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452 PRECAST SEGMENTAL BRIDGE CONSTRUCTION. **(REV 8-30-16) (FA 10-25-16) (7-17)**

ARTICLE 452-2 is deleted and the following substituted:

452-2 Qualification of Contractor's Personnel.

Meet the requirements of Section 105.

When mixing, handling and applying an epoxy bonding agent, provide direct supervision by a person with knowledge and experience, or trained by a technical representative of the manufacturer in the use of this material. Arrange for a technical representative of the manufacturer to be at the site as an advisor at the beginning of this work.

Ensure that all personnel who will be working with an epoxy bonding agent are thoroughly familiar with the safety precautions necessary for use of this material.

ARTICLE 452-5 is deleted and the following substituted:

452-5 Materials.

452-5.1 General: Use materials which conform to this Section and the requirements prescribed in Division III, Materials, for the particular kind and type of material specified.

452-5.2 Concrete: Use concrete as specified in Section 346 except as specifically modified herein. Use No. 67 coarse aggregate in the concrete for segments.

Screenings are not allowed as a substitute for silica sand for use in concrete for Precast Superstructure Segments.

452-5.3 Reinforcing Steel: Use ASTM A615, Grade 60 reinforcing steel which meets the requirements of Section 415. When welding reinforcing steel, meet the requirements of the American Welding Society's Structural Welding Code D1.4. The Engineer may allow shop prepared welded reinforcing grillages. Field welding of reinforcing steel is not allowed.

452-5.4 Post-Tensioning Systems: Use post-tensioning hardware components meeting the requirements of Section 462. Components are not interchangeable and must comply with the details of the approved shop drawings.

452-5.5 Epoxy Bonding Systems: Use only epoxy systems comprised of two components, a resin and a hardener, with each component distinctly pigmented so that mixing produces a third color similar to the color of the precast segments and are listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of their products must submit an application conforming to the requirements of Section 6.

In its workable state, or open time, the epoxy bonding agent must function as a lubricant for joining the segments. In its hardened state, the epoxy bonding agent must provide a watertight seal between the precast concrete segments. The hardened epoxy bonding agent must provide intimate contact for stress transfer by completely filling all interstitial space between the match cast segment faces.

Do not use resin or hardeners from containers which are damaged or have been previously opened. Combining of resin and hardener from bulk containers will not be permitted; use only pre-proportioned, full containers of components.

Submit instructions, from the manufacturer, for the safe storage, handling, mixing, and application of the materials.

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SUBARTICLE 452-8.4.2.2 is deleted and the following substituted:

452-8.4.2.2 Temperature Restrictions: Meet the requirements of Section 926 for substrate temperatures, epoxy formulation and thermal controls where precast segments are jointed with epoxy. Measure the substrate temperature at the mid-depth of the top slab for box girder sections or 4 inches from the top surface for slabs and other sections.

SUBARTICLE 452-8.5 is deleted and the following substituted:

452-8.5 Epoxy Jointing of Precast Segments: Furnish, mix and apply a two-component epoxy bonding system, meeting the requirements of this Section, to the match cast faces of joints between precast concrete superstructure and/or substructure segments in accordance with the Contract Documents.

Prior to the use of epoxy on the project, conduct a site meeting with the Engineer and epoxy manufacturer to determine the proper formulations, storage and handling, mixing and application of the epoxy.

Have the necessary materials immediately available at the location of the segment joining, in the event that the segments must be separated and cleaned or epoxy reapplied.

Include in the erection manual required by this Section, details of erection and post-tensioning operations which assure that the time elapsing between mixing components of the first batch of epoxy bonding agent applied to the joining surfaces of precast concrete segments and the application of a compressive contact pressure across the joint do not exceed 70% of the open time for the particular formulation of epoxy bonding agent used. Also, include details of how the minimum, closing, contact pressure of approximately 40 psi will be applied uniformly to each joint to which epoxy is applied during the epoxy curing period. Contact pressure may be attained through combinations of weight and temporary and/or permanent post-tensioning.

