

SECTION 706 -- CONCRETE BRIDGE FLOORS

706.01 -- Description

This work shall consist of providing all necessary materials and construction of concrete bridge floors in accordance with the plans and specifications.

706.02 -- Material Requirements

1. Reinforcement shall be furnished, handled, and placed in accordance with the requirements of Section 707.
2. White polyethylene film shall comply with the requirements of Section 1010.
3. Concrete retardants shall meet the requirements of Sections 1002 and 1007.
4. Concrete shall meet the requirements of Section 1002.

706.03 -- Construction Methods

1. a. Before placing concrete for bridge floors, the placement of top reinforcing steel shall be checked for clearance to the surface of the slab by measuring from the reinforcing steel to the strike-off screed.

b. Such checking shall be done by the Contractor in the presence of the Engineer and shall be repeated at a sufficient number of locations to demonstrate that concrete cover over the reinforcing steel as required in the plans will be obtained at all points on the slab.

c. Such checking does not preclude subsequent checks by the Engineer during and after concrete placement.

2. a. The Contractor shall perform bridge floor construction in accordance with the requirements of Section 704. Bridge floor concrete shall not be placed when the anticipated wind velocity during the concrete placement period is expected to exceed the limitations shown in Table 706.01.

Table 706.01

Temperature and Wind Velocity Limitations	
Air Temperature in the Shade, (Degrees Fahrenheit)	Maximum Wind Velocity, (Miles Per Hour)
86	9
77	16
68	22
59	28
50	40

b. Bridge floor concrete shall not be placed when the ambient air or concrete temperature is above 86°F.

3. a. The Contractor's sequence of placing shall be as shown in the plans.

b. Placement of bridge floor concrete shall be continuous, and no delays are allowed between successive loads for any reason except at an expansion or construction joint.

c. Concrete slab bridge floors shall be placed and finished at a rate of at least 10 feet/hour.

d. Concrete bridge floors on steel girders, prestressed concrete girders, or prestressed double-tee beams shall be placed and finished at a rate of at least 20 feet/hour.

4. a. The Contractor shall notify the Engineer before releasing any temporary structural supports.

b. The Contractor shall remove falsework before placing concrete floors on steel spans.

c. The Contractor's floor and curb forms shall be supported entirely by the steel frame.

5. When the plans require a construction joint between concrete curbs or railings and the concrete floors, the curbs or railings shall not be placed until the concrete floor has cured for at least 3 days.

6. a. The Contractor shall finish concrete bridge decks and approach slabs with an approved mechanical, self-propelled finishing machine.

b. The finishing machine shall consist of one or more devices mounted on a rigid frame and be capable of striking off and finishing the surface either transversely or longitudinally. Finishing machines shall be of sufficient size to finish the entire width of the bridge deck in one pass.

c. (1) The machine shall be supported on adjustable rails or tracks of sufficient strength to prevent deflection between rail supports.

(2) Preferably, the rails shall be installed outside the slab limits and shall be set and maintained true to the desired grade, line, and cross section during the entire finishing operation.

(3) Rail supports shall be unyielding, and falsework or forms shall be strengthened as necessary to support the imposed load without deflection.

(4) Rail supports located within the limits of the slab shall be constructed to allow their removal to at least 2 inches below the slab surface. The resulting holes in the concrete slab shall be acceptably filled during the final finishing operation.

(5) Supports shall not be welded to the girders.

d. The finishing machine shall make at least 2 passes over the bridge floor at such intervals as will give proper consolidation and produce the desired surface condition. The concrete shall not be disturbed or worked further, except that any remaining surface irregularities or mortar ridges shall be immediately removed by use of a long-handled float or straightedge.

e. The Engineer may require the Contractor to submit a complete description of the proposed method for handling, placing, and finishing the slab, including the equipment for transporting and delivering the concrete, the finishing machine, and complete details of the supports for such equipment. Approval by the Engineer will not relieve the Contractor of the responsibility for the satisfactory performance of his/her methods and equipment.

