

PN 511 - 4/15/2005 - ITEM SPECIAL - PATCHING CONCRETE BRIDGE DECK OVERLAYS WITH MICRO-SILICA MODIFIED CONCRETE

A. Description. This item shall consist of furnishing the necessary labor, materials and equipment to repair concrete bridge deck overlays, including the removal of loose and unsound concrete, bituminous patches, surface preparation, bonding coat and the mixing, placing, finishing, curing compressive strength testing and sealing of all the patches as directed by the Engineer.

B. Removal of Unsound Concrete. The Engineer shall sound the wearing surface and backwall tops and outline the areas to be removed. Sounding may have to be delayed until the deck is sufficiently dry to permit detection of all areas of delamination. The perimeter of all removal areas shall be sawed to a depth of 2 inches (50 mm) to produce a vertical or slightly undercut face. Additional saw cuts may be required to facilitate removal. Saw cuts shall not extend beyond the limits of the patch. Cooling water from wet sawing and dust from dry sawing shall not be allowed to contaminate the exposed patch holes. All patches other than sound concrete and all obviously loose and disintegrated concrete shall be removed. The unsound concrete may be removed by chipping or hand dressing. Chipping hammers shall not be heavier than the nominal 35-pound (16 kg) class and shall be operated at an angle of less than 45 degrees measured from the surface of the deck.

Concrete shall be removed in a manner that prevents cutting, elongating or damaging reinforcing steel. Where the bond between the concrete and a primary reinforcing bar has been destroyed, or where more than one half of the periphery of such a bar has been exposed, the adjacent concrete shall be removed to a depth that will provide a minimum 3/4 inch (20 mm) clearance around the bar except where other reinforcing bars make this impracticable. Reinforcement which has become loose shall be adequately supported and tied back into place.

C. Surface Preparation. Cleaning shall closely precede application of the bonding grout or the patching material. The surface to be patched and the exposed reinforcing steel shall be thoroughly cleaned within 24 hours prior to patching by abrasive blasting followed by an air blast. Blasting abrasives containing more than 1% free silica shall not be allowed. It may be necessary to use hand tools to remove scale from the reinforcing steel.

Contamination of the area to be patched by construction equipment or from any other source shall be prevented by placement of a clean 4-mil polyethylene sheet (or any other covering as approved by the Engineer) on the surface of the deck following the air blast cleaning. Where reinforcing steel is exposed, the Contractor shall provide adequate supports for the concrete mixer so that reinforcing steel and its bond with the concrete will not be damaged by the weight and movement of the concrete mixer, or shall provide means to convey concrete from the mixer to the patch locations.

D. Materials, Mixing, Placing and Curing. Overlays shall be patched with MSMC. Micro-Silica Modified Concrete (MSMC)

Material shall conform to the following:

Fine Aggregate (natural sand)	703.02
Coarse Aggregate (No. 8)	703.02
Portland Cement, Type 1	701.04 or 701.01
Water.....	499.02
Chemical Admixture.....	705.12, ASTM C 494, Type A or D
Air-Entraining Admixture	705.10
Superplasticizing Admixture	705.12, ASTM C 494, Type F or G (High Range Water Reducer)
Curing Materials	705.05 or 705.06, White Opaque

Bonding Grout Grout for MSMC patches shall consist of parts of volume as follows:

1 Part Micro-Silica Slurry Mix

6 Parts Cement

10 Parts Sand

1 ½ Parts Water as required to achieve a stiff slurry

The consistency of this slurry shall be such that it can be applied with a stiff brush or broom to the existing surface in a thin, uniform coating. The coating of grout shall be scrubbed onto the dry surface immediately before placing the concrete. Care shall be exercised to insure that no excess grout is permitted to collect in low spots. In no case shall the grout be permitted to dry before placing the new concrete. Grout shall be painted over all joints between the new and existing concrete immediately after the finishing has been completed. The grout shall be mixed and placed within the same time requirements as for the MSMC patches.

Proportioning and all other required characteristics of the mix, e.g. air entrainment and slump, shall be adjusted off the deck before placement of the patches begins. The MSMC mixture shall consist of a workable mixture of uniform composition and consistency with the following proportions:

Type of Coarse Aggregate	Coarse Aggregate lb (kg)	Fine Aggregate lb (kg)	Cement Content lb (kg)	Microsilica lb (kg)	Water-CM Ratio Maximum
Gravel	1520 (689)	1170 (530)	700 (318)	105 (48)	0.36
Limestone	1540 (698)	1170 (530)	700 (318)	105 (48)	0.36
Slag	1335 (605)	1170 (530)	700 (318)	105 (48)	0.36

* The specific gravities used for determining the above weights are: Natural Sand 2.62, Gravel 2.62, Limestone 2.65, Slag 2.30 and Micro-Silica 2.20.

The Contractor shall obtain a written statement from the manufacturer of the Micro-Silica admixture that he is satisfied with the compatibility of the combination of materials and the sequence in which they are combined. It shall be the Contractor's responsibility to supply a concrete which meets these specifications and provides the necessary workability, finishability and pumpability if needed. The Incorporation of individually approved materials into the concrete will not necessarily result in an acceptable mix. The use of different chemical admixtures or aggregates is a distinct possibility, all costs of which shall be included under this item of work.

Deleterious material shall not exceed one-half the requirement for superstructure aggregate and sodium sulfate soundness loss shall not exceed that specified for superstructure concrete in 703.02.