452-8.5.1 Cleanliness of Surfaces to be Joined: Ensure that the application surfaces are free from oil, form release agent, laitance or any other deleterious material that would prevent the epoxy bonding agent from bonding to the concrete surface. Remove laitance by light sandblasting, wire brushing. Do not destroy the surface shape and profile of the mating surfaces.

Ensure that the surfaces have no free moisture on them at the time the epoxy bonding agent is applied. Free moisture will be considered present if a dry rag, after being wiped over the surface, becomes damp.

452-8.5.2 Substrate Temperatures and Epoxy Formulation: Apply the epoxy bonding agent only when the substrate temperature of both surfaces to be joined is between 40°F and 115°F. The formulation of the epoxy bonding agent must have an application temperature range that conforms to the substrate temperature of the surfaces being joined. If the mating surfaces have different substrate temperatures, then use the formulation for the higher temperature in hot weather periods. In cold weather periods, use the formulation for the lower temperature. Thermal control precautions may be taken in accordance with 452-8.5.5.

452-8.5.3 Mixing of Epoxy Bonding Agent: Mix the two components of the epoxy bonding agent in strict accordance with the manufacturer's instructions, using only full and undamaged containers. Only open the containers immediately before being combined and do

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not use any which have an expired shelf life. Thoroughly stir each container of component before combining the components. Combine the two components and thoroughly mix until a uniform color is achieved. Mix with a properly sized mechanical mixer operating at no more than 600 rpm or in accordance with the recommendations of the epoxy manufacturer.

Do not mix until the segments to be joined are within approximately 18 inches of their final position. Schedule mixing of the epoxy bonding agent so that the material in a batch is applied to the face of a joint within a maximum of 20 minutes after combining the components.

The Engineer, at his discretion, may require a dry run to check the fit of two surfaces before applying the epoxy.

452-8.5.4 Mating of Segments: Immediately after each mating surface is covered with epoxy bonding agent, bring the segments together and apply the specified compressive contact pressure in accordance with the approved erection procedures. The contact pressure may be increased at any time after the epoxy has taken an initial set. Do not reduce the contact pressure until the epoxy in the joint has properly hardened and cured. If the contact pressure is reduced, do not subject the joint to tensile stress.

A discernable bead line of extruded epoxy bonding agent must be apparent along the exposed edges of the joint. Fill all areas of the joint which do not show a bead of epoxy by dispensing additional epoxy, meeting the requirements of this specification, into the joint using a pneumatic gun with epoxy cartridges. Inject epoxy to a minimum depth of 1 inch.

Catch and retain epoxy which is squeezed out of the joint in areas over waterways, roadways, buildings, etc.

Clean all extruded epoxy bonding agent from external visible surfaces in a way not to damage or stain the concrete surface. Do not smear surplus extruded epoxy bonding agent over large areas (areas more than 1 inch from each side of the joint), visible surfaces or surfaces to which a cover coat, Class 5 applied finish coat or similar or texturing is to be applied later.

Immediately after the segments are joined, swab all embedded (internal) post-tensioning ducts or conduits passing through the joints to smooth out any extruded epoxy bonding agent.

If the time between combining the components of the epoxy bonding agent and applying the compressive contact pressure exceeds 70% of the minimum open time, immediately separate the segments and clean in accordance with 452-8.5.6.

452-8.5.5 Thermal Controls:

452-8.5.5.1 Cooling in Hot Weather: If the substrate temperature exceeds 115°F, do not proceed with epoxy jointing. The Contractor may take precautions to keep the mating substrate surfaces cool by shading or wetting with clean water, except that the above requirements for no moisture at the time of application must be strictly adhered to.

452-8.5.5.2 Artificial Heating in Cold Weather: If electing to erect segments in cold weather when the substrate temperature of the mating concrete surfaces is below 40°F, an artificial environment may be used to increase the substrate temperature subject to the following:

1. Make the artificial environment by an enclosure surrounding the joint through which warm air is circulated, or heating is provided by radiant heaters.
2. Raise the temperature of the concrete substrate across the entire joint surface to at least 40°F.

