Section 706. STRUCTURAL CONCRETE CONSTRUCTION

706.01. Description. This work consists of constructing concrete portions of bridges, box, and slab culverts, headwalls, retaining walls, and other structures, and providing and installing electrical grounding systems.

706.02. Materials. Provide materials in accordance with the following:

Provide Grade T concrete for structure concrete placed under water. Unless otherwise required by the contract, provide Grade S2 for other structure concrete.

Provide Grade S2 concrete for substructure concrete.

Provide 6AA natural aggregate and with no greater than 2.50 percent absorption as specified in ASTM C 127 for Grade D superstructure concrete and Grade D superstructure concrete, night casting. Do not use slag aggregate.

Provide AASHTO M 270, Grade 36 steel, galvanized in accordance with section 707, for expansion joint cover plates. Provide plates at least ⅜ inch thick with a static coefficient of friction of at least 0.6. Provide ASTM F 593 (Type 304) stainless steel, ¾-inch diameter, flathead countersunk screws with ¾-inch diameter inserts for use in expansion joint cover plates.

Refer to Section 701, Table 701-1, and the contract for minimum flexural and compressive strengths of concrete.

706.03. Construction.

A. **Equipment.**

1. **Placing Equipment.** Provide equipment with capacity and arrangement for placing concrete in accordance with subsection 706.03.H. Make equipment available to the Engineer for inspection, testing, and approval before use.

   Use a tremie, pump, or other Engineer-approved equipment for placing concrete under water.

   If placing concrete with a tremie, provide a tremie with a capacity of at least 7 cubic feet, with a watertight discharge tube at least 10 inches in diameter. Equip the lower end of the tremie with a valve or suitable device capable of closing tightly while charging and lowering the tremie into position, and opening fully in the lowered position.

   If pumping concrete, provide a pump discharge, pipe, and fittings with an inside diameter of at least 4 inches. Do not use aluminum pipe for conveying or placing concrete.

2. **Bridge Deck Finishing Equipment.** Provide a self-propelled, transverse finishing machine capable of finishing concrete from curb to curb or from curb to bulkhead. Equip bridge deck finishing machines with rotating finishing cylinder(s), auger(s), drag float, and other structural and mechanical equipment to finish the concrete within the required tolerances.

   Provide a machine or supporting frame to transversely span the cast section and travel in the direction of concrete placement. Mount the machine on wheels operated on longitudinal rails capable of carrying the loads between supports with a deflection no greater than 1/16 inch. Use rail sections, straight within ⅛ inch per foot, and rail grades that differ from the required screed grade by no more than 1/16 inch. Install the rail at a height above the surface allowing hand floating under the rails. Mount each rail on adjustable supports that prevent deflection under the machine load.

   Place rail supports over beams. Use portable, lightweight, or wheeled work bridges capable of transversely spanning the cast section to transversely finish machine-finished deck sections.

   Provide a 3-foot, lightweight metal float and a 10-foot, lightweight, rigid straightedge, each equipped with a suitable handle. The Contractor may use truss type vibrating screeds if approved by the Engineer.

3. **Concrete Saws.** Use a self-propelled saw to neatly cut hardened concrete to the line and depth required.

4. **Texturing Equipment.** Use texturing equipment to produce uniform transverse grooves of the required width, depth, and spacing.

5. **Equipment for Applying Penetrating Water Repellent Material.** Apply penetrating water repellent material with low pressure, 15 psi to 40 psi, airless-type spray equipment or with long-nap rollers.

6. **Equipment Approval.** Obtain the Engineer's approval for all equipment and tools for placing and finishing of concrete before starting work including, but not limited to, pumping equipment, air compressors, vibrators, joint sealing equipment, straightedges, and finishing tools.

B. **False Decking.** Construct false decking to the limits shown on the plans.

Construct false decking capable of supporting all material and debris falling from the deck. Abut false decking pieces to prevent material or debris from falling through. Use a false decking system that does not damage beams and meets the approval of the Engineer.

Install false decking after erecting structural steel or precast concrete beams, or before beginning deck removal, repair, or other bridge construction activities. Do not construct false decking systems over traffic that project below beam bottom flanges. Maintain false decking to prevent hazards to vehicular, pedestrian, or waterway traffic. Remove material or debris on the flooring outside the fascia at least once per day. Leave false decking in place until completion of construction activity, as directed by the Engineer.

For bridges over waterways, the Contractor may use a barge in the waterway in place of constructing a false decking system over the waterway. Position the barge in the waterway after erecting the structural steel or precast concrete beams, or before beginning deck removal, deck repair, or bridge construction activities. Maintain the barge to prevent hazards or impediments to waterway traffic. Provide a barge large enough to support material and debris falling from the deck. Leave the barge in place until completion of the bridge construction, as directed by the Engineer. If the Engineer determines the barge is ineffective in preventing falling material and debris from entering the waterway, replace it with a conventional false decking system at no additional cost to the Department.

C. **Falsework.** Design, construct, place, and remove temporary supports required for constructing the permanent structure. Weld form supports in accordance with subsection 707.03.D.8.

Submit working drawings and design calculations for falsework in accordance with subsection 104.02. The Engineer will review the falsework and forms before concrete placement. The Engineer's review does not relieve the Contractor of responsibility for the design.

Correct settlement in the falsework during loading.

D. **Forming.**

1. **General.** Construct forms true to the lines shown on the plans. Construct mortar-tight forms with net sections capable of withstanding impacts during placement and of supporting the weight of concrete through curing. Use falsework for forms in accordance with subsection 706.03.C.

2. **Vertical Clearance.** The Department defines minimum under-clearance as the minimum vertical distance from any point on the pavement, including 24 inches either side of the pavement, to the structure.

   Maintain form work above the bottom of beams. If form work must extend below the bottom of beams, obtain the Engineer's approval. Provide and place advance-warning signs at locations directed by the Engineer before changing the existing structure under-clearance. Provide 10 working days for the Engineer to determine the locations for the advance warning signs.

3. **Removable Forms.** The Department designates surfaces formed with removable forming material as Type A, or Type B.

   a. **Type A Surface.** Type A surfaces are exposed surfaces of piers, abutments, wing walls, retaining walls; and the outside faces of girders, T-beams, slabs, columns, brackets, curbs, headwalls, barriers, railings, arch rings, spandrel walls, and parapets.

      Use metal forms or 5-ply structural grade western fir plywood for face forming material. If the grain of three plies of the plywood runs perpendicular to the studs, the Engineer will consider the $^{25}/_{32}$ inch thickness to meet 1-inch nominal thickness.

      The Engineer will allow dressed shiplap or square edged lumber, sized four sides, at least ¾ inch thick, covered by form lining, in lieu of structural plywood for form lumber. Provide metal,

composition, or plywood form lining for shiplap or square edged lumber. Provide composition or plywood lining at least ¼ inch thick.

The Engineer will approve the sizing, spacing, and dimensions of metal, composition, or special plywood forms, and allow continued use based on performance.

The Engineer may modify the requirements for pattern and minimum lumber thickness for curved Type A surfaces. Ensure that inside faces of forms for Type A surfaces are free of holes, irregularities, or unevenness.

b. **Type B Surface.** Type B surfaces are formed concrete surfaces that will not be exposed in the finished work; the bottoms of floor slabs and sidewalk; the sides of interior beams and girder; backwalls above the bridge seat; and exposed surfaces not included in Type A surfaces.

