C. TOTAL SURFACE HYDRO DEMOLITION AND MONOLITHIC DECK REPAIR 11/01/19

**1.0 Description.** This provision describes requirements for the hydro demolition process and all other preparatory and repair work associated with the placement of a concrete wearing surface on a bridge deck. Included in this provision are the requirements for scarification of the bridge deck, removal of all existing deck repairs, conventional deck repair of special repair zones prior to hydro demolition, total surface hydro demolition of the deck, conventional deck repair after hydro demolition, preparation of the deck for a concrete wearing surface, and monolithic deck repair.

**2.0 Mechanical Scarification of the Bridge Deck.**

**2.1** Prior to hydro demolition, any existing wearing surface (concrete, asphalt, seal coat, etc.) shall be removed and the original deck shall be scarified to the depth as shown on the plans or to the adjusted depth described in Section 2.4. Scarification shall be done by mechanical means such as cold milling.

**2.2** Removal of any existing deck surface, including measurement and payment, shall be in accordance with Sec 216.30. Scarification is included in the cost of the removal of the existing wearing surface.

**2.3** For decks that do not have an existing wearing surface, the deck shall be scarified with measurement and payment made in accordance with Sec 216.20, Scarification of Bridge Decks.

**2.4** Prior to scarification of the existing deck, the contractor shall verify the depth of the top mat of reinforcing steel within the deck. If the depth of the reinforcing steel is less than 0.5 inch, the cold milling depth shall be reduced to avoid damage to the reinforcing steel. Any reinforcing steel damaged by the milling operation shall be repaired or replaced at the contractor’s expense.

**3.0 Identifying Existing Deck Repairs.**

**3.1** Following scarification of the deck and prior to hydro demolition, the entire deck surface shall be thoroughly cleaned by high pressure water blasting with sufficient pressure to remove all debris. After cleaning, all existing deck repairs will be measured by the engineer and marked for removal over the full deck. Existing deck repairs are defined as any sound or unsound repairs made to the original deck previous to this project.

**4.0 Zoned Conventional Deck Repair Prior to Hydro Demolition on Existing Cast-In-Place Concrete Box Girder, Solid Slab and Voided Slab Bridges Only (Not applicable for prestressed concrete or steel beam and girder bridges.)**

**4.1** Following scarification of the deck and prior to hydro demolition, repairs shall be done inside special repair zones as called for in the contract plans in accordance with Sec 704 except as follows:

(a) The removal and replacement of all sound and unsound existing deck repairs shall be considered as half-sole repair in accordance with Sec 704.

(b) Monolithic deck repair as specified in Section 5.12 shall be used to replace shallow deteriorated concrete when only half the diameter or less of the top mat of reinforcing steel is exposed.

(c) The area to come in contact with new concrete shall be thoroughly sand or shot blasted to remove all foreign matter, dirt, free standing water, loose material and micro-cracking. Containment and disposal of material shall be in accordance with Sec 202.2.

**4.2** Hydro demolition shall not move forward until the repairs in all special repair zones are complete and properly cured.

**5.0 Total Surface Hydro Demolition and Deck Repair.**

**5.1 Description.** This work shall consist of the selective removal of all unsound original concrete over the entire top surface of the bridge deck, and establishment of a highly rough and bondable surface, with a single pass of hydro demolition equipment. Unsound original concrete is defined as existing bridge deck concrete that is deteriorated, spalled or as determined by the engineer to be unacceptable.

**5.2 Material.** Water used in the hydro demolition shall be in accordance with Sec 1070.

**5.3 Environmental Compliance.**

**5.3.1** Prior to the start of any bridge repair work, the contractor shall submit to the engineer for review an Environmental Compliance Plan (ECP) that ensures compliance with all federal, state, and local environmental laws and regulations. The ECP shall include specific details of the contractor’s plan for containment, filtering, and disposal of water, slurry, and other debris, including all best management practices (BMPs) that the contractor plans to utilize to prevent environmental pollution and protect the waters of the state.

