Section 2412. Concrete Bridge Decks

2412.01 DESCRIPTION.

Construct concrete decks on timber stringers, concrete beams, or steel girders. Apply Sections 2403 and 2404.

2412.02 MATERIALS.

A. Use materials for concrete decks meeting the requirements for the respective materials in Division 41.

B. Use concrete that meets the requirements for C-4WR and C-V47B concrete mixtures, as specified in Materials I.M. 529. Use Gradation No. 3 or 5 of the Aggregate Gradation Table in Section 4109. Meet the requirements of Section 4108 for fly ash and GGBFS. Refer to Table 2412.02-1 for the maximum allowable substitution rates:

Table 2412.02-1: Maximum Allowable Substitution Rates.

Cement Type	Maximum Allowable Substitution[(a)]	Time Period
Type I, Type II	35% GGBFS 20% Fly Ash	March 16 through October 15
Type IS, IP	0% GGBFS 20% Fly Ash	March 16 through October 15
Type I, II, IS, IP	0% GGBFS 0% Fly Ash	October 16 through March 15
[(a)] Maximum total mineral admixture substitution is 50%.		

Between October 16 and March 15, substitution of Type I/II cement with fly ash and GGBFS will be allowed when maturity method is used to determine time of opening. When heating or protection is required per Article 2403.03, F, 5, maintain 50°F (10°C) until opening strength by maturity method is reached.

C. Either the contract documents or the Engineer may require a retarding admixture. Use a water reducing/retarding admixture meeting the requirements of Materials I.M. 403, Appendix B, according to Section 2403. When placements require extended working times, increase the dosage rate for the appropriate working time and temperature. For placements requiring normal working times, set the dosage rate according to Section 4103. The Engineer may approve other admixtures.

D. Use retarding admixtures compatible with the air entraining agent used. Previous experience, satisfactory to the Engineer, will be required to indicate the approximate adjustments in proportions made necessary by the addition of the admixture and compatibility with other materials used. Agitate the retarding admixture prior to and during its use.

E. Use a single source of cement during an individual placement. Drain all aggregate for at least 24 hours after washing and before batching.

2412.03 CONSTRUCTION.

When a two course construction with a second course of bridge deck surfacing or other wearing course is specified, use the requirements of Section 2413 or in the contract documents for the second course. When an overlay for an existing deck in conjunction with repair is specified, use the requirements of Section 2413 or in the contract documents for the overlay and repair.

A. Swinging the Span and Support of Forms.

1. Before concrete is placed in the floor of a steel span, strike the centering of the span and swing the span free on its permanent supports. Support the forms for concrete decks and curbs entirely by the beams which are to support the concrete, unless specified otherwise in the contract documents.

2. Do not use temporary welds to attach hangers to prestressed or steel beams to support deck form joists. Coat deck hangers that are embedded in prestressed beams and deck hangers that drape across steel girder or prestressed beams using one of the following methods:

a. Electroplating in accordance with ASTM B 633, Service Condition SC4, minimum coating thickness of 1.0 mil (25 µm). Classification and Coating Suffix: Fe/Zn 25.

b. Mechanical galvanizing in accordance with ASTM B 695, Type I, Class 50. Minimum coating thickness of 2.0 mils (50 µm).

3. Do not weld on structural steel in the field, unless allowed in the contract documents or approved by the Engineer.

B. Placing Reinforcement.

1. Accurately place all reinforcement in the positions shown in the contract documents. Do not weld reinforcing steel unless allowed in the contract documents or approved by the Engineer.

2. In lieu of tying requirements in Article 2404.03, D, tie reinforcement rigidly using wire at alternate intersections so 50% of the intersections are tied. For steel fabric reinforcement, use electrically welded rectangular mesh in flat sheets.

3. Support horizontal reinforcement using an adequate number of supports as specified in Article 2404.03, E. Hold the upper horizontal reinforcement securely in place with tiedowns a maximum of 4 feet (1.2 m) apart to ensure the reinforcement will not rise during concrete placement.