Use metal forms or face forming material at least ¾ inch thick for Type B surfaces.

The Contractor may use material allowed for Type A surfaces for Type B surfaces, except square edge lumber for forming horizontal surfaces is prohibited. Form lining is not required for shiplap and square edge lumber.

c. **Type A and B Surfaces.** Do not use forms and face form material with defects for Type A or Type B surfaces.

For Type A surfaces, space studs no greater than 12 inches apart, center-to-center. For Type B surfaces, space studs no greater than 24 inches apart, center-to-center. Provide nominal 2 inch by 6 inch or nominal 4 inch by 4 inch sections, except the Engineer will allow nominal 2 inch by 4 inch studs for pours no greater than 3½ feet in height from the bottom of the pour to the top of the pour. Cap studs with a straight top plate at least the size of the Engineer-approved studs.

Scab all joints in plates 4 feet each way to provide continuity.

Ensure constructed forms remain true to shape. Countersink bolts and rivet heads on the inside face of the forms.

Design clamps, pins, or other connecting devices to hold forms rigidly together and allow removal without damage to the concrete. Do not use metal forms that do not present a smooth

surface or that do not line up properly. Maintain metal forms free of rust, grease, or other material that may discolor concrete.

Scab wales to prevent distortion during concrete placement and curing. Place a row of wales within 6 inches of the bottom of each pour, unless studs extend below the bottom of the pour secured by wales fastened to rods in the previous pour.

d. **Construction.** Brace forms to prevent movement during concrete placement. Do not use mechanical or adhesive methods, which will be exposed in the completed structure, to secure forms to concrete bridge decks or pavements. Finish corners square, without moldings. For exposed concrete faces, saw the form edges at corners square and straight, and place them to form a tight fit. Form chamfered corners with dimensions measured on the sides.

For Type A surfaces, arrange the forms to present a neat geometric pattern of form marks. Do not offset or shift patterns. Construct forms to allow removal without damaging concrete.

If supporting concrete deck forms by welding to structural steel beams, weld in accordance with subsection 707.03.D.8.

e. **Ties and Spreaders.** Do not use wire ties and pipe spreaders.

After removing forms, remove the ends of metal appliances inside the forms to maintain correct alignment. Remove ends to a depth of at least 1 inch from the surface of the concrete without creating an opening greater than 1½ inches in diameter. Remove metal or wooden spreaders, which are separate from form ties, during concrete placement.

f. **Form Surface Treatment.** Treat the inside of forms with a release agent that will not discolor or adversely affect the concrete. Do not allow the release agent to contact steel reinforcement or existing concrete surfaces.

4. **Permanent Metal Deck Forms.**

a. **Materials.** Use ASTM A 653 coating designation G210 steel, except Grade 50, Class 3, to fabricate permanent deck forms and supports. Galvanize fasteners in accordance with AASHTO M 232. Fabricate permanent metal deck forms, supports, and accessories in accordance with section 707.

b. **Design and Fabrication.** Verify superstructure beam dimensions before fabricating permanent metal deck forms.

Select sheet size for permanent metal deck forms as recommended by the manufacturer. Use unit working stresses no greater than 0.725 of the specified yield strength of the steel, or 36,000 psi, whichever is less.

Include construction loads of 50 psf in addition to the dead load of the form, plastic concrete, and steel reinforcement. Consider the full slab thickness shown on the plans, to be above corrugations. If not filling corrugations with styrofoam, account for the weight of the additional concrete, as required.

Design forms, form supports, and attachments to carry construction loads, dead loads, and resultant horizontal loads due to forming of cantilever overhangs. Consider the clear span of the form plus 2 inches, measured parallel to the form flutes. Design forms for a maximum deflection of ¼ inch or $^{1}/_{180}$ of the form span length, whichever is less. Do not use form camber to compensate for deflection greater than the limits specified.

c. **Construction.** Do not use metal forms below longitudinal or transverse open joints, or expansion type joints.

Do not allow form sheets to rest directly on beam flanges. Center each sheet in the bay and ensure a bearing length of at least 1 inch at each end. Attach sheets promptly to avoid hazards that may result from lateral movement or sudden uplift of the forms. Provide safety stops where necessary.

Make attachments using welds, bolts, clips, or other Department-approved methods. Attach sheets using sheet metal screws, or other Department-approved fasteners, from the top side where practical. Bolt and weld attachments in top flange compression areas. Do not flame cut metal deck forms or supports. The Department will not require repair of galvanized areas at welds or unbolted edges after shearing or punching.

Field drill ¼-inch diameter weep holes, at spacing no greater than 12 inches, along transverse and longitudinal construction joints.

Place styrofoam in corrugations and secure to prevent displacement during concrete placement. If styrofoam is omitted, the extra concrete required to fill in the corrugations will not be paid for. Place concrete onto forms from no greater than 15 inches above the top of the form.

E. **Steel Reinforcement.**

1. **Storage and Protection.** Store steel reinforcement on platforms, skids, or other supports. Store steel reinforcement neatly and clearly marked to facilitate inspection. Locate storage sites at water crossing locations above the high water elevation shown on the plans. Store epoxy coated bars on padded wood or steel cribbing, and cover to prevent exposure to ultraviolet rays.

2. **Handling of Epoxy-Coated Reinforcement.** Use systems with padded contact areas for handling coated bars. Pad bundling bands or use other banding to prevent damage to the coating. Lift bundles of coated bars with a strongback, spreader bar, multiple supports, or platform bridges to prevent bar-to-bar abrasion. Do not drop or drag the bars or bundles.

3. **Field Bending.** Do not bend reinforcing bars in the field unless otherwise shown on the plans, or to correct minor errors or omissions in shop bending. Perform field bending cold. Make field bends in accordance with subsection 905.03 for shop bends. Repair damage to epoxy coating, resulting from field bending, in accordance with subsection 706.03.E.8.

4. **Placing and Fastening.** Accurately place and firmly secure steel reinforcement during concrete placement. Ensure steel reinforcement is free of dirt and excessive rust, loose mill scale, or other deleterious material when placed. Ensure bar spacing does not vary more than 1/6 of the spacing shown on the plans, except as needed to allow placing anchor bolts and position dowels. Use wire ties to secure all bar intersections for the top mat, and other mats where the product of the length and width of bar intersection spacing exceeds 120 square inches. If the product of the length and the width of spacing does not exceed 120 square inches, tie alternate intersections. Do not weld.

   Tie bar laps near each end of the lap. Provide a clear distance from the reinforcement to the concrete surface at least equal to the dimensions shown on the plans, but no more than +25 percent of the dimension, except for deck reinforcement. For deck reinforcement, do not vary the distance from the top transverse reinforcement to the bottom of the concrete slab by more than 3/8 inch from the dimensions shown on the plans. Provide concrete clear cover over the top transverse reinforcement at least equal to the dimensions shown on the plans.

Maintain the required reinforcement distances from forms using stays, ties, hangers, bar chairs, or other Department-approved supports, except in bridge superstructures. If bar chairs are used they must be plastic or coated metal with a bearing area that prevents penetration into forming material. Use commercial grade concrete brick only in footings.

