



## SECTION 703

### CONCRETE MASONRY CONSTRUCTION

**703.1 Description.** This work shall consist of constructing culverts, bridges and other concrete structures as shown on the plans or as directed by the engineer.

**703.2 Material.** All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Bearing Pads for Structures	1038
Concrete Sealer	1053
Concrete Curing Material	1055
Concrete Tinting and Staining Material	1056
Material for Joints	1057

**703.2.1 Concrete Requirements.** All material, proportioning, air-entraining, mixing, slump and transporting of Portland cement concrete shall be in accordance with [Sec 501](#).

**703.2.2 Material Source Changes.** Changes in sources of cement and aggregate will be permitted only with written approval from the engineer. Aggregate of essentially the same characteristics, except as noted in [Sec 1005](#), and cements resulting in concrete of the same color, shall be used in any individual unit of the structure. The superstructure will be considered an individual unit of the structure unless otherwise shown on the plans.

#### 703.3 Construction Requirements.

**703.3.1 Falsework.** Falsework for concrete masonry construction shall be adequate to support and hold the forms true to lines, camber and grades shown on the plans. If requested by the engineer, the contractor shall submit detailed plans for falsework, including the supporting design computations. The engineer's acceptance of the plans will not relieve the contractor of the responsibility for obtaining satisfactory results. The falsework shall be constructed in general accordance with the submitted plans. Falsework and forms for single and multi-span concrete frames and for continuous concrete slab and girder-type bridges shall be provided for the full length of each continuous or monolithic unit and for the full width of the structure before starting concrete placement in that unit. The use of shims or blocking shall be held to a minimum. Jacks shall be placed at approved locations to secure and maintain the required camber. Means shall be provided by the contractor for accurately determining settlement of the falsework while the falsework is being loaded. The contractor shall correct for any settlement of forms or falsework during the concrete placing process.

**703.3.2 Forms.** Forms for concrete shall be built true to the lines and grades specified, and shall be mortar-tight and of sound material adequate to prevent distortion during the placing and curing of concrete. All concrete shall be formed unless otherwise specified. A concrete pad of approved thickness may be used as a form for the unexposed bottom of end bent beams on piles. If required by the engineer, formwork plans shall be submitted by the contractor before formwork is started. If during or after placing the concrete the forms sag or bulge, the affected concrete shall be removed, the forms realigned and new concrete placed. Construction camber to accommodate shrinkage or settlement impairing the strength of the

structure by the reduction of depth will not be permitted. The forms shall be designed for following minimum criteria: a fluid pressure of 150 pounds per cubic foot, and for a live load of 50 pounds per square foot on horizontal surfaces and 30 pounds per square foot on vertical surfaces for impact and vibration.

**703.3.2.1** Face lumber of forms for exposed surfaces of concrete shall have a smooth dressed surface free of loose knots, knotholes and other defects. The spacing of supports and the thickness of face lumber shall be adequate to prevent distortion due to the pressure of the concrete. Form material shall be placed with horizontal joints. Triangular moulding, smooth on three sides and having a 3/4-inch width on each of the two form sides, shall be used to bevel all exposed edges of the structure, except where special bevels are shown on the plans.

**703.3.2.2** Forms reused shall be in good condition.

**703.3.2.3** Design and construction of forms shall permit the removal of the forms without damage to the concrete. Cofferdam braces or struts that will extend through any exposed concrete section will not be permitted. Forms under copings and around offsets may be given a draft of no more than one inch per foot to permit removal without damage to the concrete. For narrow walls where access to the bottoms of the forms is not otherwise obtainable, an opening shall be provided to allow chips, dirt, sawdust or other foreign material to be removed immediately prior to placing concrete.

**703.3.2.4** Form lining will be permitted, and will be required for exposed curved surfaces. Liners other than plywood may be used with approval from the engineer.

**703.3.2.5** Fiber tubes for column forms above the ground line shall have a finish free of gaps or overlaps in the inside ply and shall be coated inside with a waterproofing material that will not stick or bond to, or discolor the concrete surface of the column. Fiber tubes for column forms from 6 inches below the finished ground line down may show seams, shall be waterproofed and need not be removed.

**703.3.2.6** If wood forms are to be used in combination with metal forms, form details shall be submitted for approval if requested by the engineer. Steel panels, or panels with metal frames and wood that leaves permanent impressions or ridges shall not be used, except for concrete box culvert-type structures and other non-exposed areas.

**703.3.2.7** The inside of all forms shall be oiled, except for forms having composition linings. The oil used shall be a light, clear paraffin-based oil or other approved material that will not discolor or damage the exposed concrete surface. The coating shall be applied before placing reinforcing steel.

