing, ensure that the fabricator reheats the member using additional heating patterns as required to obtain the desired results.

Conduct the heat-curving operation so that temperature of the steel does not exceed 1,200 °F for ASTM A709 Grades 36, 50, 50S, 50W, and HPS 50W. Do not exceed 1,100 °F for ASTM A709 Grades HPS 70W and HPS 100W. Confine heating to the patterns or areas specified in this section, and apply heat to bring the steel within the patterns or areas to the required temperature as rapidly as possible without overheating the steel. Consider any heating procedure which causes a portion of the steel to be heated to a temperature greater than the temperatures listed above as destructive heating and as a possible cause for rejection of the steel. The fabricator may propose to the Engineer various means to reaccept, repair, or replace the steel rejected for overheating. The Engineer will review the fabricator's proposal. Do not artificially cool the steel until it has cooled naturally to 600 °F. Never quench the steel with water or water and air. When appropriate, cool the steel with dry compressed air only after it has cooled to 600 °F. The fabricator shall maintain temperature controls using temperature indicating crayons or other suitable means during heating and cooling of the steel.

The Department will allow heat curving of beams and girders with the web in either a vertical or horizontal position. When heat curving beams and girders in the vertical position, brace or support them in such a manner that the tendency to deflect laterally during the heat-curving process will not cause them to overturn.

When heat curving beams and girders in the horizontal position, support them near the ends and at intermediate points, as required, to obtain a uniform curvature. Do not allow the bending stress in the flanges due to the dead weight of a beam or girder to exceed 20,000 psi. When a beam or girder is positioned horizontally for heating, maintain intermediate safety catch blocks at the midlength within 2 inches of the flanges at all times during the heating process to guard against a sudden sag due to plastic flange buckling.

Heat curve beams and girders in the fabrication shop before painting. The Department will allow performing of the heat-curving operation either before or after completing all required welding of transverse intermediate stiffeners. However, unless provisions are made for girder shrinkage, locate and attach all connection plates and bearing stiffeners after heat curving. When the Engineer requires longitudinal stiffeners heat curve or flame cut them to the required radius and then weld them to the curved girder. When attaching cover plates to rolled beams, attach them before heat curving when the total thickness of one flange and cover plates is less than 2 1/2 inches and the radius of curvature is greater than 1,000 feet. For other rolled beams with cover plates, heat curve the beams before attaching the cover plates; either heat curve or oxygen cut cover plates separately and then weld them to the curved beams.

Camber girders before heat curving. Obtain camber for rolled beams by heat-cambering or cold-cambering methods approved by the Engineer. For welded plate or built-up girders, cut the web to the prescribed camber with suitable allowance for shrinkage due to cutting, welding, and heat curving. The curving process may tend to change the existing vertical camber. This change will be most pronounced when the top and bottom flanges are of unequal widths on a given transverse cross section. However, subject to approval of the Engineer, correct moderate deviations from the specified camber by a carefully supervised application of heat.

The Engineer will not measure horizontal curvature and vertical camber for final acceptance until after the fabricator has completed all welding and heating operations and the flanges have cooled to a uniform temperature. The Engineer will check the horizontal curvature in each edge of each flange with the beam or girder in the vertical position by measuring offsets from a stringline or wire or by using other suitable means. The Engineer will check camber by similar means.

D) Facing of Bearing Surfaces. Ensure that the surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete conforms to the surface roughness requirements as defined in ANSI B46.1, Part I:

Steel Slabs	ANSI 2000
Heavy plates in contact in shoes to be welded	ANSI 1000
Milled ends of compression members, stiffeners, and fillers	ANSI 500
Bridge rollers and rockers	ANSI 250
Pins and pin holes	ANSI 125
Sliding bearings	ANSI 125

With the exception of abutting joints and base plates, coat machine-finished surfaces with waterproof grease or other approved coating, as soon as practical after the Engineer has accepted the structural steel and before removing it from the shop. Apply one coat of an approved rust inhibiting primer compatible with the finished coat instead of zinc rich primer to machine finished surfaces that are to be painted.

E) Abutting Joints. Face abutting ends of compression members and girder flanges accurately to secure an even bearing when assembled in the structure. Rough finish ends of tension members at splices to secure close and neat but not contact fitting joints. Where joints are not faced, do not allow the opening to exceed 1/4 inch.

F) End Connection Angles. Build floor beams, stringers, and girders having end connection angles to the exact length specified in the Plans measured between the heels of the connection angles, with a permissible tolerance of + 0 to - 1/16 inch. Where the Contract requires continuity, face end connections. Do not allow the thickness of the connection angles to be less than 3/8 inch, or less than that shown on the detailed drawings.

G) Finished Members. Ensure that finished members are true to line and free from twists, bends, and open joints.

H) Web Plates. Cut web plates to provide for camber of the girder. At bolted web splices, do not allow clearance between ends of web plates to exceed 3/8 inch.

I) Fit of Stiffeners. Mill or grind bearing stiffeners of girders and stiffeners intended as supports for concentrated loads to secure an even bearing against the flanges. Ensure that intermediate stiffeners fit sufficiently tight to exclude water after being painted. Ensure that clearance between the ends of horizontal stiffeners and the sides of vertical stiffeners is one inch. Place bearing stiffeners plumb. Place intermediate stiffeners perpendicular to flanges.

J) Bent Plates. Ensure that unwelded, cold-bent, load-carrying, rolled-steel plates conform to the following:

1) Take them from stock plates so the bend line will be at right angles to the direction of rolling.
2) The radius of bends, measured to the concave face for steel conforming to AASHTO M270/ ASTM A709, shall not be less and preferably shall be greater than 5.0T for all grades and thicknesses. For cross-frame or diaphragm connection plates up to 0.75 in. thick, the minimum radius is 1.5T. For all other grades of steel, the minimum bend radii recommendations from the plate manufacturer shall be followed, but the minimum radii shall not be less than the minimums required herein. "T" is the thickness of the plate.

   Plates may be bent hot, subject to approval of the Engineer. Steel must be bent at temperatures greater than 700 °F but not greater than 1,200 °F; except for ASTM A 709 Grades HPS 70W and HPS 100W in which case bend at a temperature not to exceed 1,100 °F. Ensure that hot-bent plates conform to the requirements of 1) and 2) above.

607.03.09 Pins and Rollers.

A) General. Accurately turn pins and rollers to the dimensions shown on the drawings. Furnish pins and rollers that are straight, smooth, and free from flaws. Produce the final surface by a finishing cut, and provide a smooth finished surface with an ANSI 125 standard finish.

Forge and anneal pins and rollers more than 9 inches in diameter.

In pins larger than 9 inches in diameter, bore a hole 2 inches or more in diameter full length along the axis after the forging has cooled to a temperature below the critical range. Bore under suitable conditions to prevent injury by too rapid cooling and before being annealed.

Furnish 2 pilot nuts and 2 driving nuts for each size of pin.

B) Boring Pin Holes. Bore pin holes true to the specified diameter, smooth and straight, at right angles with the axis of the member and parallel with each other. Produce the final surface by a finishing cut, and leave the finished surface smooth and polished.

Do not allow the outside-to-outside distance of holes in tension members and inside-to-inside distance of holes in compression members to vary from that specified by more than 1/32 inch. Bore holes in built-up members after completing connections.

C) Pin Clearances. Do not allow the diameter of the pin hole to exceed that of the pin by more than 1/64 inch for pins 5 inches or less in diameter, or 1/32 inch for larger pins.

607.03.10 Threads for Bolts and Pins. Furnish threads for bolts and pins that conform to the ASME/ANSI B1.1, Class 2A for external threads and Class 2B for internal threads, except that pin ends having a diameter of 1 3/8 inches or more shall be threaded 6 threads to the one inch, and except as required for high-strength steel bolts.

607.03.11 Annealing and Stress Relieving. For structural members indicated in the Contract to be annealed or normalized, finish machining, boring, and straightening after heat treatment. Normalize and anneal (full annealing) as specified in ASTM A941. Maintain temperatures uniformly throughout the furnace during heating and cooling so that temperatures at points on the members will not differ by more than 100 °F at any one time.

Maintain a record of each furnace charge that identifies pieces in the charge and lists temperatures and schedule actually used. Provide proper instruments, including recording pyrometers, for determining temperatures of members in the furnace at any time. Make records of the treatment operation available to the Engineer.

Stress relieve members, such as bridge shoes, pedestals, or other parts built up by welding sections of plates together according to the requirements of AWS D1.5 when required by the Contract.

607.03.12 Forgings. Furnish forgings that are free from internal and external cracks and other harmful defects. The Engineer will determine the method of inspection.

607.03.13 Mill and Shop Inspection and Shipping.

A) Notice of Beginning Work. Designate to the Engineer within 30 days subsequent to the award of the Contract the locations of fabricating shops and estimated quantities of steel to be fabricated at each.

The Department will not allow structural steel to be fabricated in more than 2 fabricating locations (a location will be considered all shops within one city) unless approved in writing by the Engineer.

The Engineer will not allow any work to be done in the shop before granting authorization to proceed. Furnish the Department copies of mill tests and analyses reports of such structural shapes bearing the manufacturer's name and heat number. When such identification does not exist, the Engineer may require samples for test purposes be cut from the materials. When mill tests and analyses, or subsequent tests of samples, indicate material does not comply with this section, the Engineer will reject such materials. When the Engineer rejects materials, furnish suitable material.

B) Facilities for Inspection. Furnish all facilities for inspection of material and workmanship in the mill and shop, and allow the Inspector free access to necessary parts of the premises. Notify the Engineer when material is ready for shop inspection.

Furnish power and utilities for operating inspection equipment, provide shop space for inspection work, handle material as necessary, and enforce required safety precautions for radioactive exposure.

C) Mill Orders, Change Orders, Shipping Statements, Mill Test Reports, and Shop Bills. Furnish a pdf compatible copy of mill orders, change orders, mill shipping statements, mill test reports, fabricator's shop bills (when not attached to drawings), and shipping statements to the Engineer for all structural steel materials. Ensure that mill test reports show that all materials conform to this section and are signed by a responsible representative of the company. Include the weights of individual members on shipping statements.

D) Facilities for Testing. Furnish test specimens, and all labor, testing machines, and tools necessary to prepare specimens and make full size tests.

E) Rejections. The Inspector's initial acceptance of any material or finished members will not prevent the Engineer from subsequently rejecting material or finished members when he determines that they do not conform to the Contract.

F) Weighing of Members. When the Contract specifies that the Department will pay for any part of the material by weight, weigh the finished work in the presence of the Inspector. Supply accurate scales and perform all work involved in handling and weighing various parts.

G) Marking and Shipping. Paint or mark each member with an erection mark for identification and furnish an erection diagram with erection marks shown thereon.

Mark the weights of members weighing more than 3 tons on the member. Load structural members on trucks or cars so that they may be transported and unloaded at their destination without being excessively stressed, deformed, or otherwise damaged. Ship girders and store them with the web vertical, unless the Engineer allows in writing. The Cabinet's Shop Inspector will not stamp for acceptance until the members are loaded on cars or trucks just prior to shipping.

Pack bolts of one length and diameter and loose nuts and washers of each size separately. Mark a list and description of contents on the outside of each container.

H) Handling Material. Conduct loading, transporting, unloading, and storing of structural material to maintain it clean and free from injury.

607.03.14 Field Inspection. When the substructure is constructed under a separate contract, establish lines and elevations for setting steel from the completed substructure. Obtain the Engineer's approval of the existing lines and elevations prior to submitting shop details for review. The Engineer's approval of the established lines and elevations does not relieve the substructure contractor from the responsibility for constructing the substructure to the lines and elevations shown.

Provide inspection facilities to inspect erection of structural steel. When the Contract does not require shop inspection of the structural steel, the Engineer will inspect the material and workmanship upon site delivery.

607.03.15 Field Storing and Handling Materials. Place material to be stored on blocking above ground. Maintain it clean and properly drained. Place uniform depth girders and beams upright. Support long members, such as columns and chords, on skids placed to prevent injury from deflection.

Use extreme care in handling the steel at all times to prevent damage of any parts. Insulate the steel from binding chains with approved softeners. Pad the hooks and slings used to hoist steel. Place the steel so that rubbing will not occur during shipment. Store the steel at the job site on pallets, or other means approved by the Engineer, so that it does not rest on the ground and so that its components do not fall or rest on each other.

607.03.16 Falsework, Erection Methods, and Equipment. Ensure falsework is properly designed by a Registered Professional Engineer licensed to practice in Kentucky. Construct and maintain falsework for the loads that will be placed thereon. When required, prepare and submit for review plans for falsework or for changes in an existing structure necessary for maintaining traffic. Although the Engineer has reviewed these plans, take responsibility for the falsework design.

Before starting work present for the Engineer's review, the proposed method of erection, and the proposed amount and character of equipment to use for erection. Although the Engineer has reviewed this method, take responsibility for safety and erection.

The Contractor shall have a Registered Professional Engineer, licensed to practice in Kentucky, inspect the completed falsework assembly supporting a bridge superstructure prior to placing loads. The Professional Engineer shall provide a certification, based upon visual inspection of the completed falsework assembly, that the falsework assembly conforms to the approved working drawings. However, such certification shall not require an exhaustive inspection or testing or make the Professional Engineer liable for any deficiencies in workmanship or materials employed by the Contractor or for such conditions that cannot be ascertained from a visual inspection.

When placing falsework installations adjacent to an open public road, design and protect the falsework system from errant highway vehicles or from vibration forces caused by passing vehicles.

607.03.17 Bearings and Anchorages. Set all bearing assemblies level and to the elevations specified in the Plans. Make adjustments in the horizontal positions of bearing assemblies for temperature as the Engineer directs. Obtain full bearing on the concrete under bearing assemblies regardless of tolerances.

Set masonry plates and the bearing plates of bearing assemblies on ground concrete surfaces, or elastomeric bearing pads, or on lead plates in conformance with the details specified in the Plans.

Immediately before setting bearing assemblies or masonry plates, thoroughly clean the surfaces of concrete and metal to be in contact.

Provide an approved Type IV epoxy resin system conforming to Section 826 for installing anchor bolts. Drill and install anchor bolts to the embedment depth shown in the plans. Install epoxy adhesive anchorages in accordance with manufacturer's recommendations including hole size, drilling equipment and method, hole cleaning

equipment and method, mixing and dispensing epoxy, and anchor insertion. Provide an embedment depth capable of developing the yield strength of the anchor bolt in shear and tension if applicable based on the manufacturer's literature for the epoxy material and anchor bolt material used, adjusted for edge distance and anchor spacing if applicable if no required resistance or embedment depth is shown in the plans. Do not alter the manufacturer's mixing nozzle or dispenser. Anchor bolts must be clean and free from grease, oil, or other foreign material. Furnish epoxy resin system manufacturer's written recommendations for installation, cleaning, and use for approval. Demonstrate the hole cleaning and installation method to the Engineer for approval and continue the approved process for all anchor bolt locations.

Ensure that the final adjustment and setting of expansion rockers, rollers, and anchor bolts takes into consideration dead load elongation in the span and temperature at the time of setting. Normal temperature is considered to be 60°F. Set rockers so as to be vertical at 60°F, after applying all dead load. Adjust nuts on anchor bolts at the expansion ends of spans to allow free movement of the span. Tighten nuts on anchor bolts at fixed ends of spans in accordance with the Specifications.

When expansion devices such as rockers and expansion dams have been rigidly fixed to hold them in correct alignment, release them immediately upon completing concrete placement in the portion of the structure they are installed.

607.03.18 Straightening Bent Material. Straighten bent plates and angles or other shapes by methods that will not produce fracture or other injury. Do not heat the metal unless the Engineer allows, in which case do not heat to a higher temperature than 1,200 °F for all all steels except for A709 HPS 70W and HPS 100W, which must not be heated greater than 1100°F as determined by a temperature stick or crayon. After heating and straightening, cool the metal as slowly as possible. Following straightening, carefully inspect the surface of the metal for evidence of fracture. The Department will reject metal with sharp kinks and bends. Do not straighten material by direct hammering.

607.03.19 Field Assembling. Assemble parts accurately as shown, and follow all match marks. Handle material so no part will be bent, broken, or otherwise damaged. Do not injure or distort the members by hammering them. Clean bearing surfaces and surfaces to be in permanent contact before assembling the members. Unless erected by the cantilever method, erect truss spans on blocking that is placed to provide proper camber. Leave blocking in place until tension chord splices and all other truss connections are pinned and bolted, and then release it sufficiently from the falsework to bring compression chord joints into full bearing.

607.03.20 Pin Connections. Use pilot and driving nuts in driving pins. Drive pins so that members will take full bearing. Screw pin nuts tight and burr the threads at the face of the nut with a pointed tool.

607.03.21 Misfits. The Engineer will allow the correction of minor misfits using small amounts of reaming, cutting, and chipping. However, immediately report to the Engineer any error in shop fabrication or deformation resulting from handling and transportation that prevents proper assembly and fitting of parts by moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting. Ream no more than 10% of the holes in the plate connection (flange or web), and ensure no single hole is more than 1/8 in. larger than the nominal bolt diameter. Submit the proposed correction methods for members with defects that exceed these limits or prevent the proper assembly of parts. Straighten structural members in accordance with AASHTO/NSBA S2.2. Make all corrections in the presence of the Engineer at no expense to the Department. Do not remove and reweld gusset plates without approval. Obtain the Engineer's approval of the proposed method for correction. Make the correction in the Engineer's presence.

For beams or girders that do not conform to the plan camber and grade in the erected position, either adjust the depth of the concrete slab haunch over the steel supporting members or rework the girder camber to meet the plan grade and slab thickness. Do not allow shear connectors to penetrate the slab less than 2 inches.

607.03.22 Removal of Falsework. Upon completion of erection and before final acceptance, remove all falsework, excavated or useless materials, rubbish, and temporary buildings. Replace or renew any fences damaged and restore in an acceptable manner all property, both public and private, which may have been damaged during prosecution of work. Leave the bridge site and adjacent highway in a neat and presentable condition satisfactory to the Engineer. Remove all excavated material or falsework placed in the stream channel during construction before final acceptance.

607.03.23 Cleaning and Painting.

A) General. Conform to Section 821. Furnish a coating system from the Departments List of Approved Materials for Bridge Coatings, Class I, three coat system with zinc rich primer.

