SPECIAL SPECIFICATION

4425

Concrete Bridge Deck Repair

1. Description. This Item shall govern for the repair of deteriorated and/or damaged areas of concrete bridge decks as herein specified and as directed by the Engineer. Bridge deck repairs are divided into three main classes of repair: Class I for shallow repairs where the damage does not extend to the top mat of reinforcing steel; Class II for mid-depth repair where damage extends to, or slightly below, the top mat of reinforcing steel; and Class III for full depth repair. These classes are further divided into three subclasses depending upon the desired time until return of service (opening to traffic): (A) for rapid return to service within two hours after placing repair materials; (B) for prompt return to service within 24 hours of placement of repair materials; and (C) for postponed return to service of seven days or more after placement of repair materials. For example: A shallow repair requiring an immediate return to service is classified as a Class I (A) repair while a full depth repair where opening to traffic can be delayed is classified as a Class III (C) repair.

2. Materials. All materials shall conform to the pertinent requirements of the following items, except as noted herein:

   Item 420, "Concrete Structures"
   Item 421, "Portland Cement Concrete"
   Item 440, "Reinforcing Steel"
   Special Specification, "Epoxy and Adhesives"

(1) Cementing Materials. Proprietary repair materials are acceptable for use if approved by the Engineer. Information to be included for review shall include all manufacturer's recommendations and material application instructions. At the Engineer's discretion, trial batches for proprietary repair materials may be required to verify that the compressive strengths specified herein are obtained.

Proprietary repair materials shall be certified by the manufacturer to be free of soluble chlorides or other ingredients that may potentially cause corrosion of embedded reinforcing steel.

All repair materials shall have the following minimum compressive strengths depending on the subclass of the repair (return to service time):

   Subclass (A): 2000 psi at two hours
   Subclass (B): 3600 psi at 24 hours
   Subclass (C): 4000 psi at seven days
   The 28-day strength for all subclasses shall be 4000 psi
Trial batches of Portland cement concrete furnished under Item 421, "Portland Cement Concrete", may be required to verify that the compressive strengths specified above are achieved within the given time period. Concrete repair materials shall be air-entrained per Article 421.8, "Classification and Mix Design". For Class I repairs with concrete, the slump shall not exceed one (1) inch and the maximum water-cement ratio shall not exceed 0.35. For Class II repairs with concrete, the slump shall not exceed three (3) inches and the maximum water-cement ratio shall not exceed 0.45. Repair materials for Class III repairs shall conform to the requirements for Class "S" concrete in Item 421, "Portland Cement Concrete".

Admixtures for concrete shall conform to Item 437, "Concrete Admixtures".

(2) **Coarse Aggregate.** Coarse aggregate shall be a crushed or broken aggregate conforming to Section 439.2.(1)(b), "Coarse Aggregate". For proprietary repair materials, the coarse aggregate shall be in conformance with the manufacturer's recommendations.

The maximum aggregate size for a Class I (shallow) repair shall not be greater than Grade 6 or half the average repair depth and for a Class II repair shall be Grade 5 or 6 in accordance with Article 421.2, "Materials". Coarse aggregate for a Class III (full depth) repair shall conform to the requirements for Class "S" concrete in Article 421.9., "Quality of Concrete".

For Class I repairs the coarse aggregate shall not have an absorption exceeding three (3) percent when tested in accordance with Test Method Tex-403-A.

3. **Equipment.** All equipment shall be provided by the Contractor, subject to the approval of the Engineer and shall comply with the following:

(1) **Concrete Removal Equipment.** Scarifying equipment shall conform to the pertinent requirements of Item 483, "Scarifying Concrete Bridge Slab".

Sandblasting equipment shall be capable of removing oil, dirt, slurry, curing compound, laitance, etc., from the surface of the concrete. Equipment for wet sandblasting shall be in accordance with Item 485, "Wet Sandblasting".

Sawing equipment shall be capable of sawing concrete to the specified depth.

Power-driven chipping tools not heavier than the nominal 30 pound class will be permitted for the removal of concrete.

Chipping hammers not heavier than the nominal 15 pound class shall be used to remove concrete beneath any reinforcing bars or along edges of repair area.

(2) **Proportioning and Mixing Equipment.** Mixing equipment for concrete shall be as specified in Item 421, "Portland Cement Concrete". For small areas the Contractor may mix the concrete in a small motor-driven mixer using the volume method of measuring the ingredients. The method used to measure ingredients and the mixing procedure shall be approved by the Engineer.
Mixing equipment for proprietary materials shall be in accordance with the manufacturer's recommendations.

(3) **Placing and Finishing Equipment.** Sufficient and appropriate hand tools for placing and finishing stiff plastic concrete or proprietary repair material and for working them to correct level for strike-off shall be provided.

Immersion type vibrators are required for Class II and III repairs for consolidation of a concrete repair material. Vibrator compactors are required for consolidation of Class I repairs.

A surface vibrator moving ahead of the finishing machine or a vibrating screed, approved by the Engineer, may be required for consolidation for larger repair areas. Manual type screeds with approved vibrators may be used to finish small or irregular areas.