**703.3.2.8** Ties, spreaders and all metal appliances used inside of forms to hold the forms in correct alignment and location shall be constructed such that after removal of the forms, the metal may be removed to a depth of at least one inch below the surface of the concrete. Metal tie rods used inside the forms where concrete will have an exposed surface shall be of a type that will not produce a cavity at the surface of the concrete greater than 1 1/2 inches in diameter. Bolts and rods used as ties shall not be removed by pulling the bolts and rods through the concrete. Wire ties and pipe spreaders will not be permitted, and metal or wood spreaders, which are separate from form ties, shall be removed as concrete is being placed. A bolt-through method of supporting forms for massive substructure units may be used with approval from the engineer. No form ties shall be embedded in concrete above the roadway surface on bridges, except that coil ties and threaded rods may be permitted through the vertical face of the base and vertically through the top of barrier curbs. Coil ties, and all metal to be embedded in barrier curbs shall be epoxy-coated or galvanized.

**703.3.2.9** Cavities produced by the removal of metal tie rods shall be filled with mortar composed of approximately one part Portland cement to two parts sand or a non-shrinking, non-staining type of mortar. After the cavities are filled, the finished surface shall be left smooth, even and uniform in color and texture with minimal evidence of shrinkage. White cement may be added to the mortar if necessary to obtain the required color. Tie rod cavities in surfaces against which backfill is to be placed shall be filled with mortar or an approved plastic compound in accordance with [Sec 1057](#). Patching of tie rod cavities in the interior surfaces of box girders will not be required.

**703.3.2.10** Fiber tubes for voids shall be properly designed for the use indicated. The outside surface shall be waterproof. Distortion of the tubes shall be prevented. The ends shall be covered with suitably designed mortar-tight caps. If material used for capping tubes expands when moist, preformed joint filler 5/16 inch thick shall be used around the perimeter of the caps to prevent distortion, or another method approved by the engineer.

**703.3.2.11** Steel tubes for voids shall be properly designed for the use indicated. Excessive distortion shall be prevented in handling, storage and placing. The diameter of the tube shall be as shown on the plans with a tolerance of plus zero and minus 3/4 inch. The ends of tubes shall be covered with suitably designed mortar-tight metal end caps.

**703.3.2.12** Tubes for producing voids in concrete slab superstructures shall be accurately located in positions shown on the plans and shall be positively anchored to the joists carrying the floor forms. Anchors and ties shall be designed to leave a minimum of supporting material exposed in the bottom of the finished slab of the completed structure. Details of proposed anchorage and ties for the tubes shall be submitted for approval before work is started on the bridge superstructure. One 3/4-inch diameter weep hole shall be provided near each end of each tube. Weep holes shall be placed in straight lines parallel to bents, and shall extend through the forms and be kept open at all times. Tubes shall be protected from moisture and heat until concrete is placed. Distortion of tubes after placing of concrete shall not increase the tubes' vertical axis by more than 1/2 inch.

**703.3.2.13** Falsework and form removal from under any structural concrete unit shall not be started until the concrete has attained at least the required compressive strength shown. The falsework support of all concrete spans of a continuous or monolithic series shall be first released from the center of all spans, and shall proceed simultaneously from all span centers each way toward adjacent bents. Release shall be in such a manner as to permit the concrete to gradually and uniformly take stresses due to the self weight of the concrete. Compressive strength will be determined by tests conducted in accordance with AASHTO T 22.

Class of Concrete	Compressive Strength, psi, min
B	2750
B-1	3000
B-2	3000

**703.3.2.14** Except in accordance with [Sec 703.3.6](#), forms for vertical surfaces of bridge superstructures shall be removed as soon as the concrete is self-supporting to permit prompt patching of tie holes.

**703.3.2.15** Girders and beams shall not be set on bent cap until the concrete in the bent cap has attained at least the required compressive strength shown in [Sec 703.3.2.13](#).

**703.3.3 Placing Concrete.** Placing concrete in any unit of a structure shall not begin until preparations for placing and finishing are satisfactory to the engineer. Concrete shall be

placed in the form in layers as near final position as practical with minimum handling. Each placement shall be completed in a continuous operation with no interruption in excess of 45 minutes between the placing of contiguous portions of concrete. Where a finishing machine is to be used, the machine shall be moved over the area to be finished immediately prior to placing concrete in any bridge deck pour to facilitate checking reinforcement cover and slab thickness. This checking shall be done in the presence of the engineer and with the screeds in the finishing position. Placing of concrete for bridge decks shall proceed uniformly for the full width of the placement. Once begun, placing of concrete in the superstructure of a continuous or monolithic series of spans shall proceed as rapidly as good construction practice will permit until all concrete in that series is placed. Vibrators having a minimum frequency of 4,500 impulses per minute shall be used to thoroughly consolidate the concrete in the forms and around the reinforcing steel. Sufficient vibrators shall be on hand to ensure continuous placement of the concrete without delay. The vibrators shall not be used for moving concrete nor shall vibrators penetrate or disturb previously placed layers of concrete after initial set. Vibration shall not cause segregation of the material. Reinforcing steel protruding through transverse or longitudinal headers shall not be disturbed until the concrete is at least 24 hours old.