Furnish a coating system in which all coats are produced by the same manufacturer. Follow the manufacturer's recommendations for all mixing and application conditions and methods. Apply the prime coat in the shop. Field apply the remaining coatings of the selected coating system, including stripe coating of primer, intermediate and finish coat. When using thinners, mix according to the manufacturer's written recommendation in the presence of the Engineer.

Furnish copies of the manufacturer's technical data sheets, material safety data sheets, and application procedures to the Engineer for review and approval before beginning painting.

Submit written procedures for compliance with this subsection for cleaning and painting in both the shop and the field to the Engineer for approval before beginning work. Include at least the following:

1) Surface Preparation Methods and Equipment. Detail all equipment and operational procedures intended to be utilized in any process which prepares a surface to receive a coating.
2) Painting Methods and Equipment. Detail all equipment and operational procedures intended to be utilized in the application of coatings.
3) Containment and access rigging. Detail all equipment and operational procedures to be utilized in the erection, maintenance, and dismantling of rigging, platforms, scaffoldings, and containments. All rigging and containment plans must be signed and stamped by a licensed Kentucky Professional Engineer. Include provisions for safety precautions, traffic control, and access. Address responsibility for damage to public, property and the environment due to any cleaning or painting operation.
4) Storage and Handling. Detail all equipment and operational procedures to be utilized in handling, storing, and transporting painted members.
5) Coating Manufacturer's Special Instructions. Detail all recommendations and special instructions provided from the coatings manufacturer to be utilized for surface preparation or coatings application. Submit the coating manufacturers written approval for application of the coating system to surfaces prepared in accordance to the detailed operational procedures.
6) Quality Control Plan. Detail all equipment and operational procedures to be utilized to ensure the quality of the completed coating system. Quality Control is performed as Quality Control/Quality Assurance (QC/QA), where the contractor or their representative assume the role of Quality Control (QC) and the KYTC or their representatives assume the role of Quality Assurance (QA) with additional inspections for final and/or partial final acceptance. Include at least the following:

a) Name and qualifications of painting supervisors and inspection personnel.
b) Assurance of authority and responsibility for painting supervisors to halt operations and make corrections upon discovery of non-conforming work.
c) Methods of informing painting personnel of the written approved painting procedures and their responsibility to comply.
d) Equipment and operational procedures for inspection, acceptance or rejection, and documentation of surface preparation and coatings application operations.
e) Procedures and documentation for calibration and field verification of calibration of equipment utilized for inspection of surface preparation and coatings application.
f) Process for control of project related documentation.

The Department requires acceptance testing of coatings on a per-lot basis per-shipment. The Division of Materials will perform acceptance testing. At his option, the Engineer may elect to conduct more frequent sampling and testing. The Engineer will obtain test samples of coatings to be applied at the shop and the field. Allow 10 working days for testing and approval of the sampled coating. Apply coating only after it has been approved by the Department. It is the Contractor's responsibility to maintain an adequate inventory of approved coating. The Department assumes no responsibility for lost work due to rejection of coating or approved coating subsequently found to be defective during the application process.

Store the coating according to Section 821. The Department will reject the coating when test results indicate that the material does not conform to the requirements of this section. Remove all rejected coating materials from the job before beginning any painting.

Mix coatings with a high shear mixer according to the manufacturer's instructions to obtain a smooth, lump-free consistency. Do not use paddle mixers or paint shakers. Mix in the original containers unless the Engineer approves otherwise. Ensure that all of the solids that may have settled to the bottom of the container are thoroughly dispersed. When specified by the manufacturer's product data sheet or application instructions, continuously agitate the mixed coating throughout the application process.

Apply coatings smoothly and uniformly allowing no excess coating to collect at any point. Paint the contacting surfaces of joints or connections with primer only.

When deemed unsatisfactory by the Engineer, remove, clean, and prepare again all paint work at any stage of its completion.

When necessary or requested by the Engineer, and at no additional cost to the Cabinet, furnish a technical representative from the coating manufacturer to observe the initial application of all coatings used, to advise as to proper application techniques, and to determine that proper results are being obtained. Ensure that the technical representative is also available to visit the project at all times during the work if the Engineer requests or deems a visit is necessary.

Obtain and record ambient conditions (air temperature, steel temperature, relative humidity, and dew point) to verify compliance to this subsection.

Apply coatings using methods recommended by the manufacture of the coating system to attain the manufacturers recommended dry film thickness as stated on the applicable technical data sheet.

All coating thickness measurements are dry film thickness. Determine dry film thicknesses with a Type II nondestructive dry film thickness gage. At a minimum, verify calibration of the Type II gage in accordance with SSPC PA 2,

by placing a plastic shim representing the expected dry film thickness of the coating over a representatively blasted surface, before and after obtaining dry film thickness measurements for any surfaces painted in a shift. Obtain dry film thickness measurements in accordance with SSPC PA 2 per shift for each coating application. Use of a Tooke gage or other destructive film thickness gage to assess the coating thickness on all coats may be used at the Engineer's discretion. The Engineer will reject the total coating system when any coating is determined to be less than the specified minimum thickness even when the total dry film thickness exceeds the total of the minimum for all coats.

Provide OSHA compliant safe and adequate access for proper inspection of the cleaning and painting at both the fabrication plant and the construction site during all phases of work and for a period of at least 15 working days after completing each painting section. Furnish, erect, and move scaffolding or appropriate equipment approved by the Engineer, to allow the Inspector to closely inspect all surfaces. Use rubber rollers or other protective devices on scaffold fasteners. Do not use metal rollers or other types of fasteners that may mar or damage the freshly painted surfaces.

Comply with all Federal, State, and local regulations relative to environmental contamination, safety, and protection of persons and property.

B) Preparation for Shop Coating. After fabrication and immediately before painting, remove all areas of oil, grease, or other deleterious material by solvent cleaning in accordance with SSPC SP 1. Perform blotter tests in accordance with ASTM D 4285 Standard Test Method for Indicating Oil or Water in Compressed Air; daily, per compressor, in the presence of the Engineer. Use compressed air only when there is no evidence of moisture or oil. Abrasive blast clean all exposed surfaces of the metal to a minimum of SSPC SP 10/NACE 2; Near White Metal Blast Cleaning. Use abrasive media that produces an angular profile and conforms to SSPC AB 1, AB 2, or AB 3 as applicable. Ensure that the depth of the anchor profile of the abrasive blast-cleaned surfaces meets the coatings manufacturers recommended anchor profile range as stated on the applicable technical data sheet. If no range is recommended or the recommendation allows less than 1.5 mils of anchor profile, produce an anchor profile within the range of 1.5 mils to 3.5 mils. Measure anchor profile on metal surfaces in accordance with ASTM D 4417 Method C. Take at a minimum, 3 randomly distributed anchor profile measurements for each 5,000-square foot area of prepared surface. Remove all fins, tears, slivers, and burred or sharp edges that are present on steel members, and that appear during the blasting operation, by grinding and re-blasting the area to achieve the required anchor profile.

Apply coating only after the Engineer inspects and approves the surfaces.

C) Application of Shop Coating. Apply one full coat of primer to all metal surfaces including insides of bolt holes, faying surfaces, cut outs, weep hole etc., prior to shipping steel from the plant. Include surfaces that are to be field bolted in contact. No allowances will be made for bare metal unless otherwise specified or by written permission of the Engineer. Apply primer only to clean, dry metal surfaces that meet the surface preparation standard. Ensure that the application and curing of the primer coat to surfaces that are to be field bolted in contact is in accordance with the manufacturer's recommendations as stated on the certificate of analysis certifying Class B slip coefficient of the primer.

Apply coating only when ambient conditions are in accordance with the coating manufacturers recommended ambient condition ranges for application. Maintain the manufacturer's recommended ambient conditions for curing through full cure of the applied prime coat. In the location where application and curing of coatings is to be performed, record and verify ambient conditions through the use of a 24-hour data logger system.

Ensure that the dry film thickness of the prime coat is within the manufacturers recommended dry film thickness application range on all surfaces,

except those that are to be field bolted in contact. Ensure that the dry film thickness on surfaces to be field bolted in contact does not exceed the maximum dry film thickness as stated on the certificate of analysis certifying Class B slip coefficient of the primer.

If the prime coat is deficient in thickness, follow the coating manufacturer's recommendation to achieve acceptable full prime coat thickness.

Protect freshly coated primed surfaces from subsequent blast cleaning operations. When damage occurs, thoroughly wire brush or if visible rust occurs, re-blast to the specified surface preparation condition. Vacuum and re-prime these surfaces.

Do not apply successive coats of the system over the prime coat until it is fully cured. Apply the remaining coatings of the coating system in the shop before assembly or erection in areas that will be inaccessible when assembled in the field. Apply the shop primer to interior surfaces of box sections that are to be sealed by welding.

Paint structural steel that is to be welded only after completing welding. When welding the steel in the shop and subsequently erected by bolting, apply one coat of primer after finishing the shop welding and blast cleaning.

Paint surfaces of iron and steel castings only when directed according to Subsection 607.03.08 D).

Transfer or preserve field identification erection marks and weight marks. Load the steel for shipment only after the shop coating has fully cured and the Engineer has inspected it.

D) Preparation for Field Coatings. Clean by sections, bays, or other readily identifiable portions of the structure (Quality Control Areas (QA areas)). Apply coating only after the Engineer has inspected and accepted each section, bay, or portion.

After erection, including all bolting and remedial work, prepare the shop applied prime coating for field applied coatings as follows. Remove all grease, oil, lubricants, or other deleterious material from all surfaces to be painted including lubricant or residuals from the surfaces of all galvanized nuts, bolts and washers by solvent cleaning according to SSPC SP 1. When dry overspray from the shop applied primer exists, remove by sanding. High pressure water wash all structural steel at 4,500 to 5,000 psi with a zero degree spinner tip held normal to the surface and 12 to 18 inches from the surface using clean potable water. As needed, use a non-sudsing, biodegradable detergent to remove all surface contaminants not removed by high pressure water washing. Rinse all areas where a detergent or solvent was applied by high pressure water washing with clean potable water. Repair all damaged prime coating in accordance with the coating manufacture's recommendations. Apply a field coat of approved zinc rich prime coating to all areas not possessing an acceptable shop applied prime coating or intact galvanized surfaces. Completely remove all dirt, dry spray and other foreign material before applying field coatings. Assume sole responsible for any damage resulting from field surface preparation operations. Stripe coating shall be in accordance with SSPC-PA Guide 11 and shall be applied to all coats of paint. Striping of primer applied to bare steel, iron or other metallic substrate, shall be applied after the primer repaired/touch up field application (utilizing a contrasting color of approved zinc rich primer). Striping of subsequent coats of paint shall be performed prior to full coat application. All sharp and non-radiused edges, welds, outside corners, bolt heads, threads, nuts, rivet heads, edges and ends of plates, edges and ends of diaphragms, lattice straps, inside corners of box members, seams, crevices, back to back members, pitted steel, other discontinuities and all other locations required by the Engineer, shall be stripped on all required coats of

the chosen paint system. Stripping shall extend a minimum of 1 inch from edges, corners, nuts, bolts, rivets, etc. Any alteration of striping coverage shall require written approval from the Engineer. All manufacture's recommendations shall apply to stripe coating for recoat windows, dry to handle, dry to cure, and any other stated recommendations from the Manufacture's Product Data Sheets (MPDS) for the paint system application.

The stripe coats shall be applied by spray, brush, roller, daubers, and other means and method with approval of the Engineer. If the Contractor's chosen method of applying stripe coat is not producing results acceptable to the Engineer, the Engineer will require the stripe coat application method to be changed.

The application of stripe coats, shall be considered incidental to painting of the bridge and incidental to each individual coat application. Stripe coat application shall be considered a separate inspection point, within the inspection of each applied coat of a complete coating system.When application of any coating will exceed the recoat window of the previously applied coating, abrade the surface of the previously applied coating according to the coating manufacturer's recommendations before applying additional coatings.

E) Application of Field Coatings. Apply field coatings between April 1st and November 15th. The Department may allow painting at other times when the Engineer approves in writing. Apply coatings only to clean and dry surfaces, when the ambient air temperature is 40 °F or greater, the surface temperature of the steel members to be painted is at least 5 °F above the dew point, and the relative humidity is less than 90 percent or in accordance with the coating manufacture's recommended ambient condition ranges, whichever is more stringent. Record and verify that ambient conditions are in compliance at the location where painting is to be performed prior to beginning coating application and at a minimum of every 4 hours throughout the application and curing process for each applied coating. Additional monitoring and recording of ambient conditions may be required with noticeable change in weather conditions or at the Engineers discretion.

Totally enclose each section, bay, or portion (Quality Control Areas) of the structure with containment meeting, at a minimum, the requirements of SSPC Guide 6 Class 2W during all coating applications including repair of coatings defects and deficiencies. Protect pedestrian, vehicular, and other traffic on or underneath the bridge and all portions of the bridge superstructure and substructure against damage or disfigurement by spatters, splashes, and smirches of coating or coating materials. Maintain the containment materials to prevent releases of coating materials. Monitor the containment a minimum of 15 minutes for each 4 hours of coating application operations in accordance with SSPC Guide 6 Method A and Visible Emissions Monitoring – General Surveillance Level 2 Emissions. Assume sole responsibility for all damages resulting from coating application operations. Submit a detailed written outline to the Engineer for approval before field painting. Include sketches, if necessary, of methods to prevent overspray drift. Include protection of vehicular traffic, boats, and marinas beneath the bridge, and buildings or other property in the vicinity of the bridge.

Apply field coatings (full and stripe coats) only after satisfactorily completing field cleaning and ensuring that the coating applied for retouching the shop coat is thoroughly dry. Do not apply succeeding coats until the previous coats have dried throughout the full thickness of the coating film and the coating application has been accepted by the Engineer.

Paint from the top of the structure toward the bottom, and proceed by sections, bays, or other readily identifiable portions of the structure, unless the Contract or Engineer directs otherwise.

Apply successive coats of the coating system to all exposed surfaces of the completed structure.

Stencil the completion date of painting, including the year and month, on the structure as the Engineer directs.

F) Repair of Shop and Field Coatings. Repair according to the manufacturer's recommendations and as otherwise specified in this section, or otherwise in accordance with the Engineers written approval

When spot repair will not produce a uniform and durable coating, repaint the entire member as the Engineer directs.

Repair surfaces before erection that will be inaccessible after erection.

607.03.24 Name Plates. When shown, furnish and install name plates including fastening devices.

607.04 MEASUREMENT. The Department will measure the quantity by the lump sum. The Department will not measure miscellaneous metals, shop inspections, inspection facilities and equipment, material samples for mill authorization, enforcement of required safety precaution for radioactive exposure, furnishing of technical representatives for paint, extra paint required when bolting, nameplates, or direct tension indicators for payment and will consider them incidental to this item of work.

607.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08160	Structural Steel	Lump Sum

The Department will adjust the Contract unit price for Structural Steel by the following formula when the Engineer makes plan changes that result in an increase of the estimated plan weight of steel:

$$\text{Adjusted Contract Unit Price} = \text{Original Contract Unit Price} \times \frac{\text{(Revised Estimated Plan Weight)}}{\text{(Original Estimated Plan Weight)}}$$

Bear all shop inspection costs incurred at locations other than the 2 original designated locations. The Department will initially pay for the inspection cost. Reimburse the Department subsequently.

The Department will consider payment as full compensation for all work required under this section.

The Department will make partial payment for structural steel plate stored at the fabrication shop when requested. This applies to structural steel quantities of 1,000,000 pounds or more.

SECTION 608 - CONCRETE BRIDGES

608.01 DESCRIPTION. Construct concrete bridges and parts of other bridges that are concrete.

608.02 MATERIALS.

608.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

608.02.02 Steel Reinforcement. Conform to Section 811.

608.02.03 Bearing and Expansion Plates. Conform to Section 813. When the Contract requires self-lubricating plates, furnish machine surfaces with trepanned recesses.

608.02.04 Rockers. Conform to Section 812.

608.02.05 Elastomeric Bearing Pads. Conform to Section 822.

608.02.06 Preformed Cork Expansion Joint Filler (Type II). Conform to Section 807. Use with bearing pads.

608.02.07 Forms. Conform to Subsection 601.02.

608.02.08 Structural Steel. Conform to Section 812.

608.02.09 Masonry Coating. Conform to Section 828.

608.02.10 Anchor Bolts. Conform to Section 813.

608.02.11 Precast and Prestressed Members. Conform to Subsection 605.

608.02.12 Concrete Curing Materials. Conform to Section 823.

608.03 CONSTRUCTION.

608.03.01 Foundation. Begin work after structure excavation, sheet piling, and all bearing piles have been prepared according to Sections 603 and 604.

608.03.02 Falsework and Forms. Construct all falsework and forms according to Subsections 601.03.11 and 601.03.12.

608.03.03 Classes of Concrete for Substructure. Use Class AA concrete in portions of the substructure above the top of caps except pedestals. Use Class A concrete in portions of the substructure below the top of caps and in pedestals. When placing concrete under water, use Class A Modified concrete.

608.03.04 Placing Steel Reinforcement in Substructure. Place steel reinforcement according to Subsection 602.03.

608.03.05 Placing Concrete in Substructure. Proportion, mix, and place concrete according to Subsection 601.03. Construct construction joints according to Subsection 601.03.10. Place concrete for footings to the full depth in one continuous operation, and allow them to set at least 12 hours before placing forms thereon for other parts of the substructure unit. Place concrete in columns in one continuous operation between construction joints. Allow concrete in columns to set at least 12 hours before placing forms for caps. Place concrete for bridge seats according to Subsection 601.03.09.

Finish all exposed surfaces according to Subsection 601.03.18. Bevel all exposed

edges 3/4 inch.

Cure according to Subsection 601.03.17.

608.03.06 Placing Anchor Bolts. Place anchor bolts in piers and abutments according to Subsection 607.03.17.

608.03.07 Setting Expansion Devices. Install bearing and expansion plates, bearing pads, rockers**,** and other expansion devices, except friction or sliding type, according to Subsection 607.03.17.

For friction or sliding expansion devices furnish either structural steel plates, elastomeric bearing pads, or preformed cork. Firmly anchor expansion devices in correct position as specified in the Plans. Thoroughly coat all sliding surfaces of expansion devices with graphite lubricant just before placing them in position. Do not place concrete in a manner that will interfere with free movement of the expansion devices.

When preformed cork expansion devices are specified for sliding joints, furnish preformed cork material that is the full width and depth of each contact surface and is not built up with several pieces or strips.