For bridge decks, place bar chairs parallel to the beam, spaced with the lines of supports, measured from center to center, at the ¼ point and ¾ point for beam spacing less than 9 feet, and at the 1/6 point, ½ point, and 5/6 point for beam spacing 9 feet or greater.

Use additional bar chairs outside the fascia beam to support reinforcing steel along and near the fascia. On concrete box beam bridges without slab ties, use bar chairs along the longitudinal centerline of each beam. Support the upper layer of reinforcing steel over the supports for the lower layer of steel with rows of Department-approved continuous steel bar supports consisting of at least three longitudinal wires.

Tie the upper layer of reinforcing steel to the structural steel, stud shear developers, or other structural components, at intervals no greater than 5 feet along each beam or girder. Use two loops of 16-gauge tie wire for tie-downs. Tie coated bars with coated tie wire to prevent wire from damaging the coating.

Cover epoxy coated reinforcement in the deck if concrete for the deck is not cast within two months from the time of placing the epoxy-coated reinforcement. Use a cover that will prevent exposure to ultraviolet rays.

5. **Splicing.** Do not splice bars unless otherwise shown on the plans.

6. **Lapping.** Overlap sheets of mesh or bar mat reinforcement at least 24 inches to maintain uniform strengths and fasten in at least two locations at the overlaps.

7. **Cutting Epoxy-Coated Reinforcement.** The Contractor may saw or shear bars when cutting is permitted. Repair cut or sheared bar ends.

8. **Repair of Epoxy Coating.** Repair coating damaged by bending, sawing, shearing, or damaged during shipping, unloading, storage, installation, and handling on the project.

   Patch sawed or sheared ends and visible defects in accordance with AASHTO M 284. Use a patching or repair material selected from the Qualified Products List. Clean areas requiring patching by removing

surface contaminants and damaged coating. Roughen the area requiring patching before applying patching material. Remove rust by dry blast cleaning or power tool cleaning immediately before applying patching material.

Immediately treat bars in accordance with the resin manufacturer's recommendations and before oxidation occurs. Overlap patching material onto the original coating by 2 inches, or as recommended by the manufacturer. Provide at least 8 mils of dry film thickness on the patched areas. The Engineer will consider bars with at least 5 percent damaged area in a 12-inch bar length to be severely damaged. Replace severely damaged bars. Coat mechanical splices after splice installation in accordance with AASHTO M 284 for patching damaged epoxy coating.

F. **Placing Galvanized Metal Pipe Sleeves.** Place galvanized metal pipe sleeves in the bridge to carry utility company facilities across the bridge. The utility company will provide pipe sleeves at the bridge site at no cost to the Contractor. Notify the utility company at least one week before the sleeves are needed. If the contract requires the utility company to install conduit or ducts in the structure, notify the utility company at least one week before the utility company is required to install conduit or ducts. The Department will not allow additional compensation for costs associated with delays caused by utility company operations.

G. **Placing Conduit.** Align the conduit, tightly fit the joints, and firmly secure conduit during concrete placement. Assemble and protect sleeve expansion joints in the superstructure to allow movement after concrete encasement. Place concrete encasement after the Engineer approves the alignment of, and connection to, the conduit. Swab the conduit for the entire length immediately after casting encasement to remove mortar.

H. **Placing Concrete.**

1. **General.** Prepare and test work progress specimens, as necessary, in accordance with subsection 701.03.D.

   Obtain the Engineer’s written approval of forms, bracing, reinforcing steel, and preparations for casting concrete before beginning concrete placement operations. Before placing concrete, clean forms, piling, and reinforcing steel, and remove sawdust, chips, and other debris from the form interior.

   Remove struts, stays, and braces to hold forms in correct shape and alignment when the concrete elevation renders them unnecessary.

Place concrete to avoid material segregation and reinforcement displacement.

Complete each pour in a continuous operation with no interruption longer than 45 minutes, except concrete subfootings. Place and consolidate each layer before initial set of the previous layer.

For concrete subfootings, the Contractor may place a full-depth portion of the subfooting for a substructure unit at one time and complete the unit later.

Do not place additional concrete on substructure concrete until the substructure concrete cures for at least three days or attains at least 70 percent of its 28-day flexural or compressive design strength.

Do not use mechanical attachments to support forms until substructure concrete attains at least 70 percent of its 28-day flexural or compressive design strength. Verify the concrete strength by testing at least two beams or cylinders cured in the same environment as the respective concrete items. Conduct testing on the project site, witnessed by the Engineer.

The Engineer will lower the required concrete strength after reviewing calculations submitted by a Professional Engineer, licensed in the state of Michigan, showing that imposed loads will not exceed 70 percent of the concrete strength at the time the load is applied.

Regulate concrete placement so pressure caused by wet concrete does not exceed the pressure used in designing the forms.

Deposit the concrete in the forms in layers of suitable thickness, as near the final position as possible. In pier caps and wall sections, place layers no greater than 12 inches thick. The Engineer may modify the layer thickness requirements for wall sections depending on the steel reinforcement spacing.

For concrete placed by pumping, dispose of water-cement slurry used to lubricate the discharge pipe outside the forms.

Place and vibrate concrete in the dry for substructure units other than subfootings and tremie seals.

Place subfooting and tremie concrete to the full depth of the section.

Place footing concrete and column concrete in layers no greater than 36 inches.

Do not allow superstructure concrete to freefall more than 6 inches to the top of reinforcing steel. Do not allow concrete to freefall more than 5 feet in other structural applications. If concrete must drop more than 5 feet, deposit concrete through Department-approved pipes or tubes at least 6 inches in diameter and arranged to avoid concrete segregation. If reinforcing bar spacing prevents the use of a 6 inch tube, loosen the bar ties and spread the bars enough to allow the use of the tube or chute. Reposition and retie bars before covering with concrete.

Provide vibrators, approved by the Engineer, capable of visibly affecting the mixture for at least 18 inches from the vibrator.

Use mechanical, high-frequency internal vibrators to consolidate the concrete during and immediately after depositing. If using epoxy coated or other coated reinforcement, use a vibrator with a rubber coated head.

The Engineer will allow concrete consolidation using hand methods if the use of vibratory equipment is not possible.

Use vibrators to consolidate incoming concrete within 15 minutes of placement. Manipulate vibrators to work the concrete around the reinforcement and embedded fixtures, into corners and angles of forms. Vibrate freshly deposited concrete at the deposit point. Thoroughly consolidate the concrete, but do not cause segregation.

Move vibrators to prevent forming localized areas of grout. Uniformly space the points of vibration no greater than twice the radius over the visibly effective vibration area. Do not hold vibrators against forms or reinforcing steel, and do not use them for flowing or spreading concrete. Do not disturb partially hardened concrete.

Do not disturb forms or projecting reinforcement after the initial set of the concrete.

Maintain forms, reinforcing steel, and placing equipment clean and free of hardened concrete. Discharge water used to flush placing equipment away from concrete and forms.

If concreting operations extend into the night, light the work to make operations clearly visible for inspection.

Do not cast sidewalk, curb, or barrier pours until deck concrete attains at least the minimum specified 7-day flexural or compressive strength, and after completion of the 7-day continuous wet cure, unless the wet cure can be maintained during forming and placing of subsequent pours.