**703.3.3.1** Where placing operations involve dropping the concrete more than 5 feet, the concrete shall be deposited as approved by the engineer to avoid segregation and contamination. Where concrete is placed in the interior of pneumatic caissons, the concrete may be deposited through air locks or other approved devices, and the requirement of dropping the mixture no more than 5 feet may be waived.

**703.3.3.2** Concrete shall be worked under and around the reinforcing steel without displacing the steel. Forms and reinforcing steel above concrete being placed, and placing equipment shall be kept clean and free from coatings of hardened concrete. Water used for flushing the equipment shall be discharged clear of the concrete and forms.

**703.3.3.3** Concrete shall be placed around the tubes forming voids in slab spans using methods to prevent the displacement of the tubes. For tubes having an inside diameter greater than 14 inches, the concrete shall be placed in three layers. The first layer shall extend from the floor forms up to a plane 1/4- tube diameter above the bottom of the tubes and the second layer to 3/4-tube diameter. For tubes 14 inches or smaller, the concrete shall be placed in two layers, with the lower layer extending to the middle of the tube. Each layer shall be vibrated and allowed to settle after placing, before the next succeeding layer is placed. The succeeding layer shall be deposited while the concrete in the layer below is still plastic enough to permit intermixing the two layers by use of a vibrator.

**703.3.3.4** The sequence of placement of concrete for roadway slabs on a continuous series of spans will be shown on the plans, along with the minimum rates of placement required for the basic sequence and for combinations thereof. The basic sequence of placement shall be observed unless it can be demonstrated that the contractor can place and satisfactorily finish combined placements at the required rate. If the contractor wishes to alter the placing sequence or to combine units, the contractor shall submit a written request subject to approval from the engineer.

**703.3.3.5** Concrete for substructure units shall be placed in the dry unless otherwise approved by the engineer. If the supporting material at plan elevation of the bottom of a pile footing is not sufficiently stable to support the concrete, the material shall be stabilized, or the bottom of the footing shall be formed to adequately support the concrete. The stabilizing of material or forming under pile footings will be at the contractor's expense.

**703.3.3.6** Depositing concrete under water will be permitted if provided for in the contract documents or upon written approval from the engineer. The concrete shall be placed by

tremie bottom dump bucket or mechanically applied pressure. The concrete shall be placed in the final position in still water and shall not be vibrated or disturbed after being deposited. Concrete placed under water for seal courses shall be Seal Concrete in accordance with [Sec 501](#).

**703.3.3.7** Conveying, placing and pumping equipment shall have adequate capacity, be suitable for the intended work and shall be operated to produce a continuous stream of uniform concrete. Equipment shall be arranged to prevent transmission of vibration to freshly placed concrete. The system through which the concrete is pumped shall be manufactured such that no aluminum parts will come into contact with the concrete.

**703.3.3.8** At the completion of concrete placement, the last concrete in the pipeline shall not be used.

**703.3.3.9** Concrete used for filling cavities or crevices as directed by the engineer and as required in [Sec 206](#) shall be Class B concrete. This concrete shall be unformed mass concrete placed separately from and prior to the placing of footing concrete.

**703.3.3.10** When a closure pour is specified on the bridge plans, or is necessary for other requirements, the closure pour between slabs poured independently shall be expansive Class B-2 concrete. Unpolished aluminum powder shall be added to the Class B-2 concrete as recommended by the powder manufacturer or as approved by the engineer for controlled expansion. A shrinkage compensating cement may be substituted for the unpolished aluminum powder and cement. If a shrinkage compensating cement is substituted, the type and amount shall be approved by the engineer.

**703.3.3.10.1** Prior to placing the closure pour, the contractor shall release the falsework to allow the initial deflection in the slab extension. The contractor shall obtain approval from the engineer prior to placing the closure pour.

**703.3.3.10.2** The slab area to be in contact with the closure pour shall be sandblasted to remove all foreign matter and shall be cleaned to remove all dirt and loose material. After the slab area has been cleaned and any damaged epoxy coating on the reinforcing bars repaired, an epoxy-bonding compound shall be applied to the slab area to be in contact with the closure pour. The concrete bonding compound and application shall be in accordance with [Sec 623](#).