608.03.08 Protection. Protect the structure during construction. Protect concrete parapet walls of abutments and end bents or ends of concrete spans from damage by equipment or traffic by methods specified in the Plans or as directed. Do not allow any traffic over the structure from the time it is completed until the pavement is completed, without protecting the ends of the bridge.

608.03.09 Placing Superstructure. Do not place any superstructure on finished piers or abutments until attaining the required concrete strength or the table in Subsection 601.03.15 for applying significant loads. With the exception of rigid frame structures, do not start the erecting or placing of the superstructure until removing the forms and determining the character of concrete in the substructure.

Construct the concrete deck according to Subsection 609.03. Construct the concrete beams according to Subsection 605.03.

608.03.10 Concrete Pile Piers, Steel Pile Piers, and Abutments. Construct all precast or cast-in-place concrete pile piers and abutments, and steel pile piers and abutments according to the lines, grades, dimensions, and design specified in the Plans and according to Sections 601, 602, and 604. Remove falsework under pier caps according to Subsection 601.03.14.

608.03.11 Construction Date and Identification. Stencil the construction date and identification according to Subsection 601.03.19.

608.03.12 Inspection Facilities. Provide facilities for inspection of work as it progresses and for final inspection of completed work. Provide ladders, or other satisfactory means, to enable the Engineer to examine and inspect pier and abutment caps and bearings. Remove them after final inspection and the Engineer's approval of work.

608.03.13 General Requirements for Superstructure. Give all exposed surfaces a finish according to Subsection 601.03.18. Construct bridge slabs according to Subsection 609.03. Construct precast and prestressed beams according to Subsection 605.03.

608.03.14 Steel Reinforcement for Superstructures. Place all steel according to Subsection 602.03.

608.03.15 Concrete Bridge Layout. Dimensions specified in the Plans are for a normal temperature of 60 °F. Layout dimensions are horizontal measurements.

608.03.16 Permissible Finish Variations. Do not allow lines of the finished concrete,

except bridge slabs and precast piles, to vary more than 1/4 inch per 10 feet or vary from plan lines more than 0.1 percent of the distance between extremities of the unit considered.

The Engineer will decide whether any variations in excess of those stated are cause either for removal and replacement of the work according to Subsection 105.01.04 or for a reduction in payment.

608.04 MEASUREMENT.

608.04.01 Concrete. The Department will measure the quantity according to Subsection 601.04.

The Department will not measure furnishing inspection facilities or stenciling for payment and will consider them incidental to this item of work.

608.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

608.04.03 Structural Steel. The Department will measure the quantity according to Subsection 607.04.

608.04.04 Masonry Coating. The Department will measure the quantity according to Subsection 601.04.

608.04.05 Quality Control. Measure and pay according to Section 113.

608.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08100-08105, 02555	Concrete, Class	See Subsection 601.05[1]
08150	Steel Reinforcement	See Subsection 602.05
08160	Structural Steel	See Subsection 607.05
02998	Masonry Coating	See Subsection 601.05

[1] *When the variation is not within the permissible limits and the Engineer does not require removal and replacement, the Department will deduct from the total Contract price the product of the volume of Concrete not within the permissible limits multiplied by the Contract unit price for the Concrete.*

The Department will consider payment as full compensation for all work required under this section.

SECTION 609 — REINFORCED CONCRETE BRIDGE SLABS

609.01 DESCRIPTION. Construct reinforced concrete slabs on bridges.

609.02 MATERIALS AND EQUIPMENT.

609.02.01 Steel Reinforcement. Conform to Section 811.

609.02.02 Concrete. Conform to Subsection 601.02 and 601.03.

609.02.03 Joint Materials. Conform to Section 807.

609.02.04 Structural Steel Joints. Conform to Section 812.

609.02.05 Forms. Conform to Subsection 601.02.13.

609.02.06 Concrete Curing Materials. Conform to Section 823.

609.02.07 Welded and Seamless Steel Pipe for Bridge Floor Drains. Conform to Section 810.

609.02.08 Zinc Oxide-Zinc Dust Primer. Conform to Federal Specification TT-P-641, Type II.

609.02.09 Finishing Machines. Provide each finishing machine with at least 2 movable footbridges from which to perform finishing and curing.

Furnish a self-propelled finishing machine equipped with:

1) one or more augers or other equally effective device to move and position the concrete,
2) a cylinder to compact and finish the concrete, and
3) a pan float.

Provide a machine that is readily adjustable so all its devices may be easily operated to satisfactorily position, consolidate, and finish the concrete.

Use machines that span the full width of the bridge, are adjustable to grades paralleling the roadway crown, and are of rigid construction to ensure a surface finish true to the lines, grades, and cross sections specified in the Plans or established by the Engineer. Give consideration to setting finishing machine on skew if angle exceeds 15 degrees.

Support the machine by rails or tracks of sufficient section modulus to withstand the imposed loads and deflect no more than 1/16 inch between the rail supports. Provide rails or track that are sufficiently rigid to prevent the machine from riding up when finishing concrete of the specified slump. Install the rails outside the limits of the roadway slab, set and maintain them true to grades paralleling the bridge grade, throughout the entire finishing operation.

609.02.10 Hand Operated Internal Vibrators. Conform to Subsection 601.02.

609.03 CONSTRUCTION.

609.03.01.

A) Swinging the Spans. Before placing concrete slabs on steel spans or precast concrete release the temporary erection supports under the bridge and swing the span free on its supports.

B) Lift Loops. Cut all lift loops flush with the top of the precast beam once the beam

is placed in the final location and prior to placing steel reinforcement. At locations where lift loops are cut, paint the top of the beam with galvanized or epoxy paint.

609.03.02 Forming. Form according to Subsection 601.03.12. Construct falsework according to Subsection 601.03.11. Construct falsework and forms for multiple slab spans to provide the camber required in the finished structure.

Department will allow the use of permanent steel bridge deck forms as follows:

A) Design. Conform to the following criteria for designing permanent steel bridge deck forms:

1) Design the steel forms on the basis of dead load of form, reinforcement, and plastic concrete plus 50 pounds per square foot for construction loads. Do not allow the unit working stress in the steel sheet to exceed 0.725 of the specified minimum yield strength of the furnished material, or to exceed 36,000 psi.
2) Do not allow deflection under the weight of the forms, the plastic concrete, and reinforcement to exceed 1/180 of the form span or 1/2 inch whichever is less, and do not base this deflection on a total loading of less than 120 pounds per square foot.

   Base the permissible form camber on the actual dead load condition. Do not use camber to compensate for deflection in excess of the forgoing limits.
3) Use the design span of the form sheets as the clear span between edges of support angles plus 2 inches measured parallel to the form flutes. Do not use a fabricated panel length that is less than the distance between edges of beam flanges minus 2 inches.
4) Compute physical design properties according to AISI Specification for the Design of Cold-Formed Steel Structural Members.
5) Maintain the plan dimensions of both layers of primary deck reinforcement from each surface of the concrete deck.
6) Do not consider permanent steel bridge deck forms as lateral bracing for compression flanges of supporting structural members.
7) Except when permitted by the Engineer, do not use permanent steel bridge deck forms in panels where longitudinal deck construction joints are located between stringers.
8) Do not weld to any steel girder, stringer, or floor beam; to reinforcement bars in concrete beams; or to form supports fabricated from non-weldable grades of steel. Protect flanges from damage during erection of forms.
9) Submit fabrication, shop, and erection drawings, with design calculations, to the Engineer for review. Clearly indicate on these plans the grade of steel, the physical and section properties for all permanent steel bridge deck form sheets, and the locations where the forms are supported.
10) Adjust the steel forms to grade, from the plan construction elevations, to provide the plan slab thickness with no additional dead load other than that of the steel forms.
11) Fasten laps between sheets to ensure mortar tightness. Consider direction of concrete placement to determine lap orientation.

B) Installation. Install all forms according to approved fabrication and erection plans.

On steel members, do not rest form sheets directly on the top of the girder, stringer, or floor beam flanges. Securely fasten sheets to form supports with a minimum bearing length of one inch at each end. Place form supports in direct contact with the flange of girder, stringer or floor beam. Make all attachments by permissible welds, screws, bolts, clips or other approved means. However, do not weld form supports to flanges of steel. Ensure that welding and welds are

according to the provisions of AWS D 1.5 pertaining to fillet welds, except that the Engineer will allow 1/8 inch fillet welds. Welder certification is not required.

Securely fasten all forms to supports while placing them.

On concrete beams, show all support hardware that is to be cast into the beam, on the shop drawings. Make attachments to the form supports or to the auxiliary components by permissible welds, screws, bolts, clips, or other approved means.

Protect the concrete beam from damage.

Clean all form welds of slag and wire brush just before placing the deck concrete.

Thoroughly clean, wire brush, and paint any form metal where the galvanized coating has been damaged or where white rust has formed on the metal with 2 coats of zinc oxide-zinc dust primer with no color added, to the satisfaction of the Engineer. It is not necessary to touch up minor heat discoloration in areas of welds.

Locate transverse construction joints in the concrete deck slab at the bottom of a flute and field drill 1/4 inch weep holes at not less than one foot on center along the line of the joint. Locate the joint and weep holes at the lowest portion of the concrete soffit.

C) Inspection. The Engineer will carefully observe placement of the bridge deck slab. If the Engineer determines that an event such as a delay that may have caused a cold joint or insufficient vibration of concrete during the placement of the concrete warrants inspection of the underside of the deck, remove at least one section of the forms at a location and time selected by the Engineer to provide visual evidence that the concrete mixture and construction procedures are obtaining the desired results.

When forms are removed for inspection, do not replace the forms, but repair the adjacent metal forms and supports to present a neat appearance and ensure their satisfactory retention. Upon removal of the forms, the Engineer will examine the concrete surfaces for cavities, honeycombing and other defects. If the Engineer finds irregularities, and determines that these irregularities do not justify rejection of the work, repair the concrete and give it an ordinary surface finish. If the Engineer determines that the concrete where the form was removed is unsatisfactory, remove additional forms, as necessary, for the Engineer to inspect. Modify methods of construction as the Engineer requires to obtain satisfactory concrete in the slab. Remove or repair all unsatisfactory concrete.

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

609.03.03 Placing and Fastening Reinforcement. Place all steel reinforcement to within ± 1/4 inch vertically and horizontally of the position shown and according to applicable requirements of Subsection 602.03. When concrete overlays are included in the original bridge construction, construct according to the tolerance requirements for a new slab. Tie down reinforcing mats securely with wire 0.148 inch or greater in diameter at intervals of no greater than 8 feet in both the longitudinal and transverse directions to prevent upward movement of reinforcement during construction operations. When tied to the forms, extend the ties through the forms.

Do not deposit any concrete until the reinforcement is in place and the Engineer has inspected and approved it, and observed a complete and thorough "dry run" with the finishing machine over the entire slab area to be placed to ensure accurate placement of steel top clearance and proper slab depth.

The Engineer may allow splicing the reinforcement according to Subsection 602.03.

609.03.04 Expansion and Fixed Joints. Place all joints according to the details specified in the Plans or as directed. Correct improperly placed joints to the satisfaction of the Engineer even when the correction requires removal and replacement.

A) Open Joints. Place open joints in the locations specified in the Plans and

construct them by the insertion and subsequent removal of a template of approved material. Accomplish the insertion and removal of the template without chipping or breaking the corners of the concrete. Do not extend reinforcement across an open joint.

B) Steel Joints. Accurately shape the plates, angles, or other structural shapes at the shop, to conform to the configuration of the concrete slab. Ensure that the surface in the finished plane is true and free of warping. Employ methods in placing the joints to keep them in correct position during placement of the concrete. Set the opening at expansion joints to the temperature adjustment specified in the Plans. Avoid impairment of the clearance. When placing concrete, make adjustments in the joint widths to accommodate temperature changes.

C) Cold-Applied or Hot-Applied Sealing Compound. Ensure that all joints to be sealed are free of cracked or spalled areas. Chip cracked areas back to sound concrete.

Ensure that the faces of all joints to be sealed are free of all foreign matter, curing compound, oils, greases, paint, dirt, free water, and laitance. Thoroughly clean all joint faces by sandblasting or by means of a mechanical rotary wire brush.

Immediately before sealing, blow out the joint with air from an air compressor equipped with an oil and water trap. Use an air compressor of such capacity as will maintain 90-psi pressure when air is delivered to the joint through a nozzle no more than 1/4 inch in diameter.

When any sealing compound has not bonded to the joint wall or face, remove it and clean and reseal the joint.

Place all cold-applied sealing compound with a manufacturer recommended applicator, and follow the manufacturer's mixing and placing instructions. Provide a copy of these instructions and the specifications for the applicator to the Division of Materials.

D) Preformed Neoprene Joint Seals. Ensure that all seals are true to the joint alignment. Ensure that seals are recessed 3/8" + 1/8" below the surface of the concrete roadway or the armored edges. Ensure that all joints to be sealed have clean armored or concrete surfaces, free of concrete spalls, excessive corrosion and/or dirt and debris. Remove and replace any seal that is damaged during installation. Remove any seal that is improperly positioned in the joint and reinstall it at the proper elevation.

Install the seals in structures immediately after expiration of the curing period. Install all seals securely and ensure that they are free from any objectionable curling or twisting in the joint groove. Apply joint adhesives in accordance with the manufacturer's recommendations.

When specified for longitudinal joints in structures, install the seals in practical lengths, without field splicing unless deemed necessary by the manufacturer.

E) Neoprene Expansion Joints. Furnish neoprene expansion joint consisting of any one of the manufactured joint seals specified in the Plans. Determine which of the specified joint seals will be used and obtain written approval of joint details, prior to placing the deck concrete.

Submit shop drawings for approval according to Subsection 607.03.01. Ensure that these drawings, along with joint details, include a layout plan of the joint units to be used. Also include procedures for setting expansion joint width, so the opening will be the specified width at 60 °F. The Engineer will approve of details of installation and his decision will be final.

Include the details and material specifications for the manufactured neoprene expansion joints and incidental accessories, sealants, and adhesives with the shop drawings for approval.

Before beginning work on the joint, furnish the manufacturer's written installation instructions.

Comply with the manufacturer's installation instructions, apply sealants and adhesives, and install joint units as shown on the approved shop drawings and as specified in this section.

When the Engineer requests, obtain technical assistance from the supplier of the joint. Failure of the joint supplier to provide adequate technical assistance may be cause for removal of the joint seal from the Department's List of Approved Materials.

Remove all forms and debris from the joint opening. Ensure that concrete or metal surfaces where the neoprene expansion joints are to be set are dry; clean and free from dirt, grease, and contaminants; level; and sound with no broken or spalled concrete. Ensure that adjacent joint seats are on a straight plane with each other.

Furnish and install the neoprene strip sealing element in one continuous unbroken length for the entire joint length. For the strip seal type joint, ensure that the locking groove in the metal extrusion is clean and free of any dirt or corrosion before installing the neoprene strip seal element. Bond the strip seal in place with the manufacturer's recommended adhesive which meets the Engineer's approval.

Where longitudinal joints cross transverse joint seals, provide a seal by flattening and extending the longitudinal joint neoprene seal element under the transverse joint pad. When this procedure is not practical, use a separate neoprene apron, bonded to the longitudinal seal element.

Ensure that the finished joint presents a smooth, neat appearance. Wipe or scrape away excess sealant before it becomes hard. Upon completion of an entire joint, grind any uneven concrete or armored edge.

609.03.05 Drainage. Install deck drains at the locations shown or as directed and place them before placing the bridge deck slab. Paint all drain pipes according to Subsection 607.03.23. Provide transverse drainage of the roadway surface by means of a suitable crown or cross slope in the floor slab. Effectively drain gutters using weep holes or drain scuppers constructed at locations and in the manner specified in the Plans. Install drain scuppers to prevent drainage water from staining exposed surfaces of girders and abutment walls. In general, extend drain pipes through the concrete slab to a distance of no less than one inch below the slab or underlying beam. Provide the under surface of cantilever brackets and overlapping slabs with a V groove (drip strip) 1/2 inch in depth at a point no more than 6 inches from the outside face of the overhang for the purpose of arresting flow of moisture to prevent staining.

609.03.06 Weather Limitations and Placing Concrete. Do not place any concrete within deck slabs during the months of January or February, except for barriers, plinths, curbs, walks, etc, without Engineer approved cold weather plan. Place all deck concrete according to Subsection 601.03.09. Any time the ambient temperature is anticipated to be 85 °F or higher, place concrete in the deck slab during evening hours after ambient temperatures cool to below 85 °F and cease placement before temperatures rise above 85 °F. Cool forms and beams tops by water spray if their temperature exceeds 85 °F.

Always protect deck placement from rain water being introduced into the concrete and from rainwater surface damage. Cease deck placement immediately or cover it for complete protection when rain occurs.

609.03.07 Depositing, Consolidating, and Striking Off Slab Concrete. Wet the reinforcing steel and forms with water prior to placing concrete. Deposit the concrete between the curbs or between the longitudinal joints when specified in the Plans to the full depth of the slab, and consolidate it. Consolidate by means of hand-operated internal vibrators according to Subsection 601.03.09. Use a spade in addition to vibrating, if required, to ensure that no honeycomb, voids, or air pockets exist against the forms. Continue consolidating the concrete until there is complete contact between the reinforcing steel and the concrete, and until mortar flushes to the top surface.

When using permanent steel bridge deck forms, place emphasis on proper vibration of

the concrete to avoid honeycombing and voids, especially at construction joints, expansion joints, and valleys and ends of form sheets. Obtain the Engineer's approval of pouring sequences, procedures, and mixtures.

Continuously place concrete in any slab between expansion joints or between construction joints as specified in the Plans.

Prevent displacement of reinforcement during placing of concrete. Place concrete in the sequence as specified in the Plans and in the absence of such designation, place as directed. Obtain written approval to change the pouring sequence. Provide sufficient work capacity to place concrete at a minimum rate of 25 cubic yards per hour.

When, in case of an emergency, it becomes necessary to introduce a construction joint, form it by means of a vertical bulkhead constructed to produce a keyed joint and located as approved by the Engineer.

In placing concrete around steel shapes, place it only on one side of the shape until it flushes up over the bottom flange of the shape on the opposite side, after which place it on both sides to completion.

Do not place concrete railings monolithic with the slab.

On continuous, composite design structures, keep concrete in slabs plastic for a sufficient length of time to allow the structure to deflect to the natural deflected shape.