**5.3.2** All drains, joints, and other locations where discharge water could exit the deck shall be blocked in order to direct runoff to a central collection and filtering location, as designed by the contractor. When runoff is allowed to be dispersed adjacent to the bridge, BMPs shall be utilized to contain and filter the slurry to prevent the discharge of slurry or other contaminants.

**5.3.3** No direct payment will be made for compliance with this ECP, including, but not limited to, containment of the water and slurry, installing, maintaining, and removing the BMPs, filtering, and disposal of all waste materials.

**5.4 Equipment.**

**5.4.1 General.** The hydro demolition process shall consist of a water supply system, a high pressure water pumping system, and a demolition type unit. The demolition unit shall be robotic, computerized, and self-propelled, utilizing a high pressure water jet stream that is capable of removing concrete to the desired depths specified with a single pass of the unit, including the selective removal of all unsound original concrete. It shall also be capable of cleaning rust and concrete particles from all exposed reinforcing steel. The resulting concrete surface profile shall be one that is highly rough and bondable.

**5.4.1.1** The hydro demolition equipment shall provide shielding to ensure containment of all dislodged concrete within the removal area in order to protect the traveling public and work crew from flying debris on, adjacent to, and below the work site.

**5.4.1.2** Vacuum equipment shall be utilized for clean-up of hydro demolition debris. This equipment shall be equipped with fugitive dust control devices and shall be capable of removing wet debris and standing water in the same pass.

**5.4.2 Calibration.** The hydro demolition equipment shall be calibrated on a representative sample of sound deck concrete, as directed by the engineer. The calibration will demonstrate the ability to cut to the desired depth or depths, as indicated on the plans, in a single pass. The minimum allowable water pressure shall be 13,000 psi and the maximum water pressure shall not exceed 20,000 psi. The calibration shall accomplish the desired surface roughness, profile, and cutting depth as indicated on the contract plans. The equipment shall then be moved to an area of deteriorated deck, as directed by the engineer, in order to demonstrate the ability to remove all unsound original material. The equipment shall selectively remove all unsound original concrete, avoid the removal of unnecessary sound concrete, and provide a highly rough and bondable surface.

**5.4.2.1** If the equipment does not demonstrate the ability to produce the desired result, as determined by the engineer, the equipment shall be removed from the project and the contractor shall provide other equipment for calibration. No additional contract time or compensation will be allowed for the mobilization of replacement equipment to the work site.

**5.4.2.2** After the contractor has calibrated the equipment settings to the satisfaction of the engineer so that the equipment does selectively remove all unsound original concrete and provide a highly rough and bondable surface, without removing additional sound concrete, the calibration will be approved by the engineer and the contractor shall record the equipment settings as follows:

|  |  |
| --- | --- |
| Water Pressure Gauge |   |
| Water Pressure Gauge Inside Special Repair Zones a |  |
| Machine Staging Control (Step) |   |
| Machine Staging Control (Step) Inside Special Repair Zones a |  |
| Nozzle Size |   |
| Nozzle Type |   |
| Nozzle Travel Speed |   |
| Water Usage Rate |   |

a Only applicable inside special repair zones on existing cast-in-place concrete box girder, solid slab and voided slab bridges. Not applicable for prestressed concrete or steel beam and girder bridges.

**5.5 Removal of Existing Deck Repairs Prior to Hydro Demolition.**

**5.5.1** For bridges without special repair zones, prior to hydro demolition, the contractor shall remove all sound and unsound existing deck repairs using conventional hand/mechanical equipment in accordance with Sec 704.

**5.5.2** For bridges with special repair zones, prior to hydro demolition, the contractor shall remove all sound and unsound existing deck repairs outside special repair zones using conventional hand/mechanical equipment in accordance with Sec 704.

**5.5.3** Removal shall not include any unsound original bridge deck concrete.

**5.5.4** Payment for removal of both sound and unsound existing deck repairs will be made per Section 7.2.

**5.5.5** Following removal of existing deck repairs, all debris shall be removed from the deck prior to hydro demolition, at no additional cost.