4. Allow the Engineer to inspect and approve reinforcement placing and fastening. The Engineer's approval is required before concrete can be placed in a deck. Make adjustments when checks indicate anticipated concrete cover over reinforcement different than specified in the

contract documents. If the lack of concrete cover over reinforcement is due to over camber of the beams or improper elevation of beam splice points, adjust the beam haunch to provide proper cover, while maintaining a smooth profile for the length of the deck.

5. When the self propelled finishing machine described in Article 2412.03, D, is required, check the elevation of upper reinforcement using this machine (properly adjusted for finishing) with a suitable attached template adjusted to detect any reinforcement too close to the surface. Set the template to a tolerance of minus 1/4 inch (6 mm) to allow clearance of wire ties.

C. Placing Concrete.

1. Place concrete deck sections according to the sequence shown in the contract documents or as modified by the Engineer.

2. When cold weather protection is necessary, do not place concrete without the Engineer's written permission.

3. Do not place concrete if the temperature of the plastic concrete, at the time of placing exceeds 90°F (32°C). The Contractor may (at their own expense) cool the plastic concrete below 90°F (32°C) by a method the Engineer approves.

4. Do not place concrete if the theoretical rate of evaporation for that day exceeds 0.2 lbs. per square foot per hour (1 kg/m^2 per hour). Use the Theoretical Rate of Evaporation Chart located within the appendix to calculate the theoretical rate of evaporation. For this chart, use:

- The National Weather Service's maximum air temperature, relative humidity, and maximum steady wind velocity without gusts for the date and the location of the concrete deck placement, and
- The temperature of plastic concrete at time of placement.

D. Surface Finish.

1. After placing and vibrating the concrete as provided in Articles 2403.03, C and D, promptly strike it off with a template to provide a smooth surface with the proper crown. Ensure supports for the strike off template are parallel to the center line of the structure, firmly fastened in place, and set to the correct elevation. Include proper allowance for deflection caused by the concrete. Ensure screed supports extend sufficiently beyond each end of the bridge to accommodate the strike off template or finishing machine. Ensure they provide support for bridges when operating a longitudinal float. If required, provide any or all of the items specified in Article 2301.03, A, 3, which may be adapted to the work.

2. In lieu of the above requirements, apply the following to all bridges longer than 60 feet (20 m):

a. After depositing and vibrating the concrete as provided in Articles 2403.03, C and D, promptly strike it off to the proper elevation using

an approved self propelled and mechanically operated finishing machine.

b. Ensure the finishing machine operates on adequately supported rails adjusted to conform to the grade specified. Include allowance for anticipated dead load deflection shown in the contract documents.

c. Ensure supporting rails extend beyond each end of the bridge a sufficient distance to accommodate the finishing machine.

d. Ensure the finishing machine will not cause undue deflection of the bridge members or falsework.

e. The screeds of the finishing machine may be of metal or metal shod wood.

f. Make a sufficient number of passes with the finishing machine to obtain a void free surface struck off to the elevation specified.

g. Finishing machines other than as described above will be considered for approval.

3. After the final pass of the finishing machine or after the floating operation (if used), smooth the surface to meet the requirements of Article 2301.03, H. Check with 10 foot (3 m) straightedges. Correct surface irregularities.

4. After smoothing and checking for smoothness, promptly give the surface a final finish while the concrete is still plastic. When the contract documents show a second course of bridge floor surfacing or other wearing course, finish the surface of the first course with a burlap drag. Smooth and check the final surface for smoothness without additional finishing for one course bridge decks on Interstate and Primary projects.

a. Interstate and Primary Projects.

1) Transverse grooving or tining in plastic concrete of bridge decks (and bridge approaches when included in the bridge project) will not be allowed unless otherwise stated in the contract documents.

2) Cut longitudinal grooves into hardened concrete surfaces using a mechanical cutting device. Perform longitudinal grooving after surface correction grinding.