**703.3.3.10.3** Immediately following application and before the concrete bonding compound has set, the closure pour shall be placed.

**703.3.4 Joints in Concrete Masonry.** Construction and expansion joints in concrete masonry shall be located where shown on the plans, except that in case of an unforeseen contingency, an emergency construction joint may be permitted.

**703.3.4.1** Surfaces of construction joints shall be roughened or scored unless shear keys are shown on the plans. The face edges of all joints shall be carefully finished, and feathered edges shall be avoided. When the placing of concrete is temporarily discontinued, the concrete shall be cleaned of laitance and other objectionable material after becoming firm enough to retain form, and shall be thoroughly wetted before placing new concrete. Contraction joints in floor slabs of truss bridges may be sawed. Waterstops and flashings as shown on the plans shall be continuous if practical. Splices shall be watertight.

**703.3.4.2** Preformed sponge rubber expansion joint material shall be of the dimensions shown on the plans. Splices shall be held to a practical minimum and shall be made by lacing with copper wire or soft-drawn galvanized steel wire. All joint material shall be securely stitched to one face of the concrete with No. 10 gage copper wire or No. 12 gage soft-drawn

galvanized steel wire. Unless joint sealing is specified, the sponge rubber material shall be left exposed for the material's full length with clean and true edges.

**703.3.4.3** Geotextile filter cloth, three feet wide double in thickness, meeting the requirements of [Sec 1011.3.4](#), shall be centered on transverse joints in top slab and sidewalls for both cast-in-place and precast box culverts.

**703.3.5 Concrete Finishes.** Riding surfaces shall be finished true to the alignment, grade, cross section and camber shown on the plans. These surfaces shall be finished by use of an approved mechanical finishing machine. On skewed structures the finishing machine shall be adjusted to finish the surface approximately parallel to the skew if the angle of skew exceeds 45 degrees, or if the angle of the skew exceeds 30 degrees and the placement width divided by the span length equals or exceeds 0.8. Vibratory screeds shall not be used, including those that are a part of the proposed finishing machine.

**703.3.5.1** Machine finishing shall be with an approved self-propelled mechanical finishing machine. The engineer may waive the use of a finishing machine on isolated irregular shaped areas of the bridge surface. The finishing machine shall travel on adjustable rails or guides set to proper grade, and supported outside the limits of the finished riding surface. Where a longitudinal joint is shown on the plans, the finishing machine rails or guides shall be placed as close as practical to the longitudinal joint. The rails shall be supported to limit the full operating load deflection between supports to 1/8 inch or less. The rails shall be placed parallel with the centerline of roadway or the longitudinal axis of the area to be finished. Where supports are located such that fresh concrete must be placed around the supports, the rails or guides shall be furnished in sections of 10 feet or less and placed above the concrete surface. The sections and supports shall be removed and the holes filled with concrete immediately after the final straightedging. The finishing machine shall make sufficient passes to obtain the specified cross section and surface finish. The final pass of the machine shall be of the maximum practical length, and shall be coordinated with the rate of placement. Finishing machine loads will not be permitted on concrete that has not reached a compressive strength of 3200 psi.

**703.3.5.2** Where hand finishing of riding surfaces is permitted, the surface shall be finished to the specified cross section and surface texture .

**703.3.5.3** Sufficient work bridges shall be provided to complete the work in an orderly and continuous manner. Work bridges shall be supported outside the limits of concrete placement.

**703.3.5.4** The riding surface shall be checked with a 10-foot straightedge immediately after the final finishing operation. The straightedge shall be pulled lightly across the surface from one edge of the finished area to the other without interruption. Reaching from outer edges to the center of the finished area will not be permitted. Each transverse pass shall overlap the previously straightedged portion by approximately one-half the length of the straightedge. The straightedge shall not be used to cut or move concrete from its finished position. Any irregularities, bumps or improperly finished areas shall be refinished and the surface again checked by repeating the straightedging operation.

**703.3.5.5** The roadway surface, except within 12 inches of the inside face of the curb, shall be textured as soon as the condition of the concrete will permit. The roadway finishing shall otherwise be in accordance with [Sec 502.4](#). Hand-operated devices producing a satisfactory texture will be permitted. At the contractor's option, a finned float with a single row of fins may be used. The grooves produced by the finned float shall be approximately 1/8 inch wide at 5/8 to 3/4-inch centers and shall be approximately 1/8 inch deep. This operation shall be performed at such a time and in such a manner that the desired texture will be achieved while minimizing displacement of the layer aggregate particles.

**703.3.5.6** As soon as curing has been completed, the riding surface will be thoroughly straightedged by the engineer, and all variations exceeding 1/8 inch in 10 feet will be plainly marked. Areas more than 1/8 inch high shall be removed by an approved device consisting of multiple cutting edges leaving a grooved surface finish comparable to that produced by the broom. The use of a bush hammer or other impact device will not be permitted.