7. a. For finishing concrete slab widenings or other small or irregular deck areas, hand-finishing methods will be allowed.

b. (1) After the concrete has been consolidated, as specified in Subsection 704.03, the surface shall be carefully struck-off with an approved screed to conform to the grade and cross section shown in the plans and to accurately match adjacent existing concrete surfaces.

(2) The screed shall be advanced with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and manipulated so that neither end is raised from the side form or template during the process.

(3) Excess concrete shall be maintained in front of the cutting edge to avoid creation of surface low spots.

c. The surface shall be floated using approved methods and equipment to remove all surface irregularities and to seal the surface. Special attention shall be given to areas adjacent to construction joints to achieve proper consolidation and surface finish.

d. Immediately after floating, the surface shall be tested with a 10 foot straightedge. Any depressions shall be filled with fresh concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to areas adjacent to deck joints so that these surfaces are especially smooth.

8. a. Before the concrete obtains initial set, the Contractor shall give all finished bridge floor surfaces a drag finish with wet burlap, carpet, or a soft bristled broom. The drag finish shall create a uniform, fine-grained finish on the sealed concrete surface.

b. (1) All concrete bridge floors and approach slabs except those which are to receive a subsequent concrete overlay surface course shall also be tine textured. Tining shall consist of creating uniform, transverse grooves in the final concrete surface.

(2) The grooves shall be approximately 1/8 inch wide by 1/8 inch deep, spaced 0.6 inch apart.

(3) Grooves shall be discontinued at 2 feet from the bridge curb or rail.

(4) Tines shall not be made with a garden rake.

(5) A corrugated bull float shall be used to make the tine grooves.

9. a. For this Specification, the bridge deck is defined as the concrete deck and pavement cast between the bridge grade beams. Approaches outside the grade beams are excluded.

b. Environmental conditions during placement are critical to the quality of concrete in bridge decks. Of particular importance is the evaporation rate. The Contractor shall predict the evaporation rate for the duration of the deck casting based on the Contractor's estimate of the start and completion times. Local weather forecasts can be used to predict the wind speed, air temperature and relative humidity. The Contractor may estimate the concrete temperatures from those actually measured during the previous day's placement, from test batches, or from estimates of aggregate, cement and water temperatures. The Contractor shall use the predicted weather conditions and the Evaporation Nomograph, Figure 2.1.5 from the American Concrete Institute Manual of Concrete Practice 305R, Chapter 2 or Figure 710.01 in the Nebraska *Standard Specifications for Highway Construction* 1997 English Edition, to estimate the evaporation rate. The Contractor shall record the wind velocity, air temperature, concrete temperature, and relative humidity immediately before and after casting the deck and provide the Project Manager a copy of this data. The attached data sheet or similar Contractor record may be used to record the data.

c. When the evaporation rate is estimated to exceed 0.15lb/sf/hr (0.75 kg/m²/hr), the Contractor will only be allowed to cast the bridge deck when additional measures are implemented to create and maintain environmental conditions on the bridge deck which are satisfactory for concrete placement and have been approved by the Project Manager. These measures may consist of:

- Fogging,
- Placing clean, saturated wet burlap on the finished concrete no later than 1 1/2 hours after the concrete leaves the truck/pump chute and is on the deck,
- Erecting wind breaks, and/or
- Cooling the concrete.

(1) Fogging is only a temporary measure that allows the Contractor to delay placing the saturated wet burlap. Saturated wet burlap must be applied before the Contractor stops the fogging operation. Saturated wet burlap must always be applied and be maintained saturated wet until 96 hours after casting. The Contractor must use extreme caution when applying saturated wet burlap 90 minutes after placement to avoid damage to the deck. Any damage, except partial removal of tining imprints, caused by dragging the saturated wet burlap over the surface of the newly cast concrete, shall be repaired by the Contractor at no additional cost to the Department. (Partial removal of tining imprints is defined as less than 25% of the total deck surface.) Any smoothness damage as defined by applicable contract smoothness requirements shall be repaired by the Contractor at no additional cost to the Department.