4. **Construction Methods.** All areas to be repaired will be marked by the Engineer. Determination as to the class of repair will be made after the final concrete removal has been completed. The entire perimeter of the area to be repaired shall be saw-cut on the top surface to a depth of approximately one (1) inch. This saw-cutting depth may be lessened as directed by the Engineer in areas where insufficient cover is suspected so that the reinforcing steel will not be cut. For Class III repairs, the bottom surface of the deck shall be chipped around the entire perimeter of the patch area using lightweight chipping hammers to provide as near a vertical surface as possible. Feather edges around this perimeter will not be permitted. The minimum depth of repair for a Class I repair is 3/4 inch.

(1) **Concrete Removal.** All loose, delaminated, spalled or fractured concrete shall be removed to sound material. A jack hammer not heavier than a nominal 30 pound class may be used for removal of loose or deteriorated concrete to a depth down to the existing top reinforcing steel. This class of jack hammer may also be used for concrete removal between existing reinforcing bars to a greater depth, but chipping hammers, not heavier than a nominal 15 pound class, shall be used for removal of concrete beneath any reinforcing bars. Care shall be taken to prevent cutting, stretching or damage to exposed reinforcing steel by direct impact of these power tools. All jack hammers and chipping hammers shall be operated at an angle of 45 degrees or less, measured from the surface of the slab and directed away from the edge of the repair perimeter. Disposal of removed material is the responsibility of the Contractor.

When bond between existing concrete and reinforcing steel that will remain in place has been destroyed, the concrete adjacent to and below the bar shall be removed to a minimum one (1) inch below the bar to permit new concrete to bond to the entire periphery of the exposed bar.

Any reinforcing steel damaged, cut or broken by the Contractor's operations or with section loss due to corrosion greater than 25 percent, shall be restored with new bars of the same size by lapping or welding as directed by the Engineer.

Once the bulk concrete removal has been completed, the perimeter of the area to be patched will be sounded by the Engineer to insure that the removal operation did not
cause additional damage to the existing deck. Any additional damage detected during this sounding shall be repaired as specified herein at no additional cost to the Department.

(2) **Surface Preparation.** Prior to placing repair materials, all exposed reinforcing steel and newly exposed concrete surfaces shall be cleaned by wet or dry sandblasting. The surface shall then be cleaned by water blasting. For a concrete repair material, the prepared surface shall be moist and in an approximately saturated surface dry condition before placing the repair material but should not have any standing water. Surface conditions for proprietary materials shall be in accordance with the manufacturer's recommendations.

Bonding grout or epoxy is not required for Class III repairs. Class I and II repairs will require the use of a bonding agent. The bonding agent may be a Portland cement or latex modified Portland cement grout, or an epoxy system. Immediately before placing the repair material, a thin uniform coating of bonding agent shall be scrubbed into the prepared surface. Care shall be exercised to insure that all surfaces, including vertical faces, receive a thorough, even coating and that no excess bonding agent is permitted to collect in pockets. The bonding agent shall be applied so that it does not become dry prior to application of the repair material. The manufacturer's recommendations for bonding agents shall be followed for proprietary materials.

Form work for Class III repairs shall comply with the provision of Article 420.9, "Forms" and the method of attachment shall be approved by the Engineer.

(3) **Placing and Finishing Repair Materials.** Unless approved by the Engineer, concrete or proprietary repair materials shall not be placed when the air temperature (taken in the shade away from artificial heat) is below 50 F. The temperature of the concrete when placed shall be between 50 F and 85 F.

The replacement material shall be placed and struck off slightly above final grade. It shall then be mechanically consolidated and screeded to final grade. All concrete for Class II and III repairs shall be vibrated to insure complete consolidation into corners and angles of the edges. Hand finishing with a float may be required in order to produce a tight, uniform surface.

The Engineer will specify the type of surface finish in accordance with Article 420.19, "Finish of Roadway Slabs".

(4) **Curing.** Repairs made using concrete shall receive a wet burlap cure as soon as possible after the concrete has been textured. Failure to apply the wet burlap before the repaired area has dried out or cracked shall be cause for rejection of the repair so affected. The wet burlap shall be wet continuously until the repaired area is opened to traffic, but not longer than eight (8) days. The surface temperature of the repair shall be maintained above 40 F for the required curing period. Form work for Class III repairs shall remain in place for the specified curing period. Curing of proprietary repair materials shall be in accordance with the manufacturer's recommendations. Rejected repair areas shall be removed and replaced at no additional cost to the Department.
Any cracks visible in the repair area or around the perimeter of the repair area shall be sealed no sooner than 24 hours after the required curing has been completed. The material used to seal these cracks may be a proprietary crack sealer such as methacrylate or a super low viscosity epoxy subject to prior approval by the Engineer.

5. Measurement. Bridge deck repairs will be measured by the square foot of surface area for the various classes of repairs (Class I, II and III). When a repair involves multiple depths, the areas for each class will be measured separately.

6. Payment. The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Bridge Deck Repair", of the various classes and subclasses specified. A bid price shall be provided for each of the three classes of repair (I, II and III). The subclass (return to service time) will be determined by the Engineer and will remain the same for all classes of a given repair.

These prices shall be full compensation for furnishing and placing all materials, removing and disposing of all loose or deteriorated concrete, saw-cutting, cleaning and/or replacing of reinforcing steel, and for all labor, equipment, tools and incidentals necessary to complete the work.