Do not place heavy equipment on the deck until deck concrete attains at least the 28-day flexural or compressive design strength, and after completion of the 7-day continuous wet cure.

2. **Hot Weather Limitations.** Cast concrete mixtures for bridge decks when the rate of evaporation at the site is less than 0.20 psf per hour, in accordance with Figure 706-1. Cast structural concrete only when the temperature of the concrete being placed is below 90 °F.

   Supply Engineer-approved equipment for determining the relative humidity and wind velocity on the project.

3. **Placing Concrete Under Water.** Deposit concrete under water if shown on the plans. Use Grade T concrete proportioned in accordance with Table 701-1. Place concrete under water in a compact mass, in the final position, using a tremie or by pumping. Equip the tremie tube so the bottom end closes if concrete does not encase the pipe. Do not use bottom dump buckets. Maintain still water at the point of deposit, and provide tight forms. Do not disturb the concrete after deposit.

   Support the tremie tube to allow free movement of the discharge end over the entire work surface and to allow rapid raising or lowering to adjust the concrete flow. Place the concrete full depth in one continuous operation, starting from one end of the cofferdam. Always keep the tremie tube in the freshly deposited concrete; only withdraw the tremie tube upon completion of each pour, or as required by piling or cofferdam bracing.

   After withdrawing the tremie tube, recharge it with concrete above water, lower it to the new position, and set the discharge end into freshly deposited concrete. During placing operations, maintain the tremie tube full to the bottom of the hopper. After dumping a batch into the hopper, induce the flow of concrete by raising the discharge end of the tube slightly. Do not remove the end from the concrete.

   Remove laitance or other deleterious material without damaging the concrete. Place concrete to at least the elevation of the top of tremie seals, but no more than +6 inches above the seals. Remove excess concrete.

   Dewater cofferdams after the tremie concrete has been placed and has attained at least 50 percent of the 28-day compressive design strength or after test beams cured in water on top of the tremie concrete break with a modulus of rupture of at least 325 psi, as specified in Table 701-1. These strength requirements are in no way

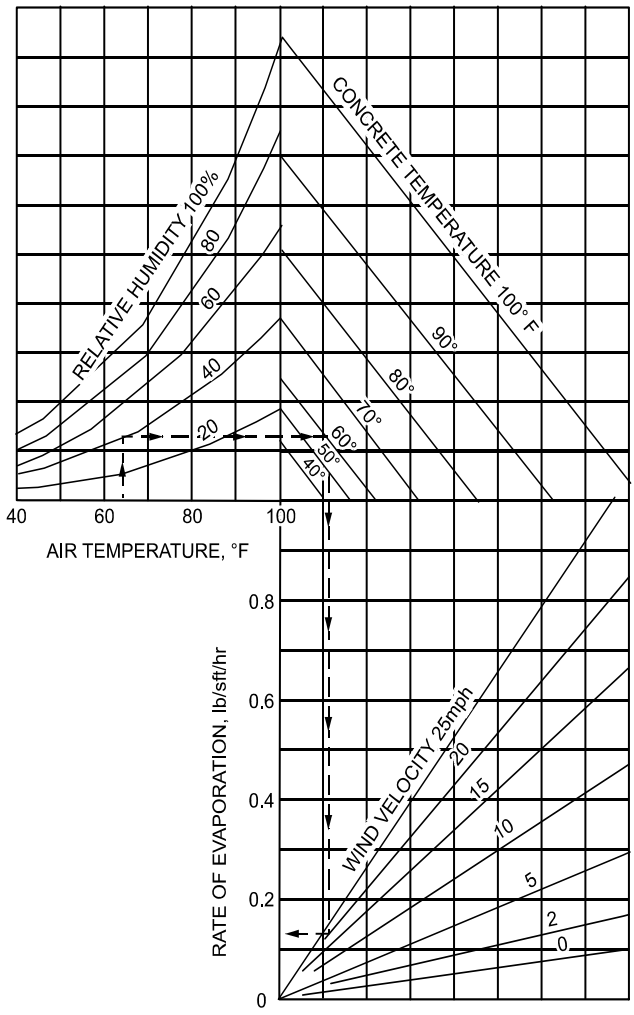

Figure 706-1: Surface Evaporation for Concrete

Estimate the evaporation rate in accordance with the following:

a. Enter the air temperature, measured from 4 feet to 6 feet above the evaporating surface, on the windward side and shielded from the sun;
b. Move up to the line corresponding to the relative humidity;
c. Move right to the line corresponding to the concrete temperature;
d. Move down to the line corresponding to the wind velocity, measured from 18 inches above the evaporating surface;
e. Read the evaporation rate on the scale to the left of this point.

construed as relieving the Contractor of responsibility for failure of any part of the cofferdam.

I. **Nighttime Casting of Superstructure Concrete.**

1. **Construction Methods.** Begin work from one hour after sunset to midnight, or as directed by the Engineer. Use the sunset time published by the National Weather Service for the proposed date of night casting or the time determined by the Engineer. Coordinate nighttime deck pours with the Engineer to allow scheduling of inspection.

   Conform to the deck pouring sequence and curing requirements shown on the plans. If approved by the Engineer, the Contractor may consecutively pour areas shown on the plans for simultaneous pour, the same night, using retarder in the first pour to prevent initial set until completion of the second pour.

2. **Lighting Requirements.** Provide light sources to achieve a minimum average intensity of 10 foot-candles over the entire work area, including the concrete testing area. Submit the deck lighting scheme to the Engineer for approval. Ensure lighting alignment does not interfere with or impede traffic on open roadways. Refer to subsection 812.03.H for additional lighting requirements for night work.

J. **Cold Weather Precautions.** Protect concrete to prevent damage from cold weather. Remove and replace frozen concrete or concrete damaged by cold weather at no additional cost to the Department.

If the National Weather Service forecasts that air temperatures will remain below 50 °F, but above 40 °F, apply ordinary protection requirements to protect concrete.

If the National Weather Service forecasts air temperatures below 40 °F during the curing period, apply low temperature protection requirements to protect concrete.

Cure in accordance with subsection 706.03.N.1, except only one application of interim curing compound is required.

1. **Ordinary Protection.** Ordinary protection consists of using tarpaulins, straw covering, or other Engineer-approved methods to protect concrete. If the prevailing temperatures will produce concrete temperature less than 45 °F, raise the concrete temperature in accordance with subsection 601.03.F.1.

Seal keyways, anchor bolt wells, or other depressions on exposed horizontal surfaces against water intrusion.

If approved by the Engineer, protect footings by completely submerging them under water inside the cofferdam area 2 hours after placement. After submersion, maintain water level necessary to cover the concrete, and keep ice from contacting the concrete.

2. **Low Temperature Protection.** Low temperature protection consists of using insulated forms or heating and housing to protect concrete. Place concrete in the forms at temperatures specified in subsection 601.03.F.1. Maintain concrete at a temperature of at least 40 °F.

   a. **Insulated Forms-Substructure Concrete.** Apply blanket insulation tightly against the forms and fasten securely. Insulate corners and edges. If depositing concrete against previously cast concrete, extend the blanket insulation at least 14 inches and hold in place against the previously cast concrete. Patch or cover tears and holes in the blanket.