Place the concrete in each integral unit of the superstructure continuously. Do not begin placing concrete without sufficient approved material on hand nor without sufficient forces and equipment to complete that unit without interruption. Avoid joints in the concrete due to work stoppage. Form construction joints, when necessary, according to Subsection 601.03.10.

Place concrete in slab spans in one continuous operation for each span. Place concrete in transverse strips the entire width of the bridge. Place concrete for the full depth and ensure that the width of strips is such that concrete in any one strip does not take its initial set before placing the adjacent strip.

When expansion devices such as rockers, expansion dams, and similar fixtures have been rigidly fixed to hold them in correct alignment, immediately release them upon completion of concrete placement in the portion of the structure in which they are installed.

Immediately following consolidation of the concrete, strike off the surface to crown and cross section with the finishing machine. Move the machine in the direction that work is progressing. Maintain a slight excess of concrete at all times so no low spots are left in front of the finishing machine. Prevent the excess concrete from tearing the surface. After finishing, do not work, walk on, or disturb the concrete in place except as described in this section.

In general, do not add water to the surface of the concrete to assist in finishing operations. If the Engineer allows the application of water to the surface, apply it as a fog spray using approved spray equipment.

609.03.08 Working the Surface. Following the striking off or screeding, randomly check the surface for irregularities and mortar ridges, at least every 50 feet of bridge length, with an approved 10-foot straightedge operated parallel to the centerline of the bridge and slab surface. Eliminate all variations greater than 1/8 inch.

After the concrete slab has cured, the Engineer will again check the slab for variations exceeding 1/8 inch. Perform any corrective action that the Engineer deems necessary.

After completing the finishing operation, ensure that the surface of the concrete presents a uniform appearance; conforms to the required grade and cross section; and is free from surplus water, rough and porous spots, irregularities, depressions, and other objectionable surface features resulting from improper finishing.

609.03.09 Finish with Burlap Drag. If the Contract does not require texturing, finish the slab using a burlap drag. Use a burlap drag of double thickness, at least 3 feet wide, and long enough to span between curb faces. Lay the burlap on the slab surface and drag it in the direction the slab is being placed, keeping approximately 2 feet of its width in contact with the slab surface. Keep the burlap drag damp, clean, and free from hardened concrete.

609.03.10 Texturing. Texture the surface by forming transverse grooves. Form the transverse grooves by approved manual tools such as rakes with spring steel tines. Form the grooves in the concrete at an appropriate time during concrete set, so that in the hardened concrete, the grooves will be between 0.09 to 0.13 inch in width, between 0.12 and 0.19 inch in depth, and be spaced at random intervals between 0.3 and 1.0 inch. Terminate the grooves approximately 18 inches from faces of the curbs, concrete barrier walls, or other vertical walls.

Regardless of the method used to form the grooves, ensure that the grooves are relatively smooth and uniform, are formed without tearing the surface or without bringing pieces of the coarse aggregate to the top of the surface, and are formed to drain transversely.

Correct any individual areas of hardened grooved concrete that do not conform to these requirements by the cutting of acceptable grooves in the hardened surface with an approved cutting machine or by other approved methods.

609.03.11 Waterproofing Membranes and Surface Courses for Slabs. When a waterproofing membrane overlay or special surface course is specified in the Contract, prepare the slab surface according to the procedures designated in the Contract. Do not texture the surface and do not apply a liquid membrane forming curing compound when the slab is to be waterproofed or receive a surface course.

609.03.12 Curing. Immediately after finishing and while the surface is slightly damp, apply Type II (white pigmented) membrane-forming curing compound to the slab between the curb lines. Do not dilute or alter the compound, but thoroughly agitate it immediately before applying it. When the compound is too viscous to apply, warm it in a water bath to approximately 100 °F before applying it. Apply the compound uniformly using an approved pressure sprayer at a rate of one gallon per 120 square feet. If the Engineer deems the application is not uniform as it progresses, apply the compound in 2 applications, each at a minimum rate of one gallon per 240 or less square feet. Start the second application after completing the first application. The Engineer will determine the total quantity of compound actually applied to the slab and compute the actual rate of application. When the Engineer determines the total actual application rate is less than one gallon per 120 square feet actual coverage, apply additional compound immediately and uniformly over the entire surface at a rate the Engineer directs.

When the Contract does not require texturing, reduce the total rate of application to one gallon per 150 square feet. If the Engineer deems the application is not uniform as it progresses, apply the compound in 2 applications, each at a minimum rate of one gallon per 300 square feet. Start the second application after completing the first application. When the Engineer determines the total actual application rate is less than one gallon per 150 square feet actual coverage, apply additional compound immediately and uniformly over the entire surface at a rate the Engineer directs.

Prevent the compound from being applied to reinforcing steel, concrete surfaces to be bonded to other concrete, or any other surfaces not specifically designated to receive the compound. When having inadvertently applied the compound to areas or surfaces not designated, remove by sandblasting or other approved methods.

After applying the compound, and as soon as possible without damaging the surface texture, cover the slab between the curb lines with curing blankets or a double thickness of burlap and keep the slab continuously wet until the required compressive strength is attained as determined by testing field cured cylinders. If other operations are not delayed, the Engineer may require 7 days wet cure regardless of cylinder strengths. If using curing blankets, place and maintain blankets and apply water as specified in Subsection 601.03.17.

609.03.13 Surface Finish. Finish exposed areas of curbs, railings, and plinths, as specified in Subsection 601.03.18.

609.04 MEASUREMENT.

609.04.01 Concrete. The Department will measure the quantity in cubic yards

according to the Record Plans. The Department will base the final quantity on the design quantity. The design quantity includes beam haunches. The Engineer will not measure differences between the theoretical and actual haunch heights for payment. When there is an error or omission in the design quantity in excess of 2 percent, the Department will adjust the design quantity accordingly. The Department will adjust quantities resulting from authorized dimension changes. The Department will not subject these quantities to the 2 percent limitation.

The Department may measure the depth of concrete cover above the top mat of steel reinforcement in inches according to KM 64-313. The Department will not measure the depth of concrete cover above the top mat of steel reinforcement as a separate pay unit, but will use it to calculate an adjusted Contract quantity for Concrete.

The Department will not measure furnishing inspection facilities, joint construction, or stenciling for payment and will consider them incidental to this item of work.

609.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

609.04.03 Drain Pipe. If this item is a separate pay item, the Department will measure the quantity in linear feet. If this item is not a separate pay item, the Department will not measure the quantity for payment and will consider it incidental to Structural Steel.

609.04.04 Structural Steel. The Department will measure the quantity, including drainage systems and structural steel expansion joint systems, according to Subsection 607.04. The Department will not measure paint, fittings, and connections for payment and will consider them incidental to this item of work.

609.04.05 Neoprene Expansion Dams. The Department will measure the quantity in linear feet.

609.04.06 Joint Sealing. The Department will measure the quantity according to Subsection 606.04.08.

609.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08100-08105, 02555	Concrete, Class[1]	See Subsection 601.05
08150	Steel Reinforcement	See Subsection 602.05
08160	Structural Steel	See Subsection 607.05
02998	Masonry Coating	See Subsection 601.05
08820, 08821	Drain Pipe, Size	Linear Foot
08469-08472	Neoprene Expansion Dam, Size	Linear Foot
08540	Joint Sealing	See Subsection 606.05

[1] *The Department will adjust the Contract quantity for Concrete by the Schedule for Adjusted Quantity for Depth of Cover Deficiency (KM 64-313). The adjusted quantity is equal to the theoretical slab volume of concrete times the ratio of the area in square feet, which is not within the specified tolerance to the plan slab area in square feet, times the factor listed in the Schedule for Adjusted Quantity for Depth of Cover Deficiency. The Department will not make additional payment for depth of cover in excess of the specified thickness.*

Schedule for Adjusted Quantity for Depth of Cover Deficiency

Depth of Cover Deficiency (inches)	Quantity Adjustment Factor
0.00 to -0.25	0.00
-0.26 to -0.50[4]	0.06
-0.51 to -0.63	0.12
-0.64 to -0.75	0.25
-0.76 to -0.88	0.50
-0.89 to -1.50	[1]
-1.51 or greater	[2]
0.00 to +0.50	0.00
+0.51 to +0.63	0.12
+0.64 to +0.75	0.25
+0.76 to +0.88	0.37
+0.89 to +1.00	0.50
+1.01 or greater	[3]

[1] *Construct a concrete overlay at no expense to the Department. The Department may apply a factor of 1.00 to small isolated areas in lieu of a concrete overlay.*

[2] *Remove and replace these areas with concrete of the specified thickness at no expense to the Department.*

[3] *Perform corrective work at no expense to the Department. The Department may require removal of any excess concrete or removal and replacement of the entire slab. The Department may apply a factor of 1.00 to small isolated areas in lieu of corrective work.*

[4] Quantity Adjustment Factor only applies if the contractor elects to core the bridge deck as per KM 64-313. If the contractor accepts the adjustment based on the pachometer reading this Quantity Adjustment Factor is 0.00.

The Department will consider payment as full compensation for all work required under this section.

SECTION 610 — CONCRETE BOX CULVERTS AND CONCRETE HEADWALLS

610.01 DESCRIPTION. Build all concrete box culverts and concrete headwalls according to the Contract.

For box culverts constructed using precast sections, conform to Section 611. For precast headwalls, conform to Section 710.

610.02 MATERIALS.

610.02.01 Concrete. Conform to Subsection 601.02 and 601.03.

610.02.02 Steel Reinforcement. Conform to Section 811.

610.02.03 Concrete Pipe. Conform to Section 810.

610.02.04 Joint Materials. Conform to Section 807.

610.02.05 Masonry Coating. Conform to Section 828.

610.02.06 Concrete Curing Materials. Conform to Section 823.

610.03 CONSTRUCTION. Conform to Subsection 601.03 for all concrete construction.

610.03.01 Footings. Construct footings to the elevation specified in the Plans, and increase the depth when the Engineer determines that it is necessary to provide sufficient bearing or to prevent undermining. Only raise footing elevations when encountering solid rock at elevations above those specified in the Plans and with the approval of the Engineer.

Form the outside face of all footings of concrete headwalls for pipe, box, or arch culverts to the full depth of the footing. Do not place any concrete in the foundation until the Engineer has inspected and approved the depth of excavation and character of the foundation material.

Whenever the natural foundation material is not sufficiently stable to support the structure or whenever it is anticipated that high water may cause excessive erosion around the footings, the Engineer may order Extra Work to provide the structure with adequate support or protection according to Subsection 109.04.

When the condition of excavation for footings is otherwise satisfactory but is such that concrete cannot be placed without mud becoming mixed with the concrete, remove the entire mass of mud and replace it with stable material or prevent infiltration of mud by methods such as a layer of coarse aggregate and geotextile fabric or a layer of plastic material. Perform work by methods other than removing and replacing the entire mass of mud according to Subsection 109.04.

610.03.02 Apron Walls and Headwalls.

A) Apron Walls. The Engineer may require additional depth than that specified in the Plans if necessary to prevent undermining. Form the outside faces of all concrete apron walls for the full depth. When necessary to form the back face or the end of apron walls due to the lack of solid material, do not exceed the excavation limits specified for footing structure excavation.

Pave the space between wings when the Engineer directs. In this event, relocate the apron walls so that they are in a straight line between the ends of the wings, or at locations to provide the best protection.

B) Headwalls. Construct headwalls according to the Standard Drawings for Headwall Supplement. When headwalls for pipe culverts are located at the shoulder, construct the top of the headwalls parallel to the shoulder line for both line and grade.

610.03.03 Drainage. Place weep holes consisting of 4-inch pipe or formed to 4 inches in diameter at intervals not to exceed 25 feet in retaining walls, nor exceeding 10 feet in box culverts. Place the outlet invert elevation of weep holes in box culverts 4 inches above the flowline of the culvert. Raise box culvert weep holes to accommodate significant silting when the Engineer directs. Make adequate provisions for thorough drainage of backfill and embankment according to Subsection 603.03. Boxes less than 4 feet in height are not required to have weepholes.

610.03.04 Placing Concrete. Place concrete according to Subsection 601.03.09.

Place the base slab or footings, and allow them to cure before constructing the remainder of the structure. Construct base slabs, footings, and apron walls as monolithic units when practical. When construction joints are necessary, place them at right angles to the culvert barrel.

Bond construction joints, according to Subsection 601.03.10.

In constructing all box culverts having a clear height of 5 feet or more, place concrete in the side walls, and allow it to set before placing the top slab.

For culverts having a clear height of less than 5 feet, if desired, pour the culvert top slab monolithically with the side walls. When using this method of construction, make all necessary construction joints vertical and at right angles to the axis of the culverts.

Construct each wingwall as a monolithic unit. Place construction joints, where unavoidable and when not specified in the Plans, horizontal or vertical as appropriate.

610.03.05 Removing Forms. Remove forms according to Subsection 601.03.14.

610.03.06 Surface Finish and Placing Fill. Finish surfaces according to Subsection 601.03.18. Texture top slabs of box culverts to be used as the wearing surface for traffic according to Subsection 609.03.10, and conform to the roadway rideability requirements of Subsection 501.03.19.

Place backfill or embankment as allowed by concrete strength.

Backfill according to Subsection 603.03. Construct embankment according to Subsection 206.03.

610.03.07 Extensions to Existing Culverts. Construct extensions according to the lines and grades established and to dimensions specified in the Plans.

Remove portions of the existing structure designated to be removed according to Subsection 203.03. Remove portions of the existing structure designated to be removed in a manner that provides a neat junction with the extension, and leave undamaged that portion of the existing structure that is to remain in service. For exposed joints in the finish work, the Engineer may require sawing of the existing concrete to a depth sufficient to ensure a neat joint. Repair all damage to the existing structure due to his activities. Remove and dispose of all silt or other debris that may have collected within the barrel of the existing structure. The Engineer will only require this silt and debris removal once, unless erosion control measures were not adequate.

610.04 MEASUREMENT.

610.04.01 Concrete. The Department will measure the quantity according to Subsection 601.04.

610.04.02 Steel Reinforcement. The Department will measure the quantity according to Subsection 602.04.

610.04.03 Structure Excavation. The Department will measure the quantity according to Subsection 603.04. The Department will measure the removal and replacement of unstable material in footing excavation as Structure Excavation.

610.04.04 Removal of Existing Structure. The Department will measure the quantity

according to Subsection 203.04. The Department will not measure repair of damage to, removal of silt and debris from, and providing a neat cut for the joint on the portion of the structure designated to remain for payment and will consider them incidental to this item of work.

610.04.05 Headwall. The Department will measure the quantity as each.

610.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08100, 08102-08105, 02555	Concrete	See Subsection 601.05
08150	Steel Reinforcement	See Subsection 602.05
----	Structure Excavation	See Subsection 603.05
02731	Remove Structure	See Subsection 203.05
01200-01223	Pipe Culvert Headwall, Size	Each

The Department will consider payment as full compensation for all work required under this section.

SECTION 611 PRECAST REINFORCED CONCRETE BOX CULVERT SECTIONS

611.01 DESCRIPTION. Install precast reinforced concrete box sections used as culverts, storm drains, and sewers.

611.02 MATERIALS.

611.02.01 Concrete. Conform to Subsections 601.02 and 601.03 and the Precast/Prestress Concrete Manual.

611.02.02 Steel Reinforcement. Conform to Section 811.

611.02.03 Backfill Material. Conform to Subsection 206.03.01.

611.02.04 Free Draining Backfill Material. Conform to Section 805.

611.02.05 Grout. Conform to Subsection 601.02.

611.02.06 Sand. Conform to Section 804.

611.02.07 Sand for Pipe Bedding. Conform to Section 804.

611.02.08 Crushed Aggregate for Bedding. Conform to Section 805.

611.02.09 Joint Sealer for Rigid Pipe. Conform to Section 807.

611.02.10 Geotextile Fabric. Conform to Section 843.

611.03 CONSTRUCTION.

611.03.01 Transportation and Handling. Handle and store the precast units so that flexural stresses are not induced until the concrete age is 7 days or attains a compressive strength of 3,000 psi.

Remove and replace all sections that are not in true alignment and grade or that show undue settlement after laying, or are otherwise damaged.

611.03.02 Precast Unit Construction. Construct units according to ASTM C1577, replacing Table 1 (Design Requirements for Precast Concrete Box Sections Under Earth, Dead and HL-93 Live Load Conditions) with KY Table 1 (Precast Culvert KYHL-93 Design Table), and Section 605 with the following exceptions and additions:

1) A water meters is not required if using dry-cast methods.
2) Mark all box culverts sections with the following information on the inside top of each section with letters no less than 2 inches high:

    a) Span, rise, maximum and minimum design earth cover, and KY Table 1.
    b) Date of manufacture.
    c) Name and trademark of the manufacturer.

    For entrance and exit box sections, indent the required information. Mark interior sections by indenting or with waterproof paint.
3) Furnish precast sections at least 4 feet long.
4) Contrary to ASTM C 1577 Section 10.3, ensure the compressive strength of the cores tested is equal to or greater than the design strength.

611.03.03 Shop Drawings. Precast box sizes outside the depth or size range of ASTM C 1577 will require shop drawings with structural steel calculation by an engineer licensed in Kentucky. Precast box dimensions and fill depth within KYHL-93 or KY Table 1 will not require shop drawings or calculations unless requested by the engineer. Precast wing walls and headwalls will require shop drawings and stamped calculations by an engineer licensed in Kentucky for all precast structures.

Submit shop drawings for review according to Subsection 105.02, except do not include original tracings. Include on the shop drawings details of joint configuration, the size of rubber gaskets or butyl rubber sealants when used, the area of steel reinforcement, lift holes, and the size and location of reinforcement.

611.03.04 Excavation. Perform structure excavation according to Section 603, except as modified in this subsection.

611.03.05 Bedding. Perform bedding as specified in the Plans or Standard Drawings. Level the compacted bedding with a template or straightedge to ensure uniform support throughout the entire width and length of the structure.

When desired, substitute crushed aggregate up to 3/4 inch maximum size for sand as bedding material. Do not use DGA or gravel base for this substitution. Substitute measure for measure.

The Engineer will require a vertical trench from the bottom of the excavation to the top of the culvert or original ground, whichever is lower, as specified in the Plans or Standard Drawings.

611.03.06 Laying Sections. Do not lay any unit until the Engineer approves the proposed location. Take soundings for foundation design at the inlet and outlet of each culvert and at intervals no greater than 20 feet along the grade line of the bottom of the culvert, to a depth of 3 feet. Perform soundings on the centerline and at each edge of the culvert. Where ledge rock, gravel, hardpan, or other unyielding material is encountered or known to exist within the limits stated, prepare the foundation as specified in the Plans or Standard Drawings.