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3. Prevent localized heating and the temperature of the substrate exceeding 95°F at any point on the surface. Direct flame heating of the concrete is not allowed.

4. Maintain the temperature of the substrate surfaces between 40°F and 95°F for at least 24 hours after joining the surfaces.

5. The Contractor may propose, for review by the Engineer, an optional method of raising and maintaining the substrate temperature of the mating surfaces. Any optional method must meet the thermal restrictions above.

Epoxy jointing operations may proceed if the air temperature is above 45°F and rising and the limitations above are met.

452-8.5.6 Failure to Comply with Time Limits or Incomplete Jointing: If the time limit between mixing of the epoxy-bonding agent and the application of the contact pressure is exceeded, or if the joint is incompletely filled and sealed, separate the segments and remove all epoxy from the faces using spatulas and approved solvent. Do not re-apply epoxy until the faces have been properly cleaned and solvents dispersed, for a period of 24 hours.

452-8.5.7 Removal of Support to Segments:

452-8.5.7.1 Span-by-Span Erection: Ensure that precast concrete segments remain fully supported by the erection truss or system until at least 20 hours after mixing of the last batch of epoxy bonding agent applied to any joint in the span.

452-8.5.7.2 Cantilever Erection: Independent support to a newly erected cantilever segment may be removed when the epoxy bonding agent in the third previous mating joint has set. It is not necessary for the epoxy bonding agent in the new joint or the immediately previous joint to be set prior to removing the independent support of the new segment provided that the temporary and/or permanent post-tensioning has been installed to carry the load of the new and previous segment along with any applied construction loading as per the requirements of the erection system.

452-8.5.8 Record of Jointing: Record and submit to the Engineer on a weekly basis the following information:

1. General:

- a. Date and time of jointing,
- b. Segment numbers or spans jointed,
- c. Weather conditions

2. For each joint (identified by location or segment numbers):

- a. manufacturer's lot number of epoxy bonding agent components.
- b. Temperature of the concrete on the joint surface at the middle of each segment when application of the epoxy bonding agent began.
- c. Time of mixing first batch of epoxy bonding agent applied to the joint and completion of application.
- d. Time of applying the required compressive contact pressure.

3. Details of any repairs performed including reason for repair, joint location, volume of epoxy used, method of application, etc.

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ARTICLE 452-11 is deleted and the following substituted:

452-11 Watertight Decks.

Check all segment joints, closure joints and deck hole repairs to assure every location is watertight, upon completion of all milling and grinding activities on the riding surface. Repair all locations showing evidence of leaks by cutting a 3/8 inches wide x 5/8 inches deep groove along the leak interface. Clean and completely fill the groove with epoxy meeting the requirements of Section 926. Dispense the epoxy into the groove using a pneumatic gun and epoxy cartridges. Clean all excess epoxy bonding agent from external visible surfaces in a way not to damage or stain the concrete surface. Do not smear epoxy over areas located more than 1 inch from each side of the groove.

ARTICLE 452-13 is deleted and the following substituted:

452-13 Basis of Payment.

452-13.1 General: Payment will be in accordance with the following:

452-13.2 Precast Segments-Concrete: Payment for precast superstructure and substructure segment concrete will be at the Contract bid prices per cubic yard for the various classes of concrete called for.

Such prices and payments will be full compensation for manufacture, storage, transport, assembly and erection of the segments complete and in place, including filling all concrete blockouts and similar miscellaneous details. These prices and payments will also include the furnishing and the application of epoxy bonding agent and Class 5 applied finish coating when specified in the Plans, providing temporary and permanent segment access details, material testing, special erection equipment, temporary post-tensioning, tools, labor and incidental items necessary for completing the work in accordance with the Plans, Specifications and approved shop drawings.

Cast-in-place concrete for closure and wet joint pours will be paid for under these items which also include the cost of all formwork, closure devices and other temporary construction needed to make these closures and joints and cast-in-place segments or portions thereof as designated in the Plans.

Include the cost of providing a Class 4 floor finish on the bridge deck and approach slab surfaces in the cost of superstructure and approach slab concrete.