   Cut polystyrene insulation to fit snugly between wood form studs and fasten securely. For steel forms, fit the insulation boards between the ribs and hold in place with adhesive or Department-approved fasteners.

   Provide insulating blankets or polystyrene insulation with the minimum thickness or the minimum R value specified in Table 706-1.

Table 706-1
Insulation Requirements

Thickness of Pour, (in)	Minimum Insulation Requirements			
	Unlined Steel Forms		Wood-Lined Steel or Wood Forms	
	in	R Value	in	R Value
<12	2	7.0	2	5.25
12 – 24	2	7.0	1.5	5.25
>24	1.5	5.25	1	4.0

Clean ice, snow, and frost from forms when casting concrete. Place substructure concrete when the air temperature is above 35 °F, unless the form interiors, metal surfaces, and adjacent concrete surfaces are preheated to at least 35 °F. Use only gas-fired burners if heating by direct flame. Cast substructure concrete using insulated forms only when the air temperature is above 15 °F, except that the Contractor may cast subfootings, footings, and cast-in-place concrete piles if the air temperature is

above 0 °F. Wrap exposed portions of cast-in-place concrete piles with insulating blankets or protect them with straw.

Cover the top of pours with insulating blankets. Cover inaccessible areas around protruding reinforcing bars with straw. Cover the tops of insulated pours, including the insulation, with tarpaulins or other Department-approved material.

Leave insulated forms in place until the concrete attains at least 50 percent of the 28-day flexural or compressive design strength and for at least five calendar days after final concrete placement in individual units.

Unless otherwise directed by the Engineer, do not loosen forms to lower temperatures. Remove blankets or straw from the tops of footings no earlier than the third day after casting, to allow forming subsequent portions of the unit. Obtain the Engineer's approval before loosening forms or removing the top covering. If the outside air temperature reaches 0 °F or below, or the National Weather Service forecasts air temperatures 0 °F or below for the next 24 hours, do not remove forms for eight days after casting unless otherwise directed by the Engineer, and only if the air temperature is from 0 °F to 32 °F and the temperature difference between the air and the concrete surface is no greater than 30 °F. If possible, remove forms at mid-day.

b. **Insulated Forms-Superstructure Concrete.** If the National Weather Service forecasts air temperatures below 20 °F during the curing period, provide material and heating equipment on the project to protect forms and concrete.

Do not place superstructure concrete if the air temperature is below 40 °F, unless form interiors, metal surfaces, and the adjacent concrete surfaces are preheated to at least 40 °F. Use only gas-fired burners if heating by direct flame. Do not begin placing superstructure concrete if the air temperature is below 35 °F.

Insulating the bottom of deck forms is not required. If the National Weather Service forecasts air temperatures below 40 °F for more than 8 consecutive hours during the curing period, protect the top of the freshly cast concrete as soon as possible to maintain a concrete temperature of at least 40 °F. Use tightly joined insulating blankets or polystyrene insulation and insulate in accordance with Table 706-1.

Hang tarpaulins, or other Department-approved material from the top of the curb to enclose the entire protected section. If the temperature falls below 15 °F during the curing period, circulate heated air under the enclosed superstructure section. Maintain circulation for the remainder of the protection period required for concrete protected by heating and housing.

c. **Heating and Housing.** Before placing concrete in forms, provide housing for concrete sections being placed to maintain the specified temperatures within the enclosure.

Arrange enclosures to allow removal of forms and finishing of concrete surfaces without interrupting heating.

Provide uniform forced air or radiant heat in the enclosure. Vent the heating system to prevent exposure to carbon dioxide exhaust gases during concrete placement and curing. Before placing concrete, preheat reinforcing steel and form surfaces to temperatures from 40 °F to 75 °F.

During and after concrete placement, operate the heating system to maintain an air temperature in the enclosure from 40 °F to 75 °F. Maintain the temperature in the enclosure until concrete attains at least 50 percent of the 28-day flexural or compressive design strength.

At the end of the heating period, decrease the temperature to the outside air temperature at a rate no greater than 15 °F per 12 hours. Allow the concrete surface to dry during the cooling period. Remove the housing.

In case of a heating system failure, provide emergency salamanders for use within 1 hour. Maintain a temperature of at least 40 °F with the salamanders. Place and operate salamanders and provide for moisture, as directed by the Engineer.

K. **Construction and Expansion Joints.** Construct joints in concrete structures where shown on the plans. Clean laitance and other deleterious material from the contact concrete surface in place, and wet surfaces before placing new concrete. Finish face edges of joints to the line and elevation shown on the plans. Finish joint surfaces that provide expansion in the plane of the joint within ⅛ inch of a true plane. Form keys within reasonable tolerances, using suitable material.

1. **Sealer.** Use poured joint sealers of the type required by the contract. Handle hot-poured joint sealer material in accordance with subsection 602.03.S.

2. **Fiber Joint Filler.** Shape premolded expansion joint material to fit adjacent concrete. Hold premolded expansion joint material in place to prevent formation of concrete fins under or between expansion joint material.

3. **Joint Seals.** For concrete, install seals as shown on the plans.

   a. **Sawing Construction Joints.** Saw the joint groove at each transverse construction joint, as shown on the plans. Provide a joint groove symmetrical about the construction joint.

   b. **Sawing Expansion Joints.** Saw expansion joints as shown on the plans, and symmetrical about the filler centerline.

      Extend the depth of the saw cut below the top of the filler.

      Saw or form vertical sections of the joint in the curb or sidewalk.

   c. **Cleaning After Sawing.** Immediately after sawing, remove deleterious material from sawed joints.

   d. **Patching Transverse Joints.** Patch transverse joints in accordance with subsection 602.03.P.

   e. **Installing Seals.** Install the top of the seal ¼ inch below the surface of the deck.

4. **Expansion Joint Devices.** Select joint devices for each location, from the options shown in the contract, and inform the Engineer of selection. The Engineer will provide standard shop drawings of the joint device. The Contractor must determine the necessary dimensions. The Engineer will not review the dimensions.

   Install expansion joint devices as shown on the plans and the standard shop drawings. Install the joint seal in one continuous piece for the length of the joint, as specified by the manufacturer.

   Weld in accordance with subsection 707.03.D.8.b through subsection 707.03.D.8.d.

5. **Expansion Joint Device Covers.** Install plate covers as shown on the plans. Cast curbs and sidewalks with sliding plates in place to ensure proper alignment of inserts and screws. Apply bond breaker to sliding plates before installation. Form concrete recess areas in sidewalks to receive sliding plates and grind to provide smooth surface. Tool or grind concrete edges to a ¼-inch radius.

Apply one coat of epoxy resin adhesive to allow bent sliding plate to move freely without friction. Ensure no adhesive contacts the expansion joint device or gland. Remove foreign particles before installing plates. Install plates to position the anchors on the high side of longitudinal sidewalk grade. Repair damage to galvanized surfaces in accordance with section 716.

L. **Placing Anchor Bolts and Position Dowels in Concrete.** Set anchor bolts and position dowels in concrete using a template during concrete casting or, if shown on the plans, by drilling holes in hardened concrete in accordance with subsection 712.03.J and subsection 712.03.K.

Finish the surface around anchor bolts or position dowels in accordance with subsection 706.03.M.2.