Camber the box culvert sections as the Engineer directs. Begin placing sections at the outlet end of the pipe with the bell or groove end being laid upgrade. Fully extend successive spigot ends into each adjoining hub. Provide a “come-along” or other mechanical device to pull each section firmly into the previously placed section, tightly meshing the joints. Do not push sections together with a tractor-mounted blade. After installing the sections, seal lift holes by inserting a tapered precast concrete plug and coating the top of the joint around the plug with asphalt mastic material.

When the Plans require the volume between side-by-side installations to be filled with grout, use grout consisting of one part cement to 6 parts mortar sand or concrete sand, with sufficient water to provide a consistency suitable for job conditions.

Provide drainage with 4-inch weepholes as specified in Subsections 610.03.03 and 603.03.05 respectively, except that for side-by-side installations separated by grout, place weepholes in the extreme outside walls only.

Grout formed openings between the precast sections and any side entry of pipes or top entry of manholes to form a watertight joint. When manholes are to be placed directly on the top slab of the precast sections, provide sufficient additional steel reinforcement in the top slab to compensate for the section removed.

611.03.07 Joints. Use either rubber gaskets, butyl rubber sealants, or asphalt mastic joint sealing compound in joints between the precast box sections. Use the same material throughout each individual structure.

A) Rubber Gaskets. Use a cement and lubricant to facilitate joining the sections that is recommended by the manufacturer of the rubber gaskets. Install the rubber gaskets in a manner to snugly fit in the beveled surface of the tongue and groove ends of the section to form a flexible water-tight seal under all conditions of

service.

B) Butyl Rubber Sealants. Use a primer; rate and method of primer application; and width and method of application of the butyl rubber sealant recommended by the manufacturer. Provide the Engineer with the manufacturer's literature for installation procedures.

C) Asphalt Mastic Joints. Prime and seal asphalt mastic joints according to Subsection 701.03.05.

D) Joint Fit. Regardless of the type of sealant to be used, ensure proper meshing of the joints.

Do not allow sand or foreign materials to intrude into joints. If sand or foreign material is present within the joint upon joining the sections, thoroughly clean until no sand or foreign material is present, and reseal the joint.

If the joint is not entirely filled with sealant after connecting the culvert sections fill all exposed unsealed areas, both inside and outside the culvert, with asphalt mastic or other approved material. If using plastic gaskets, use an additional sealant compatible with the plastic and recommended by the gasket manufacturer.

Fill the exterior joint gap on the top of precast reinforced concrete boxes with mortar. Cover the exterior joint with a minimum of a 15-inch double layer geotextile fabric joint wrap. Before applying the wrap, ensure that the surface is free from dirt and foreign substance. Use one continuous roll of double layered joint wrap to cover the joint on the top of the box and to extend completely down the sides to the bottom of the box. During backfilling, keep the joint wrap in the proper location over the joint. Apply the joint wrap to all joint sections.

611.03.08 Backfilling. Backfill according to Subsection 603.03, the Plans, and the Standard Drawings. Place free draining backfill between side-by-side installations when required by the Plans. Compact the backfill as the Engineer directs.

611.03.09 Headwalls. Construct headwalls as specified in the approved Shop Drawings, Plans, or Standard Drawings.

611.04 MEASUREMENT.

611.04.01 Structure Excavation. The Department will measure the quantity according to Subsection 603.04. For necessary side-by-side installations, the Department will measure the entire excavated volume between sections when the Plans or the Engineer require excavation of this volume. The Department will measure embankment placed and subsequently excavated according to the plan requirements for bedding as structure excavation. The Department will not measure free draining backfill or grout between side-by-side installations for payment and will consider them incidental to this item of work.

611.04.02 Precast Reinforced Concrete Box Sections. The Department will measure the quantity in linear feet according to the length dimensions specified in the Plans. The Department will not measure joint materials (including the geotextile fabric wrap), shear connectors required for joining sections, and any required acceptance coring for payment and will consider them incidental to this item of work.

The Department will not measure repair of sections not in true alignment and grade or that show undue settlement after laying, or otherwise damaged.

611.04.03 Headwalls. Headwalls and wingwalls may be precast or poured-in-place. The Department will measure the quantity as each regardless of which construction method is used for construction of the headwall.

611.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	Structure Excavation	See Subsection 603.05
03010-03038	Precast Concrete Box Sections, Size	Linear Foot
01200-01221	Pipe Culvert Headwall, Size	Each
08100-08105, 02555	Concrete, Class	See Subsection 601.05
08150	Steel Reinforcement	See Subsection 602.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 612 STRUCTURAL PLATE SOIL INTERACTION STRUCTURES

612.01 DESCRIPTION. Furnish and install corrugated metal multi-plate soil interaction structures where an equivalent inner diameter of greater than 10 feet and less than or equal to 26 feet is required for drainage or other openings. Corrugated metal multi plate soil interaction structures include pipe, pipe arches, and arches.

612.02 MATERIALS.

612.02.01 Pipe. Conform to Section 809 for the following:

1) Corrugated Aluminum Alloy Structural Plate Pipe, Pipe Arches, and Arches.
2) Corrugate Steel Structural Plate Pipe, Pipe Arches, and Arches.

612.02.02 Concrete. Conform to Subsection 601.02 and 601.03.

612.02.03 Asphalt Material for Coating and Paving. Conform to Section 806.

612.02.04 Bedding and Backfill Materials.

A) Fine Aggregate. Conform to Section 804, Sand for Pipe Bedding.
B) Coarse Aggregate. Conform to Section 805, Structural Granular Backfill.
C) Flowable Fill. Conform to Section 601.02 and 601.03.

612.02.05 Joint Materials. Conform to Subsection 701.02.

612.03 CONSTRUCTION.

612.03.01 Composition. Provide structures that consist of prefabricated sections ready to be assembled and erected at the site. Furnish prefabricated sections consisting of asphalt coated galvanized (zinc coated) corrugated steel or aluminum alloy plates that have been factory shaped and punched. The Department will allow the use of a factory assembled structure when units are available that conform to the requirements of the Contract for opening size, material, corrugation dimensions, metal thickness, and coating. Ensure that factory assembled steel units are asphalt coated. The Department will not extend the Contract time to accommodate the use of factory assembled pipe or pipe arches. Ensure that field and factory assembled steel pipe and pipe arch units are asphalt coated and paved.

612.03.02 Transportation and Handling. Transport and handle according to Subsection 701.03.04.

612.03.03 Erections Plans. Submit a pdf copy of the erection plans for each unit to the Engineer. Include with each submitted set of erection plans a natural scale plan, an elevation view of the structure, and the design calculations. In lieu of design calculations, the Department will accept a manufacturer's certification that the proposed structure conforms to all of the Department's structural design requirements. The Department will return one set after review with needed corrections noted. Each time the Department requires corrections, submit a new copy of the erection plans. The Department will have 20 calendar days to review each submission.

After the Department has approved the erection drawings, submit the final approved drawings in 22 inch by 36 inch Portable Document Format (PDF) that will produce near clear prints and sharp lines on both 11 inch by 17 inch and 22 inch by 36 inch prints ("PDF Prints"). The department reserves the right to require hard copy prints on a case by case basis.

612.03.04 Shop Drawings. Before fabricating any parts of the structure, submit shop drawings according to Subsection 607.03.01.

612.03.05 Soundings for Foundation. Take the soundings for foundation design for pipe, and pipe arches according to Subsection 701.03. Where rock foundations are encountered or known to exist within the limits specified, excavate the foundation to a depth below the proposed outside bottom of the structure of 1/2 inch per foot of fill to a subgrade elevation above the proposed outside top of the structure. Excavate no less than one foot and no more than 0.75 times the height of the structure. Replace with material conforming to Subsection 612.02.04. Rock foundations include ledge rock, gravel, hardpan, or other unyielding material. Camber the pipe or pipe arch whenever directed. Do not lay the pipe in cuts until completing the rough grading.

When an unstable foundation is encountered at the grade established, remove the unstable material and replace it with material conforming to Subsection 612.02.04 to a width and depth that will provide a uniform and firm foundation.

612.03.06 Installation. Install steel pipe, pipe arches, and arches according to ASTM A 807. Install aluminum alloy pipe, pipe arches, and arches according to ASTM B 789. Provide the type and method of bedding according to ASTM A 807 and B 789.

Tighten bolts in the erected structure according to the manufacturer's recommendations, with good seam laps, while in proper shape, using nuts and bolts the manufacturer supplies.

Compact backfill according to Subsection 206.03.03. Construct in lifts of not exceeding 8 inches in thickness. Exercise care to avoid displacement of the true line of the arch. Backfill with flowable fill when the Engineer directs. Proportion flowable fill according to Subsection 601.03.

Conform to the elongation tolerance in Appendix A, Tabulation of Construction Tolerances.

612.03.07 Paving. After erecting steel structures and constructing the embankments, pave the inverts throughout their length and to a minimum width of 25 percent of the circumference for circular pipes or to a minimum of 38 percent of the circumference for pipe arches. Pave with wire reinforced asphalt paving mixture or similarly reinforced concrete.

A) Asphalt Paving. Place wire mesh of a diameter of 0.1 inch or more, having openings 6 by 6-inch or less, in the invert, and securely fasten it to bolts of the structure with wire or suitable clips. Provide reinforcing mesh in widths that are one foot less than the finished width of the pavement. Provide an asphalt paving mixture that consists of 70 percent mortar sand and 30 percent mineral filler combined with sufficient bituminous material (9 to 12 percent by weight) to provide a workable plastic mixture. Provide an asphalt material that consists of a PG 58-22 asphalt binder. Heat the aggregate and asphalt binder separately to 300 ± 60 °F, then combine and thoroughly mix them. Ensure that the invert of the culvert is clean and dry while spreading and compacting the mixture. Spread and shape the mixture by means of a template. Compact the mixture to a minimum depth of one ± 0.2 inch over the crest of the corrugations. While the compacted paving material is still warm, apply a 0.1 inch coating of heated asphalt cement throughout its width and length by spraying or other suitable means.

During the paving operation take precautions against asphyxiation, heat, or the accumulation of inflammable vapors in culverts. The Department recommends using forced ventilation.

B) Concrete Paving. Place wire mesh of a diameter of 0.1 inch or more, having openings 6 by 6-inch or less, in the invert, and securely fasten it to bolts of the structure with wire or suitable clips. Spread and shape Class D Concrete having 3/4 inch maximum size coarse aggregate throughout the required width and length of the invert to provide a uniform thickness of 1.5 ± 0.5 inch over the crest of

corrugations. Shape and smooth the concrete pavement by means of a template to conform to the approximate contours of the invert. Float finish the concrete. After initial set, cure the concrete for 3 calendar days using a double layer of wet burlap.

612.03.08 End Structures. Construct end structures according to the Contract.

612.04 MEASUREMENT.

612.04.01 Structural Plate Pipes, Pipe Arches, and Arches. The Department will measure the quantity in linear feet along the bottom centerline. The Department will not measure paving, bedding, backfilling, bolts and other hardware, erection plans and shop drawings for payment and will consider them incidental to this item of work.

612.04.02 Embankment-In-Place. The Department will measure the quantity according to Subsection 701.04.10.

612.04.03 Roadway Excavation. The Department will measure the quantity according to Subsection 701.04.11.

612.04.04 Pipe Undercut. The Department will measure the quantity according to Subsection 701.04.12.

612.04.05 Structure Excavation Unclassified. The Department will measure the quantity according to Subsection 701.04.13.

612.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
----	Aluminum Alloy Structural Plate Pipe, Size	Linear Foot
----	Aluminum Alloy Structural Plate Pipe Arch, Size	Linear Foot
----	Aluminum Alloy Structural Plate Arch, Size	Linear Foot
----	Steel Structural Plate Pipe, Size	Linear Foot
----	Steel Structural Plate Pipe Arch, Size	Linear Foot
----	Steel Structural Plate Arch, Size	Linear Foot
02230	Embankment-In-Place	See Subsection 701.05
02200	Roadway Excavation	See Subsection 701.05
02219	Pipe Undercut	See Subsection 701.05
02203	Structure Classification, Unclassified	See Subsection 701.05

The Department will consider payment as full compensation for all work required under this section.

SECTION 613 RETAINING WALLS

613.01 DESCRIPTION. Construct a standard gravity, cast-in-place reinforced concrete (CIP), or gabion retaining wall as specified in the Contract.

613.02 MATERIALS. Use the same material throughout all individual walls, and at both ends of all individual structures. Use only approved systems and materials.

613.02.01 Concrete. Conform to Section 601.02 and 601.03.

613.02.02 Reinforcing Steel. Conform to Section 811**.**

613.02.03 Joint Materials. For CIP walls conform to Section 807.

613.02.04 Geotextile Fabric. Conform to Section 843, Geotextile Fabric for Subsurface Drainage and Separation. Use fabric sheets with a minimum width and lap of 18 inches for vertical joints, one foot for horizontal joints, and 4 inches for all laps in fabric.

613.02.05 Granular Embankment. Conform to Section 805.

613.02.06 Gabion Baskets. Conform to Section 813.

613.02.07 Gabion Fill Material. Conform to Section 805.

613.02.08 Grout. Conform to Subsection 601.02.

613.03 CONSTRUCTION.

613.03.01 Design. When the plans do not include a complete design for the retaining wall, provide all design calculations, shop drawings, and construction plans required.

Comply with Subsection 107.05, covering the use of patented devices, materials, and processes.

1) Design the wall through a Registered Professional Engineer.
2) Design the wall in conformance with the AASHTO LRFD Bridge Design Specifications, current edition and all published interims, and all other AASHTO or Industry specifications required by the plans.
3) Require a minimum top wall thickness of 10 inches for standard gravity walls and a 9 inches minimum for all other CIP walls.
4) No materials are to be furnished and no fabrication or work done before the Department's review of the proposed design, drawings, and instructions.

613.03.02 Foundation. Excavate the foundation bed for the retaining wall as required. Before wall construction, compact the foundation to 95 percent of the maximum density as determined by KM 64-511. Remove and replace all foundation soils found unsuitable. If shown on the plans or directed by the Engineer, place structure granular backfill to the dimensions required under the footings or bottom units. Obtain approval by the Engineer before erection is started.

613.03.03 Standard Gravity Wall. Construct according to Standard Drawing No. RGX-002. Construct walls, footings, leveling pads, copings, and all other cast-in-place appurtenances using Class B concrete according to Subsection 601.03. When the wall will be surcharged, special drawings are required.

Ensure the base width is half the vertical height of the wall and the top width is one foot. Place transverse expansion joints 1/2 inch in width at minimum intervals of 30 feet

throughout the length of retaining walls and fill with expansion joint material. All exposed edges shall be beveled 3/4 inch.

When it is not practical to pour the wall to full height in one operation, ensure construction joints are truly horizontal and provide a bond between the sections with keys formed by beveled timbers. Where necessary to provide construction joints in the length of the wall, ensure joints are truly vertical and provide a bond between the sections with shear keys formed by beveled timbers.

Grout around and behind all pipes in the wall face. Proportion grout according to Subsection 601.03.

At the end of each day's operation slope the last level of the backfill away from the wall facing to direct runoff away from the wall face. Do not allow surface runoff from adjacent areas to enter the wall construction site.

When shown on the Plans or directed by the Engineer, backfill with structure granular backfill.

613.03.04 CIP Walls. Construct according to the structure plans.

613.03.05 Joints. Provide contraction joints at 30-foot intervals and 1/2-inch expansion joints at 90-foot intervals in all CIP walls. Provide 1/2-inch joint material in all expansion joints. Place 24-inch long, 1/2-inch diameter, commercial grade steel dowels and 12-inch long, 5/8-inch inside diameter, commercial grade steel dowel sleeves across the joint. Provide caps on one end of the sleeves. Grease one end of the dowel and insert into the sleeve. Space dowels and sleeves at 12-inch intervals along the centerline of the wall stem. Do not pass reinforcing steel through either joint. Seal joints from top to bottom with waterstops.

613.03.06 Drainage. Provide 4-inch weep hole drains at 8-foot intervals through standard gravity and CIP walls. Place fabric wrapped backfill drains at each weep hole according to Subsection 603.03.05. Place weep hole inverts 6 inches above finish grade at the front face.

613.03.07 Gabion Walls. Construct according to Standard Drawings and the Contract. Place the basket flat on the ground, flatten any kinks or bends, and erect the sides, ends and diaphragms. Ensure all creases are in the correct position and the tops of all sides are level. Lace the 4 corners of the basket together with alternating single and double loops at 5-inch intervals. Secure both ends of the lacing wire by looping and twisting. Install and lace internal diaphragms in the same manner. Place the individual assembled baskets in their proper location. Connect all adjoining baskets using individual tie wires looped and twisted at approximately 3-inch intervals along the entire perimeter of their contact surfaces.

Partially fill the first basket in line for anchorage and stretch the connected gabions to proper alignment using a come-along or other means of at least one ton capacity. Keep the baskets in tension while filling. Control joints to avoid any unraveling. Filled in one-foot layers, in a manner that will minimize voids. Place 2 connecting wires in each direction between each layer in all cells by looping lacing wire around 2 mesh openings in the front and back face, and in the ends and diaphragms. Securely fasten the ends of the connecting wires to prevent their loosening under tension. Fill cells in each course of in stages. Do not allow any cell at any time to be filled to a depth exceeding one foot more than the adjoining cell. Level the last layer of stone with the top of the basket to allow proper closing of the lid and provide an even surface for the next course. Stretch the lids tightly over the stone fill using crowbars or similar methods, until the lid meets the edges of the front and ends. Tie the lids along all edges, ends, and diaphragms in the same manner as required for connecting adjoining baskets. Place and connect succeeding courses or tiers as specified for the first course. Offset vertical joints for succeeding courses at least 18 inches from course to course. Place baskets as headers or stretchers in accordance with the Contract. Tie each course of baskets to the lower course after stretching but before filling, with individual tie wires looped and twisted at approximately 3-inch spacing along all edges and diaphragms. Reinforce vertical edges at each end of the wall that are not connected to an

adjoining basket by looping and twisting individual tie wires at approximately 3 inches spacing the full length of such edges.

Ensure the stone fill is firmly in place, bulging or distortion of the filled baskets is minimal, and all lacing and tying is thoroughly wound, looped and twisted to preclude loosening in service.