**703.3.5.7** Unless an armored joint is shown on the plans, construction and expansion joints in the roadway surface shall be carefully edged and left free of all mortar and concrete. If shown on the plans, these joints shall be sealed with joint sealing material. Joints shall be dry and cleaned immediately before the joints are sealed. Required joint sealing shall be done prior to surface sealing the bridge deck.

**703.3.5.8** Surface finish for concrete masonry units, other than those specified in [Sec 703.3.5](#), shall begin immediately following removal of the forms. Fins and irregular projections shall be removed. Form tie cavities, holes, honeycomb spots in other than exposed surfaces, and other defects shall be thoroughly cleaned, saturated with water and carefully pointed with a mortar in accordance with [Sec 703.3.2.9](#). Repaired surfaces shall be satisfactorily cured.

**703.3.5.9** Bridge seats shall be finished to a smooth even surface. Where lead plates or fabric pads are used to seat steel bearing plates, the area under the lead plates or fabric pads shall be finished to within 1/8 inch above plan elevation and shall be dressed to a uniform, level bearing with a Carborundum brick or power grinder after the concrete has set sufficiently to fix the larger particles of sand. The deviation of the bearing seat from a true level surface shall not exceed 1/16 inch. Where elastomeric bearing pads are used, the finishing of 1/8 inch above plan elevation and grinding of the bridge seat area will not be required. Wells for anchor bolts shall be completely filled with an expansive-type mortar in accordance with [Sec 1066](#) after the steel has been erected and adjusted. In lieu of wells, anchor bolt holes may be drilled in accordance with [Sec 712](#). Keyways, anchor bolt wells, holes and other depressions that might collect water and freeze shall be sealed.

### **703.3.6 Curing Concrete.**

**703.3.6.1 Bridge Decks.** Curing compound for bridge decks shall be Type 1-D liquid membrane-forming curing compound in accordance with [Sec 1055](#) Bridge Curing Compounds, except that if diamond grinding is specified, either Type 1-D or Type 2 liquid membrane-forming curing compound in accordance with [Sec 1055](#) may be used for the surfaces to be textured by diamond grinding. Wet curing is required and shall be performed in accordance with [Sec 703.3.6.1.4](#).

**703.3.6.1.1 Application Rate.** The material shall be approved by the engineer prior to use and shall be applied at the manufacturer's recommended rate, but no less than 150 square feet per gallon.

**703.3.6.1.2 Conventional Texturing.** When conventional texturing is specified, fresh concrete shall be sprayed immediately with a curing compound following texturing as specified in [Sec 703.3.5.5](#). The application of the curing compound shall progress such that no more than 10 linear feet of the textured concrete surface is exposed without curing compound at any time.

**703.3.6.1.3 Diamond Grinding.** When diamond grinding is specified in lieu of conventional deck texturing, fresh concrete shall be sprayed immediately after surface floating to smooth surface with curing compound as specified in [Sec 703.3.6.1](#).

**703.3.6.1.4 Wet Curing.** The concrete shall be covered with clean mats as soon as the curing compound has dried sufficiently to prevent adhesion, and the concrete surface will support the curing mat without marring or distorting the finish, but no more than 90 minutes after the concrete is floated or textured. If the concrete mix contains more than 15 percent fly ash or slag or combination thereof and remains plastic after 90 minutes, coverage with mats may be delayed, as directed by the engineer, until the surface will support the curing mat without marring or distorting the finish. The mats shall be sufficiently wet at the time of placement to prevent moisture absorption from the finished surface. The contractor shall control the run-off so as not to cause a traffic hazard or soil erosion. The continuous wet cure shall be maintained a minimum of seven days and until the concrete has attained a minimum compressive strength of 3,000 psi.

**703.3.6.1.5 Opening to Construction Activities.** Light material and equipment weighing less than 1,000 pounds may be carried onto the bridge deck after the deck concrete has been in place at least 24 hours, provided curing is not interfered with and the surface texture is not damaged. Vehicles, material and equipment needed for construction activities and weighing less than 4,000 pounds shall not be moved onto any span until after the last placed deck concrete has attained a compressive strength of at least 3,200 psi. Loads in excess of the above shall not be moved onto the bridge deck until the deck concrete has reached the compressive strength specified on the plans. Placement of barrier walls on bridge decks shall not begin until the 7 day wet cure is complete and the deck has reached the minimum compressive strength shown on the plans.

**703.3.6.1.6 Open To Traffic.** Structures shall not be opened to any public vehicular traffic until at least 10 days after the last placement of deck concrete and until such time that the concrete has attained the compressive strength specified on the plans.