M. **Finishing Plastic Concrete.** Do not over-vibrate or over-finish the completed surface. If approved by the Engineer, apply water to the concrete surface with a fog sprayer to aid finishing. After finishing, texture sidewalks and curbs in a transverse direction with a broom to produce uniform, narrow grooves no greater than ⅛ inch deep. Texture the final deck surface in accordance with subsection 706.03.M.3.

1. **Machine Finishing.** Use a self-propelled transverse finishing machine to strike off and finish concrete surfaces subject to highway traffic. To accommodate the type of finishing machine used, the Engineer may authorize elimination of longitudinal construction joints shown on the plans.

   Immediately before placing concrete, operate the finishing machine over the full length and width of the bridge segment to be placed, and adjacent segments if a pour sequence is required. Perform the test run with the screed adjusted to the finishing position. While operating the finishing machine, check the screed for deflection and adjustment. Measure and record the depth of the reinforcement below the screed, the controlling dimensions of deck reinforcement, and the forms. Make corrections before placing concrete.

   When finishing concrete surfaces, complete screed passes with sufficient concrete material along the leading edge to ensure filling low spots. Leave the surface at the required grade, and free of water and laitance after the final pass of the screed. Remove deleterious material from the gutters, where the Engineer allows final hand finishing.

   As soon as practical, place the work bridge behind the finishing machine.

While concrete remains plastic, test the slab surface for trueness with a 10-foot straightedge, or other Engineer-approved method. Finish the surface to the required grade and cross section.

If conditions warrant and if authorized by the Engineer, the Contractor may use truss type vibrating screeds.

Ensure complete removal of rail supports located in concrete or partial removal so no part remains less than 3 inches below finished concrete, without damaging concrete. Remove supports, fill the resulting holes with concrete, and finish flush with the deck concrete before deck concrete hardens.

2. **Hand Floated Surface Finish.** Provide a floated surface finish on areas not requiring machine finishing, such as bridge seats, sidewalks, areas of bridge decks under sidewalks, and similar surfaces. Finish by striking off the concrete surface with a screed set to the required cross section.

   The Contractor may use vibrating or oscillating screeds, if approved by the Engineer.

   Provide a movable screed on guides set to the required elevation with allowance for camber, if required. After striking-off, finish the surface with a wood or magnesium float.

   Broom finish the concrete surface under elastomeric bearings.

3. **Texturing.** Groove the final deck surface as soon as deck concrete can maintain a texture. Construct grooves perpendicular to the centerline. Form grooves in plastic concrete without causing edges to slump, or surface tearing. End grooving 12 inches to 16 inches from curb or barrier edges. Do not groove within 3 inches to 6 inches of expansion or contraction joints, or the end of the slab. Space grooves on ½-inch centers, ⅛ inch wide, and ⅛ inch deep. Random spacing is permitted if the spacing between grooves remains within the range of ¼ inch to 1 inch.

   The Engineer may require removal and replacement of deck surfaces that are not grooved as required. If the Engineer determines grooves are too shallow, but allows decks to remain in place, regroove after the concrete attains the 28-day flexural or compressive design strength. Use a machine built specifically for grooving pavements, with blades 0.095 inch ±0.003 inch wide, spaced randomly from ¾ inch to 1¼ inch on centers. Orient grooves along the initial grooving, at right angles to the centerline of the

pavement or skewed, no greater than the maximum skew of the bridge. Cut grooves uniformly to ⅛ inch deep.

Remove and dispose of residue from the grooving operations as directed by the Engineer to minimize dust and to prevent debris from entering drainage systems.

4. **Surface Tolerances.** As soon as practical, check surface tolerances. If surfaces do not meet the specified tolerances, grind with a carborundum brick or other Department-approved methods. If grinding to obtain evenness results in an elevation below the limits shown on the plans, the Engineer will direct corrective action.

   Position bridge seats within ⅛ inch of elevations shown on the plans. Finish bridge seats under bearings or masonry plates to an unevenness of no greater than 1/16 inch.

   Cast the tops of concrete subfootings within ½ inch of the elevations shown on the plans, and footings, wingwalls, parapets, slope walls, headers, and other surfaces within ¼ inch the elevations shown on the plans.

   For final deck surfaces, cast decks to within a tolerance of ⅛ inch over 10 feet. Before acceptance, the Engineer will check the deck with a 10-foot straightedge and mark defective areas. Remove or reduce high spots or ridges greater than ⅛ inch, or other defects by rubbing with a carborundum brick and water, or grinding, and re-grooving.

N. **Curing.** Protect steel reinforcement from curing compound overspray. For air temperatures below 40 °F, cure structural concrete in accordance with subsection 706.03.J. For air temperatures of at least 40 °F, cure structural concrete in accordance with subsection 706.03.N.1. Prepare and test work progress specimens, as necessary, in accordance with subsection 701.03.D.

1. **Top Surfaces Exposed in the Completed Structure.**

   a. **Other than Bridge Decks.** Immediately upon completion of concrete finishing operations, spray curing compound uniformly on the concrete surface. Use transparent or white curing compound. Apply white curing compound at a rate of at least 1 gallon of compound per 150 square feet. Apply transparent curing compound in two coats at a rate of at least 1 gallon of compound per 300 square feet for each coat. Apply the second coat when the first coat dries sufficiently to avoid runoff, but no

more than 2 hours after applying the first coat. Do not dilute the curing compound.

b. **Bridge Decks.** Use a two-phase continuous 7-day wet-cure procedure. Before beginning concrete placement operations, demonstrate to the Engineer that curing materials and equipment are on-site and that equipment is in operating condition.

Immediately after the bleed water sheen leaves the textured concrete surface, begin the first phase of the curing procedure by spraying a single coat of curing compound over the surface. Apply the curing compound at a rate of at least 1 gallon per 150 square feet of surface. Do not leave more than 10 feet of textured concrete surface exposed without curing compound.

Prepare clean, contaminant-free burlap by soaking it in clean water for at least 12 hours before beginning concrete placement. Immediately before use, drape or suspend the burlap sheeting vertically to remove excess water that may dilute or damage plastic concrete. Cover concrete surfaces with wet burlap when the curing compound has dried sufficiently to prevent adhesion, and the concrete surface can support it without deformation, but no more than 2 hours after the concrete placement. Do not allow the burlap to dry once it is in place. Do not use Burlene or other products with impervious surfaces.

Install a network of soaker hoses over the wet burlap when the concrete surface can support it without deformation. Use soaker hoses, perforated throughout their lengths within the limits of curing. Use soaker hoses of lengths and capacities capable of applying cure water uniformly and continuously over the entire bridge deck surface without the need to move the hoses periodically. Prevent excessive localized water discharge that may damage concrete surfaces. Use non-perforated hose outside the limits of curing. Demonstrate to the Engineer that soaker hose systems provide uniform and thorough coverage of the deck surface.

Place a layer of transparent or white polyethylene film, at least 4 mils thick, over the deck surface and the soaker hose system. Overlap seams in the polyethylene at least 10 inches. Activate the wet cure system and maintain it to ensure uninterrupted wet curing of the deck surface. Control the water runoff to prevent soil erosion or hazards to traffic. Do not allow curing water runoff to discharge directly into surface waters.