613.04 MEASUREMENT. The Department will measure items such as concrete barriers that are not a part of normal retaining wall construction as the wall area. When barriers are constructed on retaining walls, the plans will show the top of the wall for payment purposes.

The Department will consider all joint material, design calculations, shop drawings, and construction plans with required corrections, manufacturer supplied technical assistance incidental to the retaining wall.

613.04.01 Standard Gravity and CIP Walls. The Department will measure concrete, steel reinforcement, and structure excavation according to Subsections 601.04, 602.04, and 603.04, respectively. The Department will consider backfill, foundation preparation, portions of the footings for cast-in-place walls outside of the approved gross area, structure granular backfill, and geotextile fabric required incidental. The Engineer may include portions or all of the footings for cast-in-place walls in the gross area as shown on the plans. The Department will include the WWF dowel and dowel sleeves in the weight of steel reinforcement.

613.04.02 Gabion Walls. Unless the Contract provides for payment based on field measurements, the Department will not measure gabion walls but will make final payment at the Contract unit price for the design quantity, increased or decreased by authorized adjustments.

The Department will measure structure excavation according to Subsection 603.04.

613.05 PAYMENT. The Department will make payment for the completed and accepted quantities under the following:

Code	Pay Item	Pay Unit
08100-08105, 02555	Concrete	See Subsection 601.05
08150	Steel Reinforcement	See Subsection 602.05
02203	Structure Excavation Unclassified	See Subsection 603.05
02223	Granular Embankment	Cubic Yard
02610	Retaining Wall, Gabion	Cubic Yard

The Department will consider payment as full compensation for all work required under this section.

SECTION 614 MAINTENANCE CLEANING AND PAINTING STEEL BRIDGES

614.01 DESCRIPTION. Clean and prepare all surfaces to be painted; furnish and apply all paint; maintain, protect, and control all pedestrian and vehicular traffic; and protect the structure and all other property against damage that may result from this work. The surfaces to be painted include all structural steel surfaces and other exposed metal surfaces that may exist within the limits of the project, such as handrails, guardrails, cables, wire fence, light fixtures, metal flooring, and other metal appurtenances, except items specifically deleted in the Contract.

614.02 MATERIALS AND EQUIPMENT.

614.02.01 Paint. Conform to Section 821 or as the Contract designates. Furnish a paint system in which all coats are produced by the same manufacturer and use the same system throughout the entire project. Use a paints system from an approved supplier. A list of approved suppliers may be found in the Department's List of Approved Materials maintained by the Division of Materials.

A) **Paint Finish Coat Color.** The finish coat color shall be gray and will meet the following values.

L*	a*	b*
48.17	-3.54	0.87

B) **Acceptance Testing.** The Department requires acceptance testing of samples obtained on a per-lot basis per-shipment. The Division of Materials will perform acceptance testing. At their option, the Engineer may elect to conduct more frequent sampling and testing. Test samples may be taken at the Contractor's paint storage site. Department personnel will perform sampling. Allow (10) working days for testing and approval of the sampled paint.

It is the Contractor's responsibility to maintain an adequate inventory of approved paint. The Department assumes no responsibility for lost work due to rejection of paint or approved paint subsequently found to be defective during the application process**.**

C) Paint Storage, Handling, Sampling, Mixing and Thinning. Establish a paint storage site for receiving and storing paint delivered for use on the project. Locate the paint storage site separate from the job site. Receive all new paint at the storage site for inventory and acceptance testing. At that time, have the Contractor's QC inspector and the Department's inspectors independently inventory the supplied paint by batch number and quantities delivered. Their tallies should be compared and any differences resolved. The Department's inspector examines all paint containers delivered and rejects those with 1) broken seals, 2) rust, 3) altered, missing or illegible batch numbers or labels and 4) dents. The Department's inspector numbers and initials each container with an indelible marker. A representative of the Department samples each lot of material. Label rejected paint containers "REJECTED" and dispose of them promptly. Store unapproved or rejected containers of paint separately from those that are approved. Allow no paint at the actual job site until the Division of Materials has approved it.

Have both the Contractor's QC inspector and the Department's inspector conduct a daily start-up inventory of containers of approved paint brought to the job site noting batch numbers and the Department inspector's container number. At the end of the work day, have the QC inspector and the

Department's inspector conduct another inventory noting the number of paint containers expended, Department inspector's inventory numbers, and types of paint. Inventory paint containers brought on the job site and not used. Re-inventory those when they are taken back to the job site to be used.

All storage, mixing, and thinning shall comply with the manufacturer product data sheets (PDS)

The addition of solvents (thinning agent) to paint is permitted **only** by written approval from the Division of Materials. Use only new solvents supplied by the paint manufacturer. Solvent addition must yield paint with a volatile organic compound (VOC) content equal to or less than 2.8 lb./gal. Add solvents at the job site in the presence of the Department inspector. Use only solvents from new, unopened containers with the solvent manufacturer's labeling intact. The QC inspector will record locations where solvent-thinned paint was used.

Keep solvents used for cleaning at the job site in sealed containers away from mixing operations. Collect solvents used to clean brushes, rollers, or spray equipment in sealed containers and store them as a hazardous waste.

The paint manufacturer is required to provide a technical representative at the job site when requested by the contractor or the Department at no additional cost to the Department.

614.02.02 Brushes. Use brushes not exceeding 4 inches in width. Maintain brushes in a usable and acceptable condition at all times.

614.02.03 Spraying Equipment. Conform to the paint manufacturer's recommendations. Use equipment that applies the paint in a fine, even spray without adding thinner. Provide adequate separators and traps in the air spraying equipment to remove all water and oil from the compressed air.

614.03 CONSTRUCTION.

614.03.01 Responsibility for Damage. Protect all pedestrian, vehicular, and other traffic upon or beneath the bridge; all adjacent property; and all portions of the bridge superstructure and substructure against damage or disfigurement by paint or paint materials.

When performing work in urban areas, or when developed areas exist in the close vicinity of the work, submit for the Engineer's review a detailed written outline, including sketches, if necessary, of the proposed methods to prevent damage to these areas from the work. Include specific information for protecting vehicular traffic on or beneath the bridge, boats and marinas beneath the bridge, and buildings or other property in the vicinity of the bridge. Do not begin work until the Engineer reviews and accepts the protection methods.

Take sole responsibility for all damage resulting from painting operations, even if the Engineer reviewed and accepted the protection methods.

614.03.02 Seasonal and Weather Limitations. Apply paint between April 1st and November 15th. The Department may allow painting at other times when the Engineer approves in writing. Apply paints only to clean and dry surfaces, when the ambient air temperature is 40° F or greater, the surface temperature of the steel members to be painted is at least 5° F above the dew point, and the relative humidity is less than 90 percent or in accordance with the paint manufacture's recommended ambient condition ranges, whichever is more stringent. Record and verify that ambient conditions are in compliance at the location where painting is to be performed prior to beginning paint application and at a minimum of every 4 hours throughout the application and curing process for each applied paint. Additional monitoring and recording of ambient conditions may be required with noticeable change in weather conditions or at the Engineers discretion.

614.03.03 Prosecution of the Work. Upon beginning the operation of cleaning and painting, proceed with the operation on all working days, without stoppage, until completion. When specified in the Contract, submit a schedule proposing the sequence and time needed to clean and paint all structures included in the Contract.

Clean and paint all areas in strict conformance with the Contract, unless the Engineer approves alternate methods in writing.

A. SUBMITTALS

The Contractor shall submit the following written items to the Project Engineer 15 Working Days prior to the Pre-Construction Conference:

1. A detailed Progress of Work Schedule conforming to 108.02 including an Activity Bar Chart.
2. Traffic Control Plan
3. Worker Protection Plan
4. Environmental Compliance Plan, including a Waste Management, a Ground Water Protection Plan and an Emissions Monitoring Plan.
5. Manufacturers' recommended Film Thickness and application conditions for the paint system to be used (product data sheets and MSDS).
6. Rigging and Containment Plan, Design for rigging and containment shall be signed and stamped by a licensed Kentucky professional engineer.

All submittals must be received, accepted, reviewed and/or approved prior to beginning any work

614.03.04 Maintaining Traffic. Maintain all pedestrian, highway, railway, and waterway traffic while working. Do not leave cleaning or painting equipment on the roadways or sidewalks of any structure overnight.

Furnish and erect all necessary warning signs and other traffic control devices as directed to ensure public safety and convenience.

614.03.05 Workmanship. All structural steel surfaces are to be properly cleaned and painted to the contract documents and to the satisfaction of the Engineer. There will be no provision for missed areas or substandard work regardless of size of the area in question. All improperly prepared or painted surfaces are to be repaired to meet the provisions of this specification.

Allowable field variation of the color of all cured finish coats on structural steel will be 1.5 ΔE_{cmc}. These values shall be obtained from a spectrophotometer utilizing a D65 illuminant at 45° illumination and 0° viewing with a 2° observer. Surfaces with finish coats with color variations exceeding the 1.5 ΔE_{cmc} value will be repainted at the option of the Engineer.

614.03.06 Environmental and Worker Safety regulations

A) Governing regulations. The existing paint in this project may contain lead, which is classified as a hazardous (toxic) material. Be knowledgeable of and comply with, all lead-related environmental and health regulations governing the Contractor's operations. Comply with regulations current at the time the work is performed and all requirements herein. Collect, transport to waste storage sites, and store hazardous wastes in accordance with applicable environmental and health regulations. The contractor is solely responsible for collection, transport, storage and disposal of all industrial wastes.

B) Liabilities and Obligations. The contractor is solely responsible for compliance with all applicable environmental and health and safety regulations to the satisfaction of the applicable government regulatory agencies and the Department. The Department assumes no obligations or liabilities for work stoppages or fines due to enforcement actions by government regulatory agencies or to related delays that the Department deems necessary.

C) State and Local Regulatory Agencies. State and local regulatory agencies charged with enforcing most regulations affecting the generation of hazardous wastes and worker safety issues are:

Kentucky Occupational Safety and Health Program, Labor Cabinet,
Commonwealth of Kentucky, Frankfort, Kentucky

Environmental and Public Protection Cabinet,
Commonwealth of Kentucky, Frankfort, Kentucky

D) Groundwater Protection. The contractor will prepare and implement a groundwater protection plan in accordance with KAR and KRS current regulation and statutes, with the exception that hazardous waste or hazardous materials container volume is not limited to greater than 55 gallons or weight to 100 pounds

614.03.07 Unsatisfactory Work. Remove paint, at any stage of its completion that the Engineer finds unsatisfactory, and clean, prepare again, and repaint the surface at no expense to the Department and to the satisfaction of the Engineer. Unsatisfactory work includes but is not be limited to:

1) Failure to properly clean and prepare the surface;
2) Poor workmanship in application of the paint;
3) Painting with impure, improperly mixed, thinned, or unauthorized paint; and
4) Failure of the paint to adhere to the metal, other substrate or to previously applied paint coat.

614.03.08 Over-Coating Cleaning And Painting

A) **Containment.** Totally enclose all structural steel during all phases of the work. Use containment that meets the criteria for SSPC Guide 6 – Containment Classification Class 2W with the exception of 85% containment screens used to support the geotextile fabric conforming to 614.04.04. A minimum air movement in containment is not specified but the contractor will demonstrate that the air movement in the containment will provide the necessary engineering control to comply with OSHA worker safety requirements (i.e., lead standards as required by 29 CFR 1926).

1) **Emissions**- The contractor will provide the necessary apparatus to keep all debris from cleaning and painting operations off the roadways and waterways. The contractor will be required to submit, to the Department for approval prior to starting work, the plan that he will follow in protecting the traveling public and keeping debris off the roadways. The contractor will submit a design for the protection device. Prior to submission, the design must be reviewed and approved by a Kentucky licensed Professional Engineer. The Department will review the submission for acceptance.

Monitor and assess the quantity of emissions from containment using SSPC Technology Guide No. 6, SSPC Technology Update No. 7, and the following requirements for Visible Emissions – General Surveillance (Visible Emission Evaluations for Total Dust – Timing), EPA Ambient Air Monitoring for Toxic Metals (TSP-Lead), and Visual Assessment of Site Cleanliness.

Method A Visible Emissions-General Surveillance: Monitor containment for visible emissions for a minimum of 15 minutes for every 4 hours of surface preparation, including collection of abrasive media and cleaning of containment materials, and paint application operations. Record the duration of visible emissions from each 15 minute observation period in the logbook. Allowable visible emissions shall not exceed Level 1 Emissions, as defined in SSPC Technology Guide No. 6. Observance of emissions at any time may require (at the discretion of the Engineer) that operations cease until the containment is sufficient to prevent emissions.

Method D Conduct EPA Ambient Air Monitoring for Toxic Metals (TSP-Lead) in accordance with 40 CFR 50. Conduct background monitoring for a minimum of 3 days prior to mobilization of equipment and installation of containment materials. Select an analytical laboratory which is approved to perform TSP-Lead analyses through the National Environmental Laboratories Accreditation Program (NELAP). Submit certified analytical results for each sample to the Engineer within 5 days of obtaining the sample. Emissions monitored by this method shall not exceed 1.5 micrograms per cubic meter ($\mu g/m^3$) as a 90 day average as defined in the National Ambient Air Quality Standard (NAAQS) for Lead. Calculations to determine adjusted acceptable allowances based on NAAQS and site specific schedules are detailed in SSPC Technology Guide No. 6 and SSPC Technology Update No. 7.

Method G At a minimum, visually assess the worksite for cleanliness at the beginning end of each work shift. Record each assessment in the logbook noting the location and description of any accumulation of debris. Production work will not continue without approval of site cleanliness.

2) **Lighting**. Provide proper (OSHA Compliant) lighting on all operations (i.e. surface preparation, painting and inspection). Lighting for inspection will meet the criteria described in SSPC Guide 12 (Guide for Illumination of Industrial Painting Projects) for inspection.

3) **Housekeeping**. Collect wastes deposited, paint debris, abrasive materials and any other materials on the containment materials daily. In addition, clean containment materials prior to moving/dismantling. The Project Engineer may direct additional cleaning as conditions warrant.

4) **Access.** The contractor will provide OSHA compliant safe access for all cleaning, painting, and inspections.

B) **Surface Preparation.** Before applying any paint, thoroughly clean and properly prepare all surfaces to be coated, including drains, expansion dam troughs, and other areas subject to build up of rust and debris as required by the contract documents and to the satisfaction of the Engineer. Expect that surface conditions may vary throughout the structure, requiring different cleaning methods to prepare the surfaces for painting. Remove all contaminants that might prevent paint from adhering tightly to the underlying surface.

Pressure wash and tool clean all steel surfaces to be over-coated to requirements specified in the Contract. Obtain the minimum acceptable surface quality immediately before painting that corresponds to the Contract requirements. Do not apply paint until the Engineer inspects and accepts the cleaned surfaces.

Remove and clean all trash, debris, and other foreign substances from pockets and crevices and from around expansion dams, bearing plates, shoes, etc. Clean the entire surface of the bridge seat on each unit of the structure. Cut and remove all tree limbs or other growth overhanging or fouling the structure.

Proceed with cleaning by sections, bays, or other readily identifiable parts of work. Completely clean each section, bay, or part, and have it inspected and accepted by the Engineer before applying any paint. Provide safe access to the work to allow the Engineer to properly inspect the cleaning and painting.

When traffic or any other source produces an objectionable amount of dust, prevent dust and dirt from coming in contact with the cleaned or freshly painted surfaces. The contractor is solely responsible for any damages arising from the surface preparation operations

1) **Solvent Cleaning.** Prior to using any of the methods of substrate preparation specified herein, remove visible grease and oil from the surface. Clean the surface in accordance with SSPC-SP 1 to remove oil, grease, and any other surface contaminants. Use only solvents or detergents that are acceptable to the paint manufacturer and the Department. Use clean cloths for the final wiping of the cleaned surface. Collect, handle, store, and dispose of all cleaning materials as hazardous waste.

2) Stratified Rust Removal. Remove all stratified rust from all structural steel prior to hand-tool cleaning. Collect all rust debris and dispose of it with the other debris generated by pressure washing.

3) Pressure Washing. Clean all structural steel by pressure washing. Equip spray wands used in pressure washing with 0º spinner nozzles. Equip the pressure washer(s) with calibrated gage(s) and pressure regulators to ascertain and regulate water pressure. Furnish the Engineer with two calibrated gages of the type installed on the pressure washer(s). These gages will be used to measure the water pressure at the wand. Size the pressure washers so that no combination of hose length or pressure washer placement will result in an output pressure not less than 4,500 psi or more than 5,000 psi from any spray wand at any pressure washing location. Wand extensions greater than 36 inches will be subject to Central Office Division of Construction approval.

4) **Wash Water.** Use clean, potable water for pressure washing. Do not use water from streams, ponds, lakes and rivers. At the discretion of the contractor, a non-sudsing, biodegradable detergent may be added to the water to optimize the cleaning operation. If a detergent is used, thoroughly rinse the surface afterward. After the surface is pressure washed and allowed to dry, inspect it for remaining visible dirt. Wipe the dried surface with black and white rags to ascertain cleanliness. Re-clean and rinse as necessary to remove all contaminants on the working surface. On all surfaces not cleaned satisfactorily by pressure washing, employ one or more additional methods including: 1) hand scrubbing using wet rags, 2) solvent cleaning by wiping with solvent-soaked rags, and/or 3) steam cleaning. After using any additional cleaning procedures, pressure wash those areas.

5) **Tool Cleaning.** After pressure washing, perform mechanical surface preparation on all surfaces not possessing clean, adherent paint (e.g. loose rust, loose paint, or mill scale). Clean those surfaces to an SSPC-SP15**,** power

tool cleaning. After tool cleaning and prior to painting, remove all residue, dirt, dust, or similar contaminants from the cleaned surface to the satisfaction of the Engineer..

C) **Paint Application**. Do not paint areas until they have been inspected and approved by the Engineer. Apply paint only to dry surfaces. Allow washed surfaces to dry 24 hours before applying paint. Regardless of the location of painting activities, do not paint during periods of any rainfall.

When necessary or requested by the Engineer, furnish a technical representative from the paint manufacturer to observe the initial application of all paints used, to advise as to proper application techniques, and to determine that proper results are being obtained. Ensure that the technical representative is also available to visit the project at all times during the work if the Engineer requests or deems a visit is necessary.