(2) Fogging shall be accomplished using pressurized equipment that distributes at least 0.10 gallon of water/ hour/square foot (4 l/h/m^2) of bridge deck placed. As an example, on a 36-foot (11 m) wide deck, the system must be able to distribute at least 3.6 gallons of water/hour/linear foot (44.7 l/h/m). The fog spray must be produced from nozzles, which atomize the water and which are capable of keeping the finished deck surface area saturated without depositing noticeable standing water. (Atomized water should have an average droplet diameter of approximately 80 microns (0.08 mm or 0.003 inch) or less.) Water that drips from nozzles must not be allowed to fall onto the concrete that is being cured.

(i) Fogging must begin progressively along the length of the deck immediately after tining the concrete (approximately 30 minutes after casting), and the fog must be applied over the entire placement width until saturated wet burlap is in place.

(ii) The Contractor must submit a letter certifying that their fogging equipment will meet the requirements of this Special Provision.

(iii) Use of white, clear, or black polyethylene film (plastic sheeting) is prohibited.

d. If environmental conditions are such that the evaporation rate is less than 0.15 lb/sf/hr ($0.75\text{kg/m}^2/\text{h}$) and the forecast temperature is predicted to be above 40°F (4.5°C), then the Contractor has the option to use the following curing procedures instead of those in Paragraph 9c. above:

(1) The Contractor shall incrementally apply white-pigmented curing compound within 45 minutes after the finish machine passes over the concrete. The application rate shall be in accordance with the manufacturer's application procedures and Subsection 603.03, Paragraph 6, Protection and Curing in the Nebraska *Standard Specifications For Highway Construction*.

(2) The Contractor shall place uniformly saturated wet burlap on the finished concrete within 3 hours after applying white-pigmented curing compound. The Contractor must keep the burlap uniformly saturated for at least 96 hours. If the temperature at the time of casting and for the next 96 hours is not expected to exceed 75°F (24°C), then the Contractor has the option to limit the application of water to the burlap after 24 hours and cover the saturated wet burlap with opaque polyethylene film sheets for the remaining 72 hours.

e. When placing concrete in cold weather, the following alternate curing is authorized (Cold weather is defined as air temperature expected to be 40°F(4°C) or less.).

(1) The finished concrete surface shall be covered with a layer of saturated and clean burlap approximately 90 minutes after the concrete is placed on the deck. The saturated wet burlap shall be immediately covered with a layer of white opaque polyethylene film.

(2) The curing system shall remain in place for at least 72 hours.

(3) All other requirements for cold weather concreting, as defined in Subsection 704.03, shall apply.

f. The Contractor must provide a list of equipment, equipment certification, and the number of personnel that will be dedicated to the curing operation at least 24 hours before the actual casting date.

g. The Contractor is responsible for the repair of all visible cracks more than 3 inches (75 mm) in length that develop on the bridge deck up to the time the project is accepted at no additional cost to the Department.

h. The Department will determine the method for repairing any cracked concrete.

i. The Contractor shall repair bridge deck cracks even if the environmental conditions do not indicate that the evaporation rate at the time of casting and immediately after casting will exceed 0.15lb/sf/hr (0.75 kg/m²/hr).

j. Concrete Bridge curbs and rails shall be cured in accordance with Subsection 704.03.

Bridge Deck Environment						
Project:			Date:			
Location:			Project No.:			
Control No.:			Station No.:			
	Time Measured	Air Temp.	Relative Humidity (%)	Concrete Temp.	Wind Velocity (MPH/KPH)	Evaporation Rate
Prior to Casting						
After Casting						
----- <i>Signature</i>						

10. a. The Contractor shall test the cured concrete for surface irregularities with either a 10 foot straightedge placed or operated parallel to the centerline of the roadway or some other device for measuring deviations from a plane. Variations greater than 1/8 inch shall be plainly marked for removal, except that for decks which are to receive a subsequent concrete overlay course, where 1/4 inch variations are allowed.