Maintain the wet cure until the concrete attains at least the minimum specified 7-day flexural or compressive strength, and for at least 7 days following concrete placement. Do not remove the wet cure system based on 7-day compressive strengths attained in less than 7 days.

2. **Top Surfaces to Which Succeeding Portions of the Structure Will Be Bonded.** Maintain top surfaces on which succeeding portions of the structure will be placed, including but not limited to, medians, shoulders, sidewalks, barriers parapets, membrane waterproofing, and latex overlays, free of curing compound.

   Cure these surfaces by keeping them continuously wet until the concrete attains at least the minimum specified 7-day flexural or compressive strength, and for at least 7 days following concrete placement. Stop curing during casting of succeeding structure portions. Begin wet curing when the concrete hardens sufficiently to prevent marring or water damage.

3. **All Surfaces Other than Top Surfaces.** Cure surfaces, other than top surfaces, by keeping continuously wet until the concrete attains at least 70 percent of the 28-day flexural or compressive design strength, and for at least 5 days following concrete placement. Alternately, cure concrete by leaving forms or other waterproof devices in place during the curing period, or by applying transparent membrane curing compound for structures.

   Do not use membrane curing compound on surfaces requiring water curing and bonding of additional concrete, or surfaces requiring application of joint waterproofing or protective coatings.

   Clean surfaces of steel dowels, anchors, waterstops, and similar devices of curing compound before encasement.

   For structures, apply transparent membrane curing compound in two coats, each of at least 1 gallon of compound per 300 square feet of surface. Apply the first coat immediately after removing forms. Apply the second coat from 30 minutes to 2 hours after applying the first coat.

   Apply curing compound using a brush, roller, or spray equipment capable of producing a uniform film, without causing the compound to run or sag. Obtain the Engineer's approval for spray equipment before use.

If the method of applying the compound does not produce a uniform film, stop using the curing compound and keep the concrete surface wet for the required curing period.

O. **Removing Falsework and Temporary Supports.** Leave falsework and temporary supports for concrete structures other than railings, in place until the concrete attains at least 70 percent of the specified 28-day flexural or compressive design strength, and for at least 5 days following concrete placement. Prepare and test work progress specimens, as necessary, in accordance with subsection 701.03.D.

Unless otherwise directed by the Engineer, the Contractor may remove falsework for railings after 15 hours.

Remove materials used to construct falsework outside low water limits to at least 6 inches below the finished ground surface. Remove falsework material inside low water limits to the stream bed.

P. **Removing Forms.** Do not remove vertical forms, including bulkheads at construction joints, until at least 15 hours after completion of the pour. Remove forms under slab spans, beams, girders, and brackets in accordance with subsection 706.03.O. If forms are braced against finished work portions subject to movement due to temperature changes, remove restraining falsework or adjust to prevent damage to the new work.

Q. **Placing Beams on Substructure Units.** Do not place beams until substructure concrete attains at least 70 percent of the specified 28-day flexural or compressive design strength. Prepare and test work progress specimens, as necessary, in accordance with subsection 701.03.D.

R. **Finishing Hardened Concrete.**

1. **General.** Remove concrete fins and irregular projections from surfaces, except those that will not be exposed, or those not requiring waterproofing. Clean honeycomb areas, broken corners or edges, cavities produced by form ties, other defects, and holes greater than ¾ inch in diameter and ⅜ inch deep. Keep surfaces saturated with water until pointed and trued with mortar. Mix the mortar using cement and fine aggregate of the proportions used in the concrete grade finished. Use a cement mixture composed of ⅔ of the brand used in the concrete and ⅓ white cement. Use fine aggregate from the same source as used in the concrete. Use workable mortar that has attained initial set. Restore consistency by reworking, but not retempering. Cure mortar patches in accordance with subsection 706.03.N.

2. **Rubbed Surface Finish.** If the plans show a rubbed surface finish, start rubbing as soon as possible after removing forms and completing pointing and truing required in accordance with subsection 706.03.R.1. Immediately before beginning rubbing work, keep the concrete saturated with water for at least 1 hour. Allow time before wetting concrete to allow mortar in pointing of holes and defects to set. Do not damage mortar used in pointing of holes and defects. Rub the surfaces with a medium-coarse carborundum stone. Do not paint or plaster surfaces with neat cement or mortar. Continue rubbing to obtain a uniform surface, including the removal of form marks, projections, and irregularities, and filling of voids. Leave paste produced by this rubbing in place.

   After casting all concrete above the treated surface, obtain the final finish by rubbing with a fine carborundum stone and water. Continue rubbing to produce a smooth surface, uniform in color.

   After completion of final rubbing and the after the surface dries, rub with burlap to remove loose powder. Leave rubbed surfaces free of unsound patches, paste, powder, and marks the Engineer determines objectionable.

S. **Penetrating Water Repellent Treatment.** Select penetrating water repellant from the Qualified Products List. Before applying the material, provide the Engineer with the product data sheets showing manufacturer's recommended surface preparation, application procedure, and temperature range.

Unless adjacent steel surfaces require coating after concrete cleaning, protect them to prevent damage. If damage occurs, repair it according to the contract at no additional cost to the Department.

1. **Application.** Apply penetrating water repellent material in accordance with the manufacturer's recommendations and at the rate specified in the Qualified Products List. Do not dilute or alter penetrating water repellent material.

2. **Limitations.** Cure concrete at least 28 days before treating. Allow concrete to air dry during the final 48 hours of the curing period. Apply penetrating water repellent material to surface dry concrete.

   Apply penetrating water repellent material when the concrete and the air temperature are within the range recommended by the manufacturer, but no cooler than 40 °F.

   Do not spray the water repellent material if wind, rain, or other conditions prevent required application.

T. **Electrical Grounding System.** Ensure licensed electricians, experienced in grounding system installation, complete grounding work. Install a ground at each side of the bridge, at opposite ends.

Weld bonding jumpers across the steel structure at the expansion joints and across the steel fence posts at expansion joints. Install grounding cables down the piers or abutments from the bonding jumpers, fence posts, or steel fence, to the grounding rod. Make connections with exothermic welds. Use the required mold and associated equipment for each connection.

Install bonding jumpers and grounding cables to allow for at least 2 inches of expansion between connections.

Measure ground resistance using the fall of potential method and do not exceed 25 ohms. If a single 8-foot grounding rod does not attain 25 ohms, drive additional 8-foot grounding rods, added to the top of the first rod or driven as a second ground, and connect to the first ground.

U. **Name Plates.** Furnish and install name plates as shown on the plans. Before installation, submit name plates, with the required data imprinted legibly in the surface, to the Engineer for approval.

V. **Wall Drain.** Attach wall drain strips as recommended by the manufacturer. Peel geotextile layers from the core at the lower edge and wrap around the foundation underdrain. Provide additional geotextile sections to completely encapsulate the pipe-strip junction. Shingle lap geotextile to preclude entrance of backfill material.

Hold the top composite strip snug against the wall using mechanical means or a heavy bead of caulk, as approved by the Engineer, until the backfill placement.

Repair damage to composite strips or replace the strip. Ensure delivery and storage of composite strips in ultraviolet resistant wrapping. Protect composite strips from prolonged exposure to sunlight in accordance with the manufacturer's instructions.