Spread the paint smoothly and uniformly, and work it into all corners and crevices without allowing excess paint to collect at any point. When the Engineer determines that the Contractor's chosen method of paint application is not satisfactory, the Contractor and the paint manufacturer shall submit remediation and application procedures for review. Apply paint with daubers or other equipment as needed on surfaces inaccessible to brushes. When applying paint with spray equipment, immediately brush the area sprayed as necessary to secure uniform coverage and to eliminate wrinkling, blistering, and air holes.

Paint from the top of the structure toward the bottom, and proceed by sections, bays, or parts of the work, unless the Contract or Engineer directs otherwise. Finish painting each coat on each section, bay, or part of work before applying a succeeding coat to any portion of that section, bay or part. Ensure that each coat is thoroughly dry throughout the full thickness of the coat before applying another coat.

Stripe coating shall be in accordance with SSPC-PA Guide 11 and shall be applied to all coats of paint. Striping of primer applied to bare steel, iron or other metallic substrate, shall be applied after the full primer application (utilizing a contrasting color of approved zinc rich primer). Striping of subsequent coats of paint shall be performed prior to full coat application. All sharp and non-radiused edges, welds, outside corners, bolt heads, threads, nuts, rivet heads, edges and ends of plates, edges and ends of diaphragms, lattice straps, inside corners of box members, seams, crevices, back to back members, pitted steel, other discontinuities and all other locations required by the Engineer, shall be striped on all required coats of the chosen paint system. Striping shall extend a minimum of 1 inch from edges, corners, nuts, bolts, rivets, etc. Any alteration of striping coverage shall require written approval from the Engineer. All manufacture's recommendations shall apply to stripe paint for recoat windows, dry to handle, dry to cure, and any other stated recommendations from the Manufacture's Product Data Sheets (MPDS) for the paint system application.

The stripe coats shall be applied by spray, brush, roller, daubers, and other means and method with approval of the Engineer. If the Contractor's chosen method of applying stripe coat is not producing results acceptable to the Engineer, the Engineer will require the stripe coat application method to be changed.

The application of stripe coats, shall be considered incidental to painting of the bridge and incidental to each individual coat application. Stripe coat

application shall be considered a separate inspection point, within the inspection of each applied coat of a complete paint system.

Conform to the tolerance requirements of Appendix A, Tabulation of Construction tolerances or as the Contract specifies.

Prime Coat - Paint all structural steel with one (1) coat (dry film thickness per manufacturer's product data sheet) of organic zinc rich primer
Stripe Coat Primer as per above
Stripe Coat Intermediate as per above
Intermediate Coat—Paint all structural steel with one (1) full intermediate coat epoxy (dry film thickness per manufacturer's product data sheet)
Stripe Coat Finish as per above
Finish Coat - Paint all structural steel with one (1) full finish coat urethane (dry film thickness per manufacturer's product data sheet)

1) **Thinning.** Do not thin paint unless the Engineer gives written permission. Add only thinners specified or recommended in writing by the manufacturer according to the written recommendations of the manufacturer. Provide the Engineer with the manufacturer's technical data sheets and application instructions for the thinner and its use with the paint.

2) **Mixing.** Thoroughly mix the paint in the original containers. Use a mechanical mixer to mix the paint so the pigment is in uniform suspension. Frequently stir the paint to keep it thoroughly mixed while being applied to keep the pigments in suspension, according to the paint manufacturer's written instructions or as directed.

3) **Marking.** Stencil the county number, bridge number, the month and year of the completion date, and any existing panel number system or panel number system set forth in the contract on the structure at locations determined by the Engineer. Make the legend in letters and numerals at a minimum of 3 inches and maximum 6 inches tall, and use a paint color that contrast with the background.

County Number	**XXX**
Bridge Number	**B00XXX(L, R, or N)**
Completion Date	**XX/20XX**

4) **Spray painting -** Take all steps necessary to preclude damage to public property from paint overspray. Those steps may include changes in the type of containment or cessation of spraying operations. The contractor is solely responsible for any damages arising from the painting operations.

5) **Repair of paint defects -** Paint defects, such as pinholes, cracks, blisters, and runs etc. may be encountered. Repair all defects in new paint to the manufacturer's recommendation and the satisfaction of the Engineer.

D) **Collection, Handling, Storage, Transport and Disposal Of Hazardous, Industrial Wastes And Wash Water.**

Have a "Competent Person for lead abatement" as defined by OSHA 1926.62 on site during any operations which disturb lead.

The Department will provide a site on its property for the Contractor to erect a temporary waste storage facility. Store hazardous waste at that site, in a secured six-foot high chain-link fence enclosure. The enclosure shall be built in accordance with the Standard Drawing No. RFC-001 (current edition) of the Kentucky Department of Highways Standard Drawings Book, with the exception that concrete footers are not required for posts. The fence of the storage area must be firmly attached to metal posts and have a locked gate. The gate must be secured to the fence post by a chain and a lock. Each side of the enclosure is to have appropriate placarding forbidding unauthorized entrance and announcing

that the area is a hazardous waste/lead storage site. Cover the ground where the drums will be stored with a waterproof tarpaulin. The contractor shall maintain the tarpaulin to avoid tears or punctures. The drums will be set on skids that are placed on the tarpaulin. There must be adequate aisle space between the rows of stored drums so that the drums and labels can be inspected at any time.

The storage area is to be maintained/operated to prevent releases. The drum storage enclosure must have a spill clean-up kit. The package must include, but not be limited to shovel, broom, dustpan and absorbent material for solvents. There must be access to communications or alarms whenever authorized personnel are in the storage compound.

The designated area must be secured prior to the onset of operations at the job site.

Maintain the hazardous waste storage facility and return the site to its original state when the work is completed.

Copies of all manifests with the Land Restriction Notice attached will be provided to Project Engineer.

All waste/scrap materials generated during surface preparation are to be considered hazardous. Hazardous materials are to be stored separate from paint debris. All solvents used in cleaning are also to be considered hazardous waste. Store solvent wastes in separate containers (i.e. not with the paint debris). Dispose of industrial wastes such as paint buckets, paint-contaminated rags, rollers, clogged spray hoses and brushes. Store those wastes in appropriate containers, separated from the hazardous wastes, and appropriately labeled, prior to disposal.

All wastes are to be collected and placed in appropriate containers on a daily basis.

The Contractor is solely responsible for the management and the disposal of all hazardous waste generated during the cleaning and painting operations in accordance with the Kentucky Revised Statutes, Chapter 224, Subchapter 46, and the Kentucky Administrative Regulations.

The Kentucky Transportation Cabinet will file a Notification of Hazardous Waste Activity with the Kentucky Division of Waste Management to obtain an EPA Identification Number in accordance with 401 KAR 32:010, Section 3. The Cabinet will provide the Contractor with this EPA ID number to be used in hazardous waste management in compliance with 401 KAR 32:010, Section 3 (1).

The Contractor is responsible for furnishing appropriate U.S. DOT containers that are made or lined with materials which are compatible with the hazardous waste to be stored in accordance with 401 KAR 35:180, Section 3. All hazardous wastes collected at the job site will be placed in those containers for transport to the storage site. The containers will be used and managed at the job site and at the storage site in accordance with 401 KAR 35:180. Prior to the transfer of the containers of hazardous waste from the job site to the storage area, the containers will be correctly sealed, labeled, marked and placarded as defined in the pre-transport requirements of 401 KAR 32:030.

Each container will be labeled “Hazardous Waste” and the date clearly marked when the hazardous waste is *first* added to the container in compliance with 401KAR35:180, Section 4(3). That date marked is the *start date* of the seventy-five (75) day storage period

The generator for the waste under this contract is the Kentucky Transportation Cabinet. All records including the labels on the waste containers

and the manifests are to be completed using the Transportation Cabinet as the generator.

The Department requires that all hazardous waste be removed within seventy-five (75) days of the accumulation start date. The Contractor will select a registered hazardous waste transporter to transport the containers of hazardous waste generated during the painting operations to a permitted hazardous waste treatment, storage or disposal facility. The hazardous waste will be manifested with a Uniform Hazardous Waste Manifest that is to be completed, in entirety, as per the regulations of 401 KAR 32:020 and 401 KAR 32:100. Copies of all manifests will be provided to the project Engineer and the Central Office, Division of Construction. Final pay for the project will not be released until the Department receives the final copies of the manifests that are signed and dated by receiving facility owner or operator.

Failure to remove the hazardous waste within Seventy-Five (75) days will result in a performance penalty of Two Thousand Dollars ($2,000.00) per day per drum that the containers are left in storage. This penalty is in addition to any fines that may be assessed by regulatory agencies other than the Transportation Cabinet.

Store non-hazardous wastes in appropriate containers, separated from the hazardous wastes, and appropriately labeled, prior to disposal.

All waste wash water will be filtered prior to release. Employ geotextile fabric consisting of a polypropylene, non-woven, needle-punched geotextile or equivalent. The fabric will have the following properties:

Grab tensile (ASTM D4632):	100 lbs. or greater
Apparent opening size (ASTM D4751):	0.43 mm(#40 US Sieve)
Permittivity (ASTM D4491):	0.7 - 1.0 sec. or better

Provide written certifications from the geotextile fabric manufacturer(s) that the material furnished complies with the requirements of this specification.

The Department will obtain approval for release of the filtered wash water.

The Department will conduct periodic sampling of the wash water during the project.

614.03.09 ABRASIVE BLAST CLEANING AND PAINTING

A) Containment. Totally enclose all elements to be cleaned and painted during all phases of the work. Use containment that meets the criteria for SSPC Technology Guide No. 6 – Containment Classification Class 2A with an entryway condition E2 (re-sealable).

1. **Air Pressure**. Negative air pressure meeting the requirements for Type H2 will be maintained.
2. **Air Movement**. A minimum air movement in containment is not specified but the contractor will demonstrate that the air movement in the containment will provide the necessary engineering control to comply with OSHA worker safety requirements (i.e., lead standards as required by 29 CFR 1926).
3. **Emissions.** The contractor will provide the necessary apparatus to keep all debris from cleaning and painting operations off the roadways and waterways. The contractor will be required to submit, to the Department for approval prior to starting work, the plan that he will follow in protecting the traveling public and keeping debris off the roadways. The contractor will submit a design for the protection device. Prior to submission, the design must

be reviewed and approved by a Kentucky licensed Professional Engineer. The Department will review the submission for acceptance. Monitor and assess the quantity of emissions from containment using SSPC Technology Guide No. 6, SSPC Technology Update No. 7, and the following requirements for Visible Emissions – General Surveillance (Visible Emission Evaluations for Total Dust – Timing), EPA Ambient Air Monitoring for Toxic Metals (TSP-Lead), and Visual Assessment of Site Cleanliness.

Method A Visible Emissions-General Surveillance: Monitor containment for visible emissions for a minimum of 15 minutes for every 4 hours of surface preparation, including collection of abrasive media and cleaning of containment materials, and paint application operations. Record the duration of visible emissions from each 15 minute observation period in the logbook. Allowable visible emissions shall not exceed Level 1 Emissions, as defined in SSPC Technology Guide No. 6. Observance of emissions at any time may require (at the discretion of the Engineer) that operations cease until the containment is sufficient to prevent emissions.

Method D Conduct EPA Ambient Air Monitoring for Toxic Metals (TSP-Lead) in accordance with 40 CFR 50. Conduct background monitoring for a minimum of 3 days prior to mobilization of equipment and installation of containment materials. Select an analytical laboratory which is approved to perform TSP-Lead analyses through the National Environmental Laboratories Accreditation Program (NELAP). Submit certified analytical results for each sample to the Engineer within 5 days of obtaining the sample. Emissions monitored by this method shall not exceed 1.5 micrograms per cubic meter ($\mu g/m^3$) as a 90 day average as defined in the National Ambient Air Quality Standard (NAAQS) for Lead. Calculations to determine adjusted acceptable allowances based on NAAQS and site specific schedules are detailed in SSPC Technology Guide No. 6 and SSPC Technology Update No. 7.

Method G At a minimum, visually assess the worksite for cleanliness at the beginning end of each work shift. Record each assessment in the logbook noting the location and description of any accumulation of debris. Production work will not continue without approval of site cleanliness.

4. **Lighting.** Provide proper (OSHA Compliant) lighting on all operations (i.e. surface preparation, painting and inspection). Lighting for inspection will meet the criteria described in SSPC Guide 12 (Guide for Illumination of Industrial Painting Projects) for inspection.
5. **Housekeeping.** Collect wastes deposited, paint debris, abrasive materials and any other materials on the containment materials daily. In addition, clean containment materials prior to moving/dismantling. The Project Engineer may direct additional cleaning as conditions warrant.
6. **Access.** The contractor will provide OSHA compliant safe access for all cleaning, painting, and inspections.

B) Surface preparation. Before applying any paint, thoroughly clean and properly prepare all surfaces to be coated, including drains, expansion dam troughs, and other areas subject to build up of rust and debris, as required by the contract documents and to the satisfaction of the Engineer. Expect that surface conditions may vary throughout the structure, requiring different cleaning methods to prepare the surfaces for painting. Remove all contaminants that might prevent paint from adhering tightly to the underlying surface.

Abrasive blast all structural steel and appurtenances to requirements specified in the Contract. Obtain the minimum acceptable surface quality immediately before

painting that corresponds to the Contract requirements. Do not apply paint until the Engineer inspects and accepts the cleaned surfaces.

Remove and clean all trash, debris, and other foreign substances from pockets and crevices and from around expansion dams, bearing plates, shoes, etc. Clean the entire surface of the bridge seat on each unit of the structure. Cut and remove all tree limbs or other growth overhanging or fouling the structure.

Proceed with cleaning by sections, bays, or other readily identifiable parts of work. Completely clean each section, bay, or part, and have it inspected and accepted by the Engineer before applying any paint. Provide safe access to the work to allow the Engineer to properly inspect the cleaning and painting.

When traffic or any other source produces an objectionable amount of dust, prevent dust and dirt from coming in contact with the cleaned or freshly painted surfaces.

1. **Solvent Cleaning**. Prior to using any of the methods of substrate preparation specified herein, remove visible grease and oil from the surface. Clean the surface in accordance with SSPC-SP 1 to remove oil, grease, and any other surface contaminants. Use only solvents or detergents that are acceptable to the paint manufacturer and the Department. Use clean cloths for the final wiping of the cleaned surface. Collect, handle, store, and dispose of all cleaning materials as hazardous waste.
2. **Compressed Air**. When compressed air is used for any work, use only compressed air that is free from oil and/or water. Verify the cleanliness of the compressed air in accordance with ASTM D 4285 (blotter test). Verify the cleanliness of the compressed air at least once per shift per compressor or as directed by the Engineer.
3. **Abrasive media.** Use recyclable steel grit abrasive media that conforms to SSPC AB-2 and AB-3, and will impart an angular profile in accordance with paint's manufacture's recommendations for anchor profile.
4. **Abrasive blast cleaning** - Abrasive blast clean all structural steel to an **SSPC-SP 10/NACE NO. 2** "Near White Blast Cleaning" standard as described in the current SSPC documents. Provide an abrasive sized to produce an anchor profile of 1.5 t 4.5 mils. After blast cleaning, remove all surface imperfections that remain (e.g. sharp fins, sharp edges, weld splatter, burning slag, scabs, slivers, etc.).

C) PAINT APPLICATION. When necessary or requested by the Engineer, furnish a technical representative from the paint manufacturer to observe the initial application of all paints used, to advise as to proper application techniques, and to determine that proper results are being obtained. Ensure that the technical representative is also available to visit the project at all times during the work if the Engineer requests or deems a visit is necessary.

Spread the paint smoothly and uniformly, and work it into all corners and crevices without allowing excess paint to collect at any point. When the Engineer determines that the Contractor's chosen method of paint application is not satisfactory, the Contractor and the paint manufacturer shall submit remediation and application procedures for review. Apply paint with daubers or other means on surfaces inaccessible to brushes. When applying paint with spray equipment, immediately brush the area sprayed as necessary to secure uniform coverage and to eliminate wrinkling, blistering, and air holes.

Paint from the top of the structure toward the bottom, and proceed by sections, bays, or parts of the work, unless the Contract or Engineer directs otherwise. Finish painting each coat on each section, bay, or part of work before applying a succeeding coat to any portion of that section, bay or part. Ensure that each coat is thoroughly dry throughout the full thickness of the coat before applying another coat.

Stripe coating shall be in accordance with SSPC-PA Guide 11 and shall be applied to all coats of paint. Striping of primer applied to bare steel, iron or other metallic substrate, shall be applied after the full primer application (utilizing a contrasting color of approved zinc rich primer). Striping of subsequent coats of paint shall be performed prior to full coat application. All sharp and non-radiused edges, welds, outside corners, bolt heads, threads, nuts, rivet heads, edges and ends of plates, edges and ends of diaphragms, lattice straps, inside corners of box members, seams, crevices, back to back members, pitted steel, other discontinuities and all other locations required by the Engineer, shall be striped on all required coats of the chosen paint system. Striping shall extend a minimum of 1 inch from edges, corners, nuts, bolts, rivets, etc. Any alteration of striping coverage shall require written approval from the Engineer. All manufacture's recommendations shall apply to stripe paint for recoat windows, dry to handle, dry to cure, and any other stated recommendations from the Manufacture's Product Data Sheets (MPDS) for the paint system application.

The stripe coats shall be applied by spray, brush, roller, daubers, and other means and method with approval of the Engineer. If the Contractor's chosen method of applying stripe coat is not producing results acceptable to the Engineer, the Engineer will require the stripe coat application method to be changed.

The application of stripe coats, shall be considered incidental to painting of the bridge and incidental to each individual coat application. Stripe coat application shall be considered a separate inspection point, within the inspection of each applied coat of a complete paint system.

Conform to the tolerance requirements of Appendix A, Tabulation of Construction tolerances or as the Contract specifies.