**703.3.6.1.7 Railroad Bridge.** Railroad bridge decks to be waterproofed shall not be cured with liquid membrane-forming compound.

**703.3.6.2 Concrete Masonry Not to be Sealed.** Curing of exposed concrete masonry surfaces not to be sealed shall be initiated after finishing operations are completed and as soon as marring of the concrete will not occur by application of the curing process. The surface of exposed concrete shall be covered and cured in accordance with one of the following methods. Concrete adjacent to construction joints shall be wet cured, and other locations shall be either wet cured or cured by application of Type 1-D liquid membrane-forming curing compound in accordance with [Sec 1055](#). Curing mats for curing exposed surfaces shall be kept wet for 72 hours. The mats shall remain in place until the mats are dry, or if not dry, at least 24 hours after the wet curing period. Concrete shall not be left exposed for more than 30 minutes between stages of curing and during the curing period.

**703.3.6.2.1 Damp Proofed.** Surfaces to be damp proofed shall not be cured with liquid membrane-forming compound.

**703.3.6.2.2 Footings.** Footings may be cured by submersion with approval from the engineer.

**703.3.6.2.3 Precast Members.** Steam curing or curing by complete submersion in water will be permitted for precast members. If steam curing is applied, the jets shall not impinge directly on the concrete or on the forms, free circulation around the units shall be maintained, the steam shall be thoroughly saturated at all times, and the temperature around the concrete shall be raised no more than 40°F per hour and shall not exceed 160°F at any time. After the steam curing period, the temperature inside the chamber shall be reduced at a rate of no more than 40°F per hour until the temperature has reached about 20°F above the temperature of the air to which the concrete will be exposed.

**703.3.6.3 Concrete Masonry to be Sealed.** Curing of exposed concrete masonry surfaces to be sealed shall be initiated after finishing operations are completed and as soon as marring of the concrete will not occur by application of the curing process.

**703.3.6.3.1 Curing.** Concrete curing shall be performed in accordance with [Sec 703.3.6.1](#), except for curbs, parapets, medians and bridge barriers.

**703.3.6.3.2 Curbs, Parapets, Medians and Bridge Barrier.**

**703.3.6.3.2.1 Curing.** Curing compounds for sealed concrete masonry shall be Type 1-D liquid membrane-forming curing compound in accordance with [Sec 1055 Bridge Curing Compounds](#). Wet curing will not be required for curbs, parapets, medians and bridge barriers.

**703.3.6.3.2.2 Application Rate.** The material shall be approved by the engineer prior to use and shall be applied at the manufacturer's recommended rate, but no less than 150 square feet per gallon.

**703.3.6.3.2.3 Application Time.** The application of the curing compound shall progress such that no more than 10 linear feet of the textured concrete surface is exposed without curing compound at any time.

**703.3.7 Bridge Deck Surface Texturing.** For conventional texturing, the roadway surface shall be textured in accordance with [Sec 703.3.5.5](#) prior to the application of the curing compound.

**703.3.7.1** When diamond grinding is specified, following the curing period and the attainment of design strength, the deck surface shall be diamond ground in accordance with the following.

**703.3.7.1.1** The bridge deck shall be diamond ground in accordance with [Sec 622.30](#), except traffic control and closure for grinding operations shall be as specified by other portions of the contract documents, except as noted herein. Grinding may proceed after design strengths are attained and shall be completed prior to opening to any traffic other than construction traffic.

**703.3.7.1.2** Bumps and high areas shall be removed prior to the start of final grinding operations in accordance with [Sec 703.3.5.6](#). Typically 1/8 inch, and no more than 1/4 inch shall be removed from the plan profile of the deck. The final surface shall be textured to the satisfaction of the engineer.

**703.3.7.1.3** The surface of the approach slabs and deck shall be ground simultaneously in a longitudinal manner to a distance 2 feet from the bridge barrier.

**703.3.8 Surface Sealing for Concrete.** Bridge decks shall be sealed with one application of an approved penetrating concrete sealer in accordance with [Sec 1053](#). The penetrating concrete sealer shall also be applied to the top surface of the concrete bridge approach slabs, roadway face, top of sidewalks, curbs, parapets, medians and barrier curbs. The surfaces of deck patching shall not be sealed unless the surface of the rest of the deck is being sealed. The surface of a Latex Modified Concrete overlay shall not be sealed. The surface of all other dense concrete overlays shall be sealed.

**703.3.8.1 Equipment.** Application equipment shall be as recommended by the manufacturer except as mentioned below. A low pressure, high volume method of application shall be used that will not atomize the silane. Hand pump sprayer shall not be used. The spray equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc. shall be free of foreign matter, oil residue and water prior to applying the treatment.