706.04. Measurement and Payment.

Pay Item	Pay Unit
False Decking	Square Foot
Reinforcement, Steel	Pound
Reinforcement, Steel, Epoxy Coated	Pound
Reinforcement, Steel, Culv and Headwall	Pound
Conc, Grade __	Cubic Yard
Conc, Grade S2, Subfooting	Cubic Yard
Substructure Conc	Cubic Yard

Superstructure Conc..... Cubic Yard
Superstructure Conc, Night Casting..... Cubic Yard
Water Repellent Treatment, Penetrating.....Square Yard
Expansion Joint Device .....Foot
Expansion Joint Device, Cover Plate .....Foot
Pipe Sleeve, __ inch.....Each
Pipe Sleeve, __ inch, Placed.....Each
Conduit, __ inch.....Foot
Conduit, __ inch, Placed.....Foot
Superstructure Conc, Form, Finish, and Cure
(Structure No.).....Lump Sum
Superstructure Conc, Form, Finish, and Cure,
Night Casting (Structure No.).....Lump Sum
Bridge Ltg, Furn and Rem (Structure No.) .....Lump Sum
Bridge Ltg, Oper and Maintain ..... Cubic Yard
Support, Temp.....Each
Conc, Low Temperature Protection..... Cubic Yard
Elec Grounding System.....Each
Wall Drain ..... Square Foot

A. **Plan Quantities.** Unless otherwise specified, the Engineer will calculate pay quantities for pay items listed in this subsection based on the lines and dimensions shown on the plans. The Engineer will calculate concrete volumes without subtracting the volume of steel reinforcement.

The Engineer will calculate the weight of bars or bar mats, plain or coated, from the theoretical bar weights in accordance with Table 706-2, based on the total calculated weight for the bar sizes and lengths, mesh, or bar mats. The Engineer will not make allowance for the weight of coating.

Table 706-2
Weights for Reinforcing Bars

Bar Size Designation	Weight, (lb/ft)	Diameter, Round Sections, (in)
No. 3	0.376	0.375
No. 4	0.668	0.500
No. 5	1.043	0.625
No. 6	1.502	0.750
No. 7	2.044	0.875
No. 8	2.670	1.000
No. 9	3.400	1.128
No. 10	4.303	1.270
No. 11	5.313	1.410
No. 14	7.65	1.693
No. 18	13.60	2.257

B. **Structure Concrete.** Conduct concrete quality control as specified in section 604 and the contract. The Engineer will conduct quality assurance as specified in section 605 and the contract. The Department will pay for concrete required for this work based on the quality assurance results.

Provide substructure concrete and superstructure concrete for bridge structures. Provide concrete, of the grade required for box and slab culverts, headwalls, retaining walls, tremie seals, and other structures.

The Engineer will measure superstructure concrete for decks based on batch plant tickets with deductions made for material wasted or rejected.

The unit prices for **Substructure Conc**, **Conc, Grade __**, and **Conc, Grade S2, Subfooting**, include the cost of forming, finishing and curing.

If the contract requires casting concrete against steel sheet piling, the Engineer will calculate the concrete volume based on an outline to the mid-point of the corrugations in the sheet piling section.

If casting concrete footings on or against excavated rock, the Engineer will make an allowance in concrete volume for rock overbreak within 6 inches outside and 6 inches below the neat outline of the footing.

The Engineer will measure, and the Department will pay for concrete placed by pumping as concrete placed by other methods. The Department will not adjust the unit price of concrete due to adjustments in aggregate proportions, or an increase in cement to facilitate the use of pumping equipment, or for the water-cement slurry pumped through the discharge pipe at the beginning of a pour.

C. **False Decking.** The Engineer will measure **False Decking** for the total area protected, including beam widths. The unit price for **False Decking** includes the cost of providing, installing, maintaining, moving, and removing false decking material or barges.

D. **Water Repellent Treatment, Penetrating.** The unit price for **Water Repellent Treatment, Penetrating** includes the cost of preparing concrete surfaces and providing and placing water repellent material.

E. **Expansion Joint Device.** The Engineer will determine **Expansion Joint Device** quantities by the joint device length placed within the limits shown on the plans or authorized by the Engineer, including allowance for vertical heights. The unit price for **Expansion Joint Device** includes the cost of providing and placing attaching hardware for the device.

F. **Conduit and Pipe Sleeve.** The unit prices for **Conduit, __ inch** and **Pipe Sleeve __ inch** include the cost of providing and installing conduit or pipe sleeve.

The unit prices for **Conduit, __ inch, Placed**, and **Pipe Sleeve, __ inch, Placed** include the cost of installing conduit or pipe sleeve provided by others.

The Department will not make additional payments to the Contractor for additional work of forming for conduit or ducts.

G. **Superstructure Concrete, Form, Finish, and Cure.** The Engineer will measure **Superstructure Conc, Form, Finish, and Cure** as a unit for each structure.

The unit prices for **Form, Finish, and Cure** pay items include the cost of designing, fabricating, providing, and erecting forms or permanent metal deck forms, and providing and installing Styrofoam.

H. **Bridge Lighting.**

1. **Bridge Lighting, Providing and Removing.** The Engineer will measure **Bridge Ltg, Furn, and Rem** as a unit for each structure. The unit price for **Bridge Ltg, Furn, and Rem** includes the cost of providing, placing, and removing material for nighttime lighting.

2. **Bridge Lighting, Operating and Maintaining.** The Engineer will measure **Bridge Ltg, Oper and Maintain** based on cubic yards of superstructure concrete cast at night. The unit price for **Bridge Ltg, Oper and Maintain** includes the cost of operating and maintaining the lighting system.

I. **Support, Temporary.** The unit price for **Support, Temp** includes the cost of providing, placing, and removing supports.

J. **Low Temperature Protection.** If the contract does not include a separate item for **Conc, Low Temperature Protection**, and the Department orders low temperature protection work due to Department-caused delays, or the Department orders an expedited progress schedule, the Department and the Contractor will agree on a unit price for **Conc, Low Temperature Protection** before beginning protection work.

The Department will pay for **Conc, Low Temperature Protection** based on the concrete quantity actually protected if the quantity did not increase due to the Contractor's failure to perform the work as shown on the progress schedule or due to the Contractor performing more work than shown on the progress schedule.

K. **Providing and Placing Interim Curing Material.** The unit prices for the relevant structural concrete pay items includes the cost of providing and placing interim curing material on bridge deck top surfaces, exposed in the completed structure.

L. **Electrical Grounding System.** The unit price for **Elec Grounding System** includes the cost of providing and installing the complete system to ground the bridge on two sides.

M. **Wall Drain.** The unit price for **Wall Drain** includes the cost of providing and attaching geocomposite and additional geotextile to wrap the foundation underdrain. The Engineer will measure, and the Department will pay for foundation underdrain in accordance with subsection 404.04.

N. **Name Plates.** The cost of providing, fabricating, imprinting, and installing name plates on structures is included in the unit prices for other items of work.

O. **Unstable Foundations.** The Department will pay for special treatment for unstable foundations at the unit price or authorized unit price for the item of work.

P. **Expansion Joint Device, Cover Plate.** The Engineer will determine **Expansion Joint Device, Cover Plate** quantities by the length of cover plate placed within in the limits shown on the plans or authorized by the Engineer.