Do not paint areas until they have been inspected and approved by the Engineer. Apply paint only to dry clean surfaces. Ensure that the appropriate resulting surface condition, as described in the Surface Preparation section, is present at the time of primer application (i.e. re-treat if rust-back occurs). Apply a Class I (Type I or II) or Class II (Type I or II) paint system from the List of Approved Materials and consisting of:

Prime Coat - Paint all structural steel with one (1) coat (dry film thickness per manufacturer's product data sheet) of organic zinc rich primer

Stripe Coat Primer as per above

Stripe Coat Intermediate as per above

Intermediate Coat—Paint all structural steel with one (1) full intermediate coat epoxy (dry film thickness per manufacturer's product data sheet)

Stripe Coat Finish as per above

Finish Coat - Paint all structural steel with one (1) full finish coat urethane (dry film thickness per manufacturer's product data sheet)

1) **Thinning.** Do not thin paint unless the Engineer gives written permission. Add only thinners specified or recommended in writing by the manufacturer according to the written recommendations of the manufacturer. Provide the Engineer with the manufacturer's technical data sheets and application instructions for the thinner and its use with the paint.
2) **Mixing.** Thoroughly mix the paint in the original containers. Use a mechanical mixer to mix the paint so the pigment is in uniform suspension. Frequently stir the paint to keep it thoroughly mixed while being applied to keep the pigments in suspension, according to the paint manufacturer's written instructions or as directed.

3) **Marking.** Stencil the county number, bridge number, the month, and year of the completion date, and any existing panel number system or panel number system set forth in the contract shall be stenciled on the structure at location determined by the Engineer. Make the legend in letters and numerals at a minimum of 3 inches and maximum 6 inches tall, and use a paint color that contrast with the background.

County Number	**###**
Bridge Number	**B0XXXX(L, R, or N)**
Completion Date	**MM/YYYY**

4) **Spray painting -** Take all steps necessary to preclude damage to public property from paint overspray. Those steps may include changes in the type of containment or cessation of spraying operations. The contractor is solely responsible for any damages arising from the painting operations.

5) **Repair of paint defects -** Paint defects, such as pinholes, cracks, blisters, and runs etc. may be encountered. Repair all defects in new paint to the manufacturers recommendation and the satisfaction of the Engineer

D) WASTE MANAGEMENT and RECYCLABLE SURFACE PREPARATION RESIDUE MANAGEMENT. All wastes shall be collected and placed in appropriate containers on a daily basis.

Have a "Competent Person for lead abatement" as defined by OSHA 1926.62 on site during any operations which disturb lead.

1) **Industrial waste.** Dispose of industrial wastes (non-hazardous wastes) such as paint buckets, paint-contaminated rags, rollers, clogged spray hoses and brushes. Store industrial waste in appropriate containers, and appropriately labeled, prior to disposal. Industrial waste containers not covered or designed to prohibit entry of water, must be included in and comply with Ground Water and Surface water Protection requirements conforming to 614.03.06.

2) **Hazardous Waste.** Hazardous materials shall be stored separate from paint debris. All non-reusable solvents used in cleaning shall be considered hazardous waste. Store solvent wastes in separate containers (i.e. not with the paint debris).

   a. The Department will provide a site on its property for the Contractor to erect a temporary storage facility. Store surface preparation debris and hazardous wastes at that site, in a secured six-foot high chain-link fence enclosure. The enclosure shall be built in accordance with Standard Drawing No. RFC-001 (current edition) of the Kentucky Department of Highways Standard Drawings Book, with the exception that concrete is not required for installation of posts. The fence of the storage area must be firmly attached to metal posts and have a locked gate. The gate shall be secured to the fence post by a chain and a lock. Each side of the enclosure shall have appropriate placards forbidding unauthorized entrance and announcing that the area is a storage site for lead and hazardous wastes. Cover the ground where the containers will be stored with a waterproof tarpaulin. The contractor shall maintain the tarpaulin to avoid tears or punctures. Drums shall be set on skids that are placed on the tarpaulin. There shall be an adequate aisle space between the rows of stored drums so that the drums and labels can be inspected at any time. Areas around roll off containers shall be covered with tarpaulins. Tarpaulins shall be cleaned daily to remove collected lead bearing debris. The storage area shall be maintained / operated to prevent releases. The storage area shall have a spill clean-up kit. The kit shall include, but not be limited to shovel, broom, dustpan and absorbent material for solvents. There shall be access to

communications or alarms whenever authorized personnel are in the storage compound.

The designated temporary storage facility shall be constructed and accepted by the Engineer prior to the onset of operations at the job site. The temporary storage facility shall be maintained during the active cleaning and painting of the bridge and return the site to its original state when the work is completed.

3) **Responsibility.** The Contractor shall be solely responsible for the management and the disposal of all hazardous waste generated during the cleaning and painting operations in accordance with the Kentucky Revised Statutes, Chapter 224, Subchapter 46, and the Kentucky Administrative Regulations promulgated pursuant thereto.

The Kentucky Transportation Cabinet will file a Notification of Hazardous Waste Activity with the Kentucky Division of Waste Management to obtain an EPA Identification Number in accordance with 401 KAR 32:010, Section 3. The Cabinet will provide the Contractor with this EPA ID number to be used in hazardous waste management in compliance with 401 KAR 32:010, Section 3 (1).

The Contractor shall be responsible for furnishing appropriate U.S. DOT containers that are made or lined with materials which are compatible with the hazardous waste to be stored in accordance with 401 KAR 35:180, Section 3. All hazardous wastes collected at the job site shall be placed in those containers for transport to the storage site. The containers shall be used and managed at the job site and at the storage site in accordance with 401 KAR 35:180. Prior to the transfer of the containers of hazardous waste from the job site to the storage area, the containers shall be correctly sealed, labeled, marked and placarded as defined in the pre-transport requirements of 401 KAR 32:030.

Each container shall be labeled “Hazardous Waste” and the date clearly marked when the hazardous waste is first added to the container in compliance with 401KAR 35:180, Section 4(3). That date marked is the start date of the seventy-five (75) day storage period

The generator for the waste under this contract is the Kentucky Transportation Cabinet. All records including the labels on the waste containers and the manifests shall be completed using the Transportation Cabinet as the generator.

The Department requires that all hazardous waste shall be removed within seventy-five (75) days of the accumulation start date. The Contractor shall select a registered hazardous waste transporter to transport the containers of hazardous waste generated during the painting operations to a permitted hazardous waste treatment, storage or disposal facility. The hazardous waste must be manifested with a Uniform Hazardous Waste Manifest that is to be completed, in entirety, as per the regulations of 401 KAR 32:020 and 401 KAR 32:100. Copies of all manifests with the Land Disposal Restriction Notice must be provided to the Project Manager and the Central Office, Division of Construction. Final partial payment of 15% for the project will not be released until the Department receives all copies of the manifests.

Failure to remove the hazardous waste within Seventy-Five (75) days shall result in a performance penalty of Two Thousand Dollars ($2,000.00) per drum per day or Eight Thousand Dollars ($8,000.00) per cubic yard per day that the containers are left in storage. This penalty is in addition to any fines that may be assessed by regulatory agencies other than the Transportation Cabinet.

4) **RECYCLABLE SURFACE PREPARATION RESIDUE MANAGEMENT.** The surface preparation debris generated at structural steel bridges shall be transported and recycled as a commercial substitute material in a recycling effort. All waste/debris collection, handling, storage, transportation, and disposal shall be the responsibility of the contractor.

A "Competent Person for lead abatement" as defined by OSHA 1926.62 shall be on site during any operations which disturb lead. The "competent person" shall have successfully completed the **SSPC C3 "**Supervisor/Competent Person Training for De-leading of Industrial Structures" or equivalent training.

All surface preparation debris shall be collected separate from waste materials and placed in appropriate containers on a daily basis.

Surface preparation debris shall be separated from all wastes. While on-site, the surface preparation debris shall be managed as lead containing material. Precautions shall be taken to protect employees and the public from exposure to lead. Handling and storage of surface preparation debris shall be accomplished to prevent releases to the environment.

The Department will provide a site on its property for the Contractor to erect a temporary storage facility. Store surface preparation debris and hazardous wastes at that site, in a secured six-foot high chain-link fence enclosure. The enclosure shall be built in accordance with Standard Drawing No. RFC-001 (current edition) of the Kentucky Department of Highways Standard Drawings Book, with the exception that concrete is not required for installation of posts. The fence of the storage area shall be firmly attached to metal posts and have a locked gate. The gate shall be secured to the fence post by a chain and a lock. Each side of the enclosure shall have appropriate placards forbidding unauthorized entrance and announcing that the area is a storage site for lead and hazardous wastes. The ground where the containers will be stored shall be covered with a waterproof tarpaulin. The contractor shall maintain the tarpaulin to avoid tears or punctures. Drums shall be set on skids that are placed on the tarpaulin. There shall be an adequate aisle space between the rows of stored drums so that the drums and labels can be inspected at any time. Areas around roll off containers shall be covered with tarpaulins. Tarpaulins shall be cleaned daily to remove collected lead bearing debris. The storage area shall be maintained / operated to prevent releases. The storage area shall have a spill clean-up kit. The kit shall include, but not be limited to shovel, broom, dustpan and absorbent material for solvents. There shall be access to communications or alarms whenever authorized personnel are in the storage compound.

The designated temporary storage facility shall be constructed and accepted by the Engineer prior to the onset of operations at the job site. The temporary storage facility shall be maintained during the active cleaning and painting of the bridge and return the site to its original state when the work is completed.

The Contractor shall be solely responsible for the management and the disposal of all surface preparation debris and hazardous waste generated during the cleaning and painting operations. Hazardous wastes shall be managed in accordance with the Kentucky Revised Statutes, Chapter 224, Subchapter 46, and the Kentucky Administrative Regulations.

The Contractor shall be responsible for furnishing appropriate U.S. DOT-specified containers that are made or lined with materials that are compatible with the surface preparation debris per 49CFR173.213 (non-bulk containers) or 49CFR173.240 (bulk containers). All surface preparation debris collected at the job site shall be placed in those containers for transport to the storage site. Prior to the transfer of the containers of surface preparation debris from the job site to the storage area, the containers shall be correctly sealed, labeled, marked and placarded as defined in the pre-transport requirements of 49CFR172.301 (non-bulk containers) or 49CFR172.302 (bulk containers). The Contractor shall check with the recycler and the transporter to insure that containers acceptable to both parties are employed.

The Contractor shall be responsible for the quality of the surface preparation debris placed in disposal containers. Under NO circumstances shall the debris become wet or be co-mingled with miscellaneous wastes.

5) **Transportation and recycling.** All surface preparation debris shall be transported for recycling within 90 days of initial container filling operations. The contractor shall contact the recycler to arrange for the delivery of the surface preparation debris. Current approved recycler information can be found on the Transportation Cabinet website at https://transportation.ky.gov/Construction/Pages/default.aspx. The contractor will complete the Supplier Profile Form and provide copies of it to both the approved lead recycler and the Engineer prior to transporting the surface preparation debris.

The contractor shall select a registered hazardous material (HAZMAT) transporter for transportation of the surface preparation debris. The contractor shall provide the necessary waste storage/transportation containers. The contractor shall arrange for the pick-up of the containers and delivery to the recycler.

The contractor shall be responsible for the condition of the surface preparation debris provided to the recycler. Surface preparation debris that is wet debris or that is co- mingled with other waste will be rejected by the recycler. If that occurs, the contractor must dispose of the debris as a hazardous waste. The contractor must promptly inform the Engineer in that event so that KYTC can obtain the proper permitting from the Kentucky Environmental and Public Protection Cabinet. Additionally, the contractor shall be responsible for all transportation costs, hazardous waste disposal costs and fines that are incurred.

The contractor shall supply the Engineer with all weight tickets for the commercial substitute material transported and delivered to the recycler and all Certificates of Recycling issued by the recycler for material deliveries related to this project. Final partial payment of 15% for the project shall not be released until the Engineer has received these documents.

614.03.10 Quality Control.

A) General. The contractor will provide QC inspectors to monitor all work, insure that all work is completed in accordance with the Special Notes and Standard Specifications, and record inspection results. All QC inspectors will possess at a minimum one of the following certifications: SSPC-BCI level 1 or NACE CIP level 1. The QC inspector(s) may not perform production work that requires QC/QA inspection. The Department's (QA) inspector will conduct in-progress reviews of the Contractor's operations and perform follow-up quality assurance (QA) inspections after the QC inspector has certified that a portion of work is complete.

B) **Progress of Work -** Work shall proceed by sections, bays or other readily identifiable parts of the structure. All work will proceed from top to bottom of the structure. The work will be broken down into adjacent sections (control areas) separated by bulkheads. Bulkheads will be sealed to the containment and meet all SSPC Guide 6 – Containment Classification Class 2W/2A requirements. Only one phase of work will be permitted in a given control area at any time.

In any control area, Quality Control Point inspection and approval must precede the start of succeeding phases of work. Quality Control Points are progress milestones that occur when one phase of work is complete and ready for inspection prior to continuing with the next operational step. At those points, the Contractor will provide the Departments QA inspectors with OSHA compliant access to inspect all pertinent surfaces. If QA inspection indicates a deficiency, that phase of the work shall be corrected and re-inspected prior to beginning the next phase of work.

Quality Control Point/Hold Point		**QC/QA Inspection Function**
1. Surface Preparation		
A.	Solvent Cleaning	Visual Inspection, tactile inspection, blacklight as needed
B.	Pack/Stratified Rust Removal	Visual Inspection, scraper test, impact test
C.	Water Wash and tool work	Visual Inspection for cleanliness to meet standard, black and white rag test
D.	Abrasive Blast Cleaning	Visual Inspection for cleanliness to meet standard, measure anchor profile
2. Primer Coat Application		
A.	Full Prime Coat	Visual inspection for paint defects, measure dry film thickness, (destructive testing for over-coat project) Tooke gage, PA 2
B.	Primer Stripe Coat	Visual Inspection
3. Intermediate Coat Application		
A.	Intermediate Stripe Coat	Visual Inspection
B.	Full Intermediate Coat	Visual inspection for paint defects, measure dry film thickness, (destructive testing for over-coat project) Tooke gage, PA 2
4. Finish Coat Application		
A.	Finish Stripe Coat	Visual Inspection

B.	Full Finish Coat	Visual inspection for paint defects, measure dry film thickness, (destructive testing for over-coat project) Tooke gage, PA 2

For each structure three anchor profile measurements per blaster per shift will be taken for the first 5,000 ft^2 of production. After 5,000 ft^2 of surface preparation have been completed and accepted by the Engineer, one anchor profile measurement per 5,000 ft^2 area or portion of an area will be taken. The Engineer may request additional measurements at any time.

The QC Inspector will inspect prepared surfaces to determine whether those conform to the specification conforming to 614.03.08 C and 614.03.09 C. Paint application will be inspected using KM64-258-05 (Procedure A), mechanical, and a visual inspection for any paint defects. The Engineer may request additional tests, including destructive DFT tests, at additional sites or he may elect to perform additional tests. Repair of the destructive testing is the contractor's responsibility and is incidental.

The QC inspector will maintain a handwritten record of all-painting activities, operations and inspections in the log book(s). At a minimum, the following information must be recorded:

1. All paint inventory and approval information,
2. Daily records of ambient conditions (including all measurements taken),
3. Daily progress of work information including start-up/shut-down times, bridge locations by control numbers, structural steel components by proper terminology and pertinent operations by control points, and
4. QC inspection information including evaluations at control points, rework comments, or approvals.

Make entries on consecutive pages of the logbook (in indelible ink) and make corrections by marking through mistakes with a single line. Do not remove pages or erase or obliterate entries in the logbook.

The QC inspector and QA inspector will jointly assign adjacent control areas consecutive numbers and a short description defining their location. After completion of a phase of work in a control area, the QC inspector will perform an inspection and will determine whether the area has been satisfactorily prepared. If work in a control area is unsatisfactory, the QC inspector will require the contractor to make the necessary corrections. That process will be repeated as necessary until suitable corrections have been made. Maintain all logbooks at the job site at all times during the project. Make those available, upon request, to the Department's representatives. At the end of the project, submit all such logs to the Engineer for his review and records.

C) **Test Patch** - Prior to initiation of painting, prepare at least one test patch to serve as a standard for reference during the balance of the painting operations. Locate the test patch at an accessible area incorporating surface types of the project. Use the specified surface preparation on a surface with at least 20 ft^2 per application method per paint plus 20 ft^2 for surface preparation.

When Central office personnel, the Engineer, QC inspector, and the QA inspector, agree that the appropriate level of cleanliness and surface preparation have been achieved, the contractor will apply a clear sealer, supplied by the paints manufacturer, to at least 20 ft^2 of the prepared surface. The contractor will then apply paint to the remainder (at least 20-ft^2) of the test patch. Set aside the test patch area as a standard for proper application and appearance. Do not paint the reference areas until the balance of the project is completed. After the project is complete, re-blast the area of the test patch with clear sealer, and apply all specified paints. Apply all paints, including the clear sealer, in the presence of Central Office personnel, District Office personnel, the Engineer, the QA inspector, QC inspector, and a technical representative of the paint manufacturer. If QC and QA inspectors agree, clear coat preservation of the test patch may be replaced with pictorial records.

614.04 MEASUREMENT. The Department will measure the quantity as a lump sum unit. The Department will not measure necessary cleaning and painting; and furnishing all materials, equipment, tools, tackles, and scaffolding for separate payment but will consider them incidental to this item of work. The Department will consider having the manufacturer's technical representative present incidental to this item of work.

614.05 PAYMENT. The Department will pay for this work at the lump sum Contract price for Clean and Paint Structural Steel, or a designated section of a structure. The Department will base partial payments on Department estimates per section as the work progresses. When the structure is not divided into sections, the Department will consider the entire structure as one section for pay purposes. For purposes of partial payments, the Department will allocate percentages of the lump sum Contract price to the various phases of the work as set out below depending on the number of paint coats specified.

The Department will make payment for the completed and accepted quantity under the following:

Code	Pay Item	Pay Unit
08434	Clean and Paint Structural Steel	Lump Sum[(1)]

[(1)] Two-Coat System. When the specified number of paint coats consists of a prime coat and finish coat, the Department will allocate 25 percent to the satisfactory surface preparation, 30 percent to the acceptable application of the prime coat of paint, 30 percent to the acceptable application of the finish coat of paint, and remaining 15 percent for derigging, touch up of derigging marks and damage, and environmental documentation submittals (bills of lading, certificate of recycle or manifest etc.

[(2)] Three-Coat System. When the specified number of paint coats consists of a prime coat, an intermediate coat, and a finish coat, the Department will allocate 25 percent to the satisfactory surface preparation, 20 percent to the acceptable application of the prime coat, 20 percent to the acceptable application of the intermediate coat, 20 percent to the acceptable application of the finish coat and remaining 15 percent for derigging, touch up of derigging marks and damage, and environmental documentation submittals (bills of lading, certificate of recycle or manifest etc.).

The Department will consider payment as full compensation for all work required under this section.