3) Ensure longitudinal grooves are:

a) 1/8 inch ± 1/64 inch (3 mm ± 0.4 mm) wide,

b) 1/8 inch +1/32 inch or -1/16 inch (3 mm +0.8 mm or -1.6 mm) deep, and

c) Uniformly spaced at 3/4 inch (19 mm) intervals measured center to center of groove.

4) Terminate longitudinal grooving approximately 6 inches (150 mm) from bridge joints.

5) Ensure longitudinal grooving on the bridge deck and double reinforced bridge approach sections is not placed within the area approximately 1.5 feet (0.5 m) adjacent to the curbs. To accommodate varying widths of grooving equipment, the width of the ungrooved area adjacent to curbs may be up to 3.0 feet (0.9 m).

6) Ensure longitudinal grooving of single reinforced and non-reinforced bridge approach sections is not placed within 6 inches (150 mm) of the edge of outside lane lines.

7) For staged bridge and bridge approach construction:

a) The Contractor may cut longitudinal grooves in the hardened concrete at the end of each stage of construction or wait until all stages have been completed. If the Contractor elects to delay cutting of the longitudinal grooves until completion of all stages, apply an interim coarse broom finish on the concrete deck and bridge approach during placement for all stages opened to traffic.

b) Within 30 calendar days following completion of the last stage of the project, establish temporary lane closures to accomplish longitudinal grooving for all stages.

c) The interim coarse broom finish will not be allowed as a surface texture when opened to traffic over a winter season. If the interim coarse broom texture is present and the Contractor is not in a position to finish all stages of the project, cut longitudinal grooving into the hardened concrete in order to establish an acceptable driving surface texture for the winter season.

b. Other Projects.

When the surface being placed is the wearing course, apply a suitable grooving by hand methods to the entire surface, except the area within approximately 2 feet (0.6 m) of the curbs. Apply grooving similar to that described in Article 2301.03, H, 3, with the following exceptions:

- Transverse to the centerline of the roadway.
- Randomly spaced from 3/4 inch to 1 5/8 inches (20 mm to 40 mm) with no more than 50% of the spacings exceeding 1 1/4 inches (30 mm) with a minimum of four different spacings in a 2 foot (0.6 m) width.

5. When the surface being placed is the final surface of a bridge sidewalk, give the surface of the sidewalk a transverse coarse broom texture.

6. Apply Section 2428 to smoothness of the completed deck surface for Primary projects and when specifically required for other projects.

E. Curing Concrete Decks.

Use burlap prewetted with sufficient water, prior to placement, to prevent absorption of moisture from the concrete surface. Keep the burlap wet.

1. Place the first layer of prewetted burlap in the following manner:

a. Interstate and Primary Projects.

Place on the concrete within 10 minutes after final finishing.

b. Other Projects.

Immediately after final finishing and grooving, cover the area finished with white pigmented curing compound meeting requirements of Article 4105.05 applied at a maximum rate of 135 square feet per gallon (3.3 square meters per liter). Place the first

layer of prewetted burlap on the concrete within 30 minutes after the concrete has been finished and grooved.

2. As soon as practical, but no later than 2 hours after placing the first layer, place a second layer of burlap on the deck.

3. Apply water to the burlap covering for a period of 4 calendar days. Use a pressure sprinkling system that is effective in keeping the burlap wet during the moist curing period. The system may be interrupted only to replenish the water supply, during periods of natural moisture, or during construction contiguous to the concrete being cured. The Engineer may approve interruptions for periods longer than 4 hours on the basis of the method for keeping the concrete moist.

4. Maintain continuous contact, except as noted above, between all parts of the concrete deck and the burlap during the 4 calendar day moist curing period.

5. On concrete decks placed after October 1 and prior to April 1, after 20 hours of the application of water, the Contractor may substitute the application of a moisture proof plastic film no less than 3.4 mils (86 µm) thick over the wet burlap in lieu of applying water. Maintain intimate contact between the surface of the concrete, the burlap, and the plastic film.