**703.3.8.2 Cleaning and Surface Preparation.** Surfaces which are to be treated shall meet the approved product's requirements for surface condition. Sealing shall not be done until all concrete construction or repair has been completed and cured to the requirements of the manufacturer. The contractor shall furnish the engineer with written instructions for the surface preparation requirements.

**703.3.8.2.1** Sealing shall be done after the bridge deck has been textured or diamond ground.

**703.3.8.2.2** At a minimum, the surface shall be thoroughly cleaned to remove dust, dirt, oil, wax, curing components, efflorescence, laitance, coatings and other foreign materials. The manufacturer or manufacturer's representative shall approve the use of chemicals and other cleaning compounds to facilitate the removal of these foreign materials before use. The treatment shall be applied within 48 hours following surface preparation.

**703.3.8.2.3** Cleaning equipment shall be fitted with suitable traps, filters, drip pans and other devices to prevent oil and other foreign material from being deposited on the surface.

**703.3.8.3 Test Application.** Prior to final application, the contractor shall treat a measured test coverage area on horizontal and vertical surfaces of the different components of the structure to be treated for the purpose of demonstrating the desired physical and visual effect on an application or of obtaining a visual illustration of the absorption necessary to achieve the specified coverage rate. In the latter case, the applicator shall use at least ½ gallon (1.9 liter) of treatment following the manufacturer's recommended method of application for the total of the test surfaces. Horizontal test surfaces shall be located on the deck and on the curb or sidewalk, and vertical test surfaces shall be located on a parapet or safety barrier curb so that the different textures are displayed.

**703.3.8.4 Application.** The sealer shall be applied by thoroughly saturating the concrete surfaces so that one gallon of material shall not be spread over more than 200 square feet.

**703.3.8.4.1** The concrete surface temperature shall be between 35°F and rising and 100°F and falling.

**703.3.8.4.2** At a minimum, the wet cure must be complete and the moisture content of the concrete must be at or below 8 percent as measured by a moisture meter.

**703.3.8.4.3** Allow concrete to dry a minimum of 48 hours after any measurable precipitation.

**703.3.8.4.4** The treatment shall be spread from puddles to dry areas.

**703.3.8.4.5** If the applicator is unable to complete the entire application continuously, the location where the application was stopped shall be noted and clearly marked.

**703.3.8.5 Protection of Adjoining Surfaces and the Public.**

**703.3.8.5.1** When applying the sealer, the contractor shall protect adjoining surfaces of the structure that are not to be sealed. The contractor shall also make provision to protect the public from overspray.

**703.3.8.5.2** Asphalt and mastic type surfaces shall be protected from spillage and overspray. Any asphalt pavement damaged by the sealer will result in removal and replacement at the contractor's expense. Joint sealants, traffic paints and asphalt overlays may be applied to the treated surfaces 48 hours after the treatment has been applied. Adjoining and nearby surfaces of aluminum or glass shall be covered where there is possibility of the treatment being deposited on the surfaces. Plants and vegetation shall be protected from overspray by

covering with drop cloths. Precautions shall be followed as indicated on the manufacturer's product and material safety data sheet.

**703.3.8.6 Opening to Traffic.** Traffic may be allowed on a deck when the material is tack free.

**703.3.9 Hot Weather Concreting.** The contractor shall schedule placing and finishing of bridge deck concrete during hours in which the ambient temperature will be lower than 85°F. The mixed concrete when placed in the deck forms shall have a temperature no higher than 85°F, however, if the contractor starts the concrete placement at least 30 minutes after sundown and covers the concrete with wet burlap when it will not mar the surface, but before morning solar radiation dries the surface and implements, to the extent possible, precautionary measures for hot weather concreting recommended in ACI 305R 'Hot Weather Concreting', then the concrete temperature can be increased to 90°F.

**703.3.10 Cold Weather Concreting.** Concrete work shall proceed on all structures, except bridge superstructures, whether or not heating will be required, unless it can be definitely established that the overall progress of the project will not be affected. Placing of concrete in the superstructure of a continuous or monolithic series of spans once begun shall be continued within the provisions of cold weather concreting procedures until all the concrete in that series is placed. Concrete placed in cold weather shall be protected from freezing during the curing period. Concrete shall not be placed on frozen ground, or against steel or concrete surfaces with temperatures lower than 35°F. Concrete shall not be placed where the ambient temperature is below 35°F without prior approval from the engineer. Concrete in bridge superstructures shall not be placed where the ambient temperature is below 40°F without prior approval from the engineer.