The batch weights previously described shall be corrected to compensate for the moisture contained in the aggregate at the time of use. A chemical admixture (705.12, Type A or D) shall be used. The transit mixer charge shall be limited to 3/4 of its rated capacity or 6 cubic yards, whichever is the smaller, unless a larger size is approved by the Engineer. Any admixture added after the initial mixing shall be mixed a minimum of 5 minutes at mixing speed. After all components have been added, the slump range shall be 6 +/- 2 inches (152 +/- 50 mm). The air content shall be 8 +/- 2 percent at the point of discharge. If slump loss occurs after mixing, the mix may be "retempered" with the admixture. If the consistency of the charge after "retempering" is such as to cause segregation of the components, this will be cause for rejection of the load. The MSMC shall still be placed within the 90 minute limitation.

Concrete shall be mixed in a central mixing plant or ready-mixed concrete truck capable of discharging concrete having a maximum water-cement ratio of 0.36.

Central mixing plants and ready-mixed concrete trucks shall meet the requirements of 499.06 (B). Admixtures shall be introduced into the concrete in such a manner that will disperse it throughout the entire load. Batch plants shall meet the requirements of 499.06 (A) and shall be located such that the maximum time required from start of mixing to completion of discharge of the concrete at the site of work shall not exceed 90 minutes.

The overlay patches shall be water cured as per 511.17 method (A), using continuous sprinkling and no plastic sheeting, for a minimum of 24 hours followed by a membrane cure per 511.17 Method (B).

An evaporation retardant and finishing air may be used at the Contractor's option prior to the texturing operation. Any product used for such purpose shall be specifically marketed for said use. (Plain water is not acceptable) The evaporation rate shall not exceed the hourly surface evaporation rate as determined by Figure 1 ACI 308-81.

Immediately after the texturing operation the Contractor shall spray an evaporation retardant over the textured area. The application rate shall be as per the manufacturer's recommendations. The wet burlap cure shall follow this operation as closely as possible.

The Contractor will supply a properly calibrated impact rebound hammer to verify that the patches have reached 2000 psi (13.8 MPa) compressive strength prior to opening to traffic. The MSMC patching material shall be placed only when the local ambient temperature is above 45 °F (8 °C) and is forecast to remain above 45 °F (8 °C) for the curing period. The MSMC shall not be placed when rain is forecast within the intended period. MSMC shall be placed only if the patch surface evaporation rate, as affected by the ambient air temperature, concrete temperature, deck temperature, relative humidity and wind velocity, is 0.1 pound per square foot per hour or less. The Contractor shall determine and document the atmospheric conditions subject to verification by the Engineer.

No MSMC shall be placed if the ambient air temperature is 85 °F (30 °C) or higher or predicted to go above 85 °F (30 °C) during the patching procedure regardless of the surface evaporation rate. No traffic shall be permitted on the patches until the 24 hour water cure is completed and the 2000 psi (13.8 MPa) strength is obtained. The temperature at the patch surface shall be maintained above 35 °F (2 °C) until the curing period is completed.

Figure 1 ACI 308-81 shall be used to determine graphically the loss of surface moisture for the patches. In no case shall the temperature of the MSMC exceed 90 °F (30 °C) during placement. If rain occurs during placing of the material, all operations shall cease. No MSMC patches shall be placed after October 31st except by specific permission of the Director.

During delays in the patch placement operations of more than 10 minutes, the work face of the placed patch material and any bonding grouted areas shall be temporarily covered with wet burlap. If an excessive delay is anticipated, a bulkhead shall be installed at the work face and the overlay placement operation terminated.

Unless otherwise authorized by the Engineer, patch shall not be placed adjacent to a previous patch which has cured for less than 24 hours.

Adequate precautions shall be taken to protect the freshly placed MSMC from rain.

E. Lighting. If placement of the patches is to be made at night, the Contractor shall submit a plan which provides adequate lighting for work area. The plan shall be submitted at least 15 calendar days in advance and be approved by the Engineer before concrete is placed. The lights shall be directed so that they do not affect or distract approaching traffic.

F. Screeding. The patching material shall be placed, consolidated and finished to the adjacent grade. Patches exceeding 50 ft² (4.6 m²) shall be leveled and consolidated with a mechanical vibrating

screed. Smaller patches shall be hand vibrated and leveled with a straightedge. The screed shall be placed parallel to the bridge centerline so that the deck profile remains consistent with the worn surface.

The Contractor shall test the surface of the plastic concrete for trueness and for being flush with the edges of the adjacent surfaces by use of a straightedge. The straightedging shall be done by placing the straightedge parallel to the bridge centerline with the ends resting on the existing wearing surface adjacent to the patch and drawing the straightedge across the patch. Any high or low areas exceeding 1/8 inch in 10 feet (3mm in 3m) shall be corrected. If any corrections are made, the surface shall be rechecked.

G. Texturing. After the patches have been consolidated and finished they shall be textured in accordance with 451.09.

H. Inspection and Sounding of Concrete Patches. After curing and before final acceptance, all patched areas shall be sounded. All delaminated areas shall be removed and repatched according to this note. All patches which are sound but show signs of cracking shall be sealed and the perimeter of all patches shall also be sealed with gravity fed resin.

All sounding and replacement of rejected areas will be the responsibility of the Contractor and included in the unit bid price for this item.

I. Method of Measurement. The quantity shall be the actual area in square yards of the exposed surface of all patches, irrespective of the depth of the patch, complete, in place and accepted.

J. Basis of Payment. Payment shall be made at the contract price bid for:

Item	Unit	Description
Special	Square Yard (Square Meter)	Patching Concrete Bridge Deck Overlays with Micro-Silica Modified Concrete