b. The Contractor shall grind or cut irregularities that exceed the above limits. Grinding or cutting shall not be done until the concrete is at least 7 days old, and bush hammering or other impact methods are not allowed.

c. Concrete barrier curb, bridge rail, and median barrier curb:

(1) The barrier curbs and bridge rail shall present a smooth, uniform appearance conforming to the horizontal and vertical lines shown in

the plans or ordered by the Engineer, and shall be free of lumps, sags, or other irregularities. The top and exposed faces of the barrier and bridge rail shall conform to the following requirements when tested with a 10 foot straightedge laid on the surfaces.

(2) The top of the barriers shall not vary more than 1/4 inch from the edge of the straightedge, and the faces shall not vary more than 1/2 inch from the edge of the straightedge. Areas not conforming to the requirements in Paragraph 10.c.(1) of the Subsection shall be removed and replaced at no additional cost to the Department.

11. a. Retarders may be used to aid concrete finishing.

b. Retarders shall be used to establish a one hour delay in the concrete set time when the air temperature is 60°F (15°C) or higher.

(1) Type B – Retarding Admixture or Type D – Water Reducing and Retarding Admixtures, such as Pozzolith 300R or Daratard 17, shall be used.

(2) Type A – Water Reducing Admixtures, such as WRDA-82, Procrete N or Masterpave N, shall not be used as retarders.

c. Retarders are intended to keep the concrete from setting up while construction loads are still at critical locations on the deck.

(1) Dosage rates vary depending on the length of time the retardation needs to last and the air and concrete temperature.

(2) Admixture suppliers shall supply recommendations for dosage rates for varying lengths of time and temperatures.

12. a. When the bridge floor is to receive a subsequent overlay course of high density, low slump concrete, the Contractor shall form test wells into the concrete floor surface. Wells shall be 10 inches by 10 inches and set 1 1/2 inches below the floor surface.

b. The Contractor shall place test wells at intervals not to exceed 50 feet, except at the point where placing starts. Here, the first 3 wells will be placed at 5 foot intervals.

13. Drainage:

a. The Contractor shall furnish and install deck drainage systems at the locations shown in the plans. This work includes drain boxes, pipes, anchors, supports, and connections.

b. Floor drains and appurtenances shall be fabricated from structural steel and/or galvanized standard steel pipe (schedule 40) meeting the requirements of ASTM A 36/A 36M or ASTM A 53 Grade B, respectively. After fabrication, floor drains and appurtenances shall be galvanized in accordance with the applicable sections of ASTM A 123.

14. The Contractor shall paint all exposed metal, except weathering grade steel, as prescribed in Section 709.

15. Time for Opening Bridge Floors to Public Traffic:

a. The Contractor shall not open the bridge floor to traffic until approval has been given by the Engineer. The Engineer may open the bridge when the concrete has reached a minimum age of 7 days and developed a minimum compressive strength as prescribed in the plans.

b. Construction equipment meeting legal load limits will be allowed on bridge floors after 5 days have elapsed from the time of placement provided a test specimen made during the progress of the work develops a compressive strength of at least **3500-psi (24-MPa)** as prescribed in the plans.

706.04 -- Method of Measurement

1. No field measurements are required when items are constructed according to the plan geometrics.

2. Drainage systems or floor drains will be measured as single units, complete and in place.

706.05 -- Basis of Payment

1. Pay Item	Pay Unit
Concrete Class _____ for Bridges	Cubic Yard (CY)
Drainage System at Station _____	Each (ea)
Floor Drains _____	Each (ea)

2. Finishing, curing, texturing, set retarders, and test wells are subsidiary to the concrete floor.

3. Miscellaneous items that are listed in the plans to be included in the complete structure, but for which separate items are not shown in the proposal and for which no direct payment has been provided, shall be incorporated in the structure and the necessary work performed by the Contractor. Direct payment for such items will not be made, and they shall be considered as subsidiary to the relevant pay item.

4. Payment is full compensation for all work prescribed in this Section.