**703.3.10.1** The aggregate, the water, or both, shall be heated during the season when the atmospheric temperature may drop below 40°F. Aggregate shall not be heated higher than 150°F. The temperature of the aggregate and water combined shall not be higher than 100°F when the cement is added. Any method of heating during the mixing of concrete may be used, provided the heating apparatus will heat the mass uniformly and avoid hot spots that will burn the material. The temperature of the concrete at the time of placing in the forms shall be no lower than 45°F for concrete in footings, massive piers and abutments, or less than 60 F for all other concrete.

**703.3.10.2** When the ambient temperature is below 40°F, with the approval from the engineer, curing of superstructure concrete, substructure units above ground surface, retaining walls and box culverts of more than 15 square feet opening shall be accomplished by methods that will prevent concrete from freezing. The minimum compressive strength required for form removal and ending protection from freezing shall be in accordance with [Sec 703.3.2.13](#). The contractor shall furnish temperature monitoring equipment and accessories that demonstrate to the engineer that concrete has been protected from freezing, with payment for such equipment and accessories included in the contract unit price for concrete. Exposed surfaces of the concrete shall be kept moist during the curing process. Substructure concrete below ground surface may be protected by submersion provided the temperature of the water is maintained between 40° and 80°F for seven days.

**703.3.10.3** Concrete headwalls for pipe culverts, drop inlets and box culverts of 15 square feet or less openings, may be placed without air temperature limitations, but the contractor shall be responsible for proper protection from freezing during placing and curing of the concrete.

**703.3.11 Extending and Widening Structures.** Extending and widening of existing concrete structures shall be in accordance with the details shown on the plans. A continuous groove at least one inch deep shall be sawed in the faces of the existing concrete as a guide for

the line of break to prevent spalling. Surfaces of existing concrete that are to come in contact with new concrete shall be thoroughly cleaned, saturated with water and painted with an epoxy mortar of paint consistency or other approved products. The new concrete shall be placed immediately after the cement grout has been applied. If new concrete is to be placed against the natural finish of existing concrete work, the surface shall be roughened by bushhammering or other approved methods before being cleaned and treated. Before applying a new concrete riding surface, any existing bituminous surfacing shall be removed, and the exposed concrete surface shall be roughened by bushhammering or other approved methods before being cleaned and treated. Work incidental to joining new concrete to existing concrete will be at the contractor's expense.

**703.3.12 Stenciling Structure Identification Numbers.** Bridge numbers shall be stenciled in black paint on all concrete bridges. The letters shall be capitals and 2 to 3 inches high. The bridge numbers shall be stenciled on concrete surfaces at two locations as directed by the engineer.

**703.3.13 Aesthetic Concrete Stain.** This stain shall consist of a two coat acrylic resin system. The surface preparation and application shall be in accordance with the manufacturer's recommendations. Field approval of the proposed material will be in accordance with [Sec 1056](#).

**703.4 Method of Measurement.** Final measurement will not be made unless changes from contract plans are authorized by the engineer during construction, or appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity. Where required, quantities for concrete masonry will be computed from dimensions shown on the plans, or as revised in writing by the engineer because of changes to the contract plans or due to appreciable errors, and will be computed to the nearest 1/10 cubic yard for each structure. No deduction will be made for the space occupied by reinforcing steel, conduit or piles. Deductions will be made for the space occupied by the tubes in voided slabs.

**703.4.1** Measurement of concrete quantities in seal courses will be made for the actual quantity placed, except that this quantity will be limited to that included within vertical planes 18 inches outside the neat lines of the footings, and to the maximum depth shown on the plans or as authorized by the engineer.

**703.4.2** Measurement of concrete quantities used to fill cavities or crevices will be made for the accepted quantity placed below the authorized elevation of the structure footing.

**703.4.3** Final measurement for diamond grinding will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from contract quantity.

**703.5 Basis of Payment.** The accepted quantity of concrete masonry, complete in place, will be paid for at the contract unit price for each of the pay items included in the contract.

**703.5.1** The accepted quantity of concrete used to fill cavities or crevices below final authorized bottom elevation of the footing structure will be paid for based on the accepted quantity per cubic yard at the fixed unit price specified in [Sec 109](#).

**703.5.2** No direct payment will be made for incidental items necessary to complete the work unless specifically provided as a pay item in the contract documents. No direct payment will be made for concrete required to fill overbreak where footings or walls are cast against vertical faces of rock or shale excavation.

**703.5.3** Payment for diamond grinding will be made per square yard of surface.

**703.5.4** No direct payment will be made for furnishing and applying the surface sealer and all incidental work. Payment shall be considered completely covered by the contract unit price for other items.

**703.5.5** Payment for the work necessary to complete a closure pour, including all material, labor, tools, equipment and incidentals, will be made and considered completely covered under the contract unit price for the applicable pay item for the slab.