F. Curbs.
Place curbs and barrier railing separately from the deck slab. Place them in the manner shown in the contract documents.

G. Expansion Joints.
Locate and construct expansion joints as shown in the contract documents. If steel expansion plates are required, the Contractor for the superstructure shall furnish and install all such plates including those required at the end of the bridge.

H. Filling and Sealing Joints.
After removing dummy filler strips, allow the concrete to harden during the remainder of the cure period. Clean and complete the joint after it has dried. Use filler and sealer meeting the requirements of Section 4136. When the type is not specifically designated, furnish resilient filler.

1. When using premolded filler, shape it to the proper cross section. Place it in a manner that leaves at least a 1/2 inch (15 mm) deep space in the joint from surface to filler. Seal the space above the filler. Joint edge priming may be required if the sealer manufacturer recommends. Carefully fill the space completely without smearing adjacent concrete. After the sealer has set, the surface may be lightly covered with Portland cement to prevent tracking from traffic.

2. When contract documents require an elastomeric compression type preformed seal, use material of the nominal dimensions shown. Use a heavy duty type for bridge floor application with a rated capacity which

will accommodate the joint movement. Submit, for prior approval, the manufacturer's name and a description of the specific seal to be used. Ensure steel armor fabrication shop details comply with the manufacturer's recommended setting depth. Install the elastomeric compression seal according to the contract documents, the manufacturer's recommendations, and the follow provisions:

a. Install the seal using suitable hand or machine tools. Thoroughly secure in place with lubricant adhesive covering both sides of the seal over the full area in contact with the sides of the joint. Adhesive may be applied to the concrete or steel joints or to the seals or in combination. Install seals in a substantially fully compressed condition. Unless the contract documents or manufacturer's recommendations specify otherwise, install at least 1/4 inch (5 mm) and no more than 1/2 inch (15 mm) below the surface at all points.

b. For transverse joints across roadways, use a one piece seal for the full width of the transverse joint. For longitudinal joints, provide the seal in lengths as long as is practical. Seal all joints between lengths of seals with additional adhesive.

c. Seals may be installed in concrete joints immediately after the curing period using the lubricant-adhesive. Observe the manufacturer's temperature limitations for the adhesive. Ensure joints are clean, dry, and free of all foreign material immediately prior to seal installation. Repair spalled surfaces in concrete joints to the Engineer's satisfaction.

2412.04 METHOD OF MEASUREMENT.

A. Measurement for structural concrete, reinforcement, and structural steel will be according to Articles 2403.04, 2404.04, and 2408.04, respectively.

B. Longitudinal Grooving in Concrete, in square yards (square meters), will be the plan quantity shown in the contract documents.

2412.05 BASIS OF PAYMENT.

A. Payment for structural concrete, reinforcement, and structural steel will be according to Articles 2403.05, 2404.05, and 2408.05, respectively.

B. Payment is full compensation for furnishing all materials, equipment, and labor and for performing all work necessary to complete the structure in conformance with the contract documents.

C. When Section 2428 applies, payment may be modified as specified therein.

D. Deductions will not be made for the volume of concrete displaced by deck drains, expansion joints, shear lugs, beam flanges, and joint material. The cost of joint material and metal strips for sealing joints is included in the contract unit price per cubic yard (cubic meter) for structural concrete. The weight (mass) in pounds (kilograms) of structural steel paid for includes all:

- Steel expansion plates,
- Castings of steel or iron,

- Welded shapes for deck drains,
- Bearing plates,
- Anchor bolts and other steel parts, except steel reinforcement for concrete and the associated metal fastenings.

E. The cost of any additional concrete required to meet the requirements of Article 2412.03, B, is incidental to the cost of the structural concrete.

F. Payment for Longitudinal Grooving in Concrete will be the contract unit price for per square yard (square meter).