The Bridge floor grooving will be measured and paid for separately.

No additional payment will be made for extra concrete necessitated by approved modifications to the segments or structure needed to accommodate the Contractor's construction methods.

452-13.3 Precast Segments-Reinforcement: Payment for reinforcement in precast segments, closure pours, wet joints and other cast-in-place concrete joints and details will be at the Contract bid price per pound for reinforcing steel (superstructure) and for reinforcing steel (substructure).

No additional payment will be made for extra reinforcement necessitated by approved modifications to the segments or structure for the purposes of the Contractor's construction methods.

452-13.4 Precast Segments-Post-Tensioning: Payment for permanent post-tensioning will be in accordance with Section 462.

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No additional payment will be made for extra permanent or temporary post-tensioning necessitated by approved modifications to the segments or structure for the purposes of the Contractor's construction methods, nor will payment be made for temporary tendons which are approved to be left in the structure, either stressed or unstressed, for the convenience of the Contractor's operations.

452-13.5 Precast Segments-Partial Payment: Partial payment for precast segments will be made at 65% of the bid price per cubic yard of concrete and per pound of reinforcement when the segment has been cast and accepted. Remaining payment will be made when the segment has been erected and accepted for incorporation into the structure. Payment for post-tensioning will be in accordance with Section 462.

452-13.6 Precast Segment-Non-Compliance: Any penalties or deductions for non-compliance with regard to concrete, reinforcement or post-tensioning will be applied to the work affected in accordance with the requirements of the respective specifications.

452-13.7 Precast Segment Production: Preparatory operations for superstructure segment casting will be paid for separately at the Contract Lump Sum price for precast segment production. This item consists of the work necessary for establishing and putting into operation segment casting facilities. It includes preparatory work, operations, acquisition or lease of real property, acquisition or lease of segment manufacturing equipment, acquisition or lease of equipment for the handling, transport and storage of the segments, and all other work or operations which must be performed or costs incurred prior to the manufacture of the concrete segments, including engineering services such as shop drawings.

Partial payments will be made as indicated below:

1. Upon production of documentary evidence, such as paid invoices, canceled checks or similar executed financial instruments, the cost for the acquisition of the casting forms for the precast segments by purchase, lease or manufacture will be paid up to a limit of 25% of the Lump Sum Price bid.
2. When the first precast superstructure segment has been cast out of the first operable casting form and the segment is approved and accepted by the Engineer, 25% of the Lump Sum Price bid will be paid.
3. Thereafter, when each succeeding superstructure segment has been cast out of any operable casting form and approved and accepted by the Engineer, 5% of the Lump Sum Price bid will be paid for each segment up to a limit of 50% of the Lump Sum Price bid (i.e., 5% for each of the next ten acceptable segments).

The total Lump Sum Price bid under this item will not exceed the least of:

1. 12% of the sum of the amounts paid for the concrete in the precast segments only (i.e., excluding any cast-in-place concrete in joints, closures or designated cast-in-place segments) or
2. 5% of the Contract amount excluding mobilization and this item.

The balance of the Lump Sum Price not paid after completion of casting the first eleven satisfactory superstructure segments will be paid after completion of the erection of the first span or closure of the first pair of cantilevers, whichever occurs first.

452-13.8 Epoxy Jointing: No separate payment will be made for the work of epoxy jointing of precast concrete segments. The cost of this work will be included in payment for the various precast concrete items.

452-13.9 Payment Items:

Payment will be made under:

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Item No. 400- 4- 39-Class IV Concrete (Precast Superstructure Segments)-per cubic yard.

Item No. 400- 4- 40-Class IV Concrete (Precast Substructure Segments)-per cubic yard.

Item No. 400- 8- 40-Class V Concrete (Precast Substructure Segments)-per cubic yard.

Item No. 415- 1-4-Reinforcing Steel (Superstructure)-per pound.

Item No. 415- 1-5-Reinforcing steel (Substructure)-per pound.

Item No. 452- 70-Precast Segment Production-lump sum.

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