**5.6** **Hydro Demolition Operation Requirements.**

**5.6.1** After calibration of the equipment, the contractor shall perform total surface hydro demolition over the entire surface of the bridge deck.

**5.6.1.1** For bridges without special repair zones, the settings shall be maintained throughout the operation, unless the desired results are not being attained, in which case re-calibration shall be performed.

**5.6.1.2** For bridges with special repair zones, two separate settings shall be maintained throughout the operation. One set of settings shall be maintained throughout the operation outside special repair zones unless the desired results are not being attained, in which case re-calibration shall be performed. Another set of settings shall be maintained throughout the operation inside special repair zones unless the desired results are not being attained, in which case re-calibration shall be performed.

**5.6.1.3** Calibration shall be required on each bridge and when different equipment is brought to the site for use. The engineer will periodically verify the calibration settings to ensure the desired results are being attained.

**5.6.2** The operator shall minimize the overlap of the individual hydro demolition passes to limit the amount of sound concrete removal.

**5.6.3** When the hydro demolition process is taking place above an area of concern, the contractor shall take measures to protect that area from hydro blasting through the deck, falling debris, water runoff, or any other action that the engineer considers a risk to public safety or a risk of property damage. An area of concern shall include vehicular traffic, boat traffic, pedestrian traffic, parking areas, private property, railroad property or any other area of concern as determined by the engineer.

**5.6.4** Only those vehicles directly required to perform the hydro demolition work and clean-up, or corresponding wearing surface construction equipment, shall be allowed on the bridge deck. Contamination of the deck by construction equipment or any other source shall be prevented.

**5.6.5** The contractor shall clean up the slurry and rubble from the hydro demolition operation as soon as possible following the hydro demolition process. This clean-up shall be completed prior to the drying of the slurry on the deck and reinforcing steel. The contractor shall utilize a vacuum collection type system capable of removing wet debris and water in a single operation. Following the cleaning, the surface shall be free of all debris, loose material, slurry, or cement paste.

**5.7 Incidental Conventional Concrete Removals After Hydro Demolition.**

**5.7.1** After the deck has been cleaned and dried, and is free of frost, the engineer will perform a second sounding test of the entire deck and identify any unsound original deck material that remains.

**5.7.2** The contractor shall remove all identified unsound original deck material, as well as any areas on the deck that where inaccessible to the hydro demolition equipment. This removal work shall be included in the cost of the hydro demolition.

**5.7.3** All removals after hydro demolition shall be done with pneumatic hammers no heavier than the nominal 35-pound class and operated no more than a 45 degree angle from the horizontal. Use of mechanical equipment for the purpose of chipping shall be kept to the absolute minimum to avoid creating micro-fractures on the surface of the deck.

**5.7.4 Reinforcing Steel Repair.** The contractor shall take steps necessary to prevent damage to existing reinforcing steel. All equipment shall be operated in a manner that does not damage the deck, reinforcing steel or superstructure components. Any damage caused by the contractors equipment or negligence shall be repaired at the contractors expense.

**5.7.4.1** Reinforcing steel that is exposed by the process shall be thoroughly cleaned by sand, shot or hydro blasting to the satisfaction of the engineer.

**5.7.4.2** Reinforcement repair shall be in accordance with Sec 704. Replacement of damaged reinforcing steel may include the removal of additional concrete to adequately anchor reinforcing steel to the appropriate lap splice length in accordance with Sec 706.

**5.7.4.3** No direct payment will be made for additional cleaning of reinforcing steel or for removal of loose concrete from the bars. Replacement of reinforcing steel will be made at the fixed unit price in Sec 109.15, except that no payment will be made for replacement of reinforcing steel cut or broken by the contractor.

**5.8 Conventional Repairing Concrete Deck (Half-Soling) After Hydro Demolition.**

**5.8.1** For polyester polymer concrete or low slump concrete wearing surfaces, following removal of unsound original concrete by hydro demolition and hand chipping, any areas requiring repairing concrete deck (half-soling) will be identified by the engineer.

**5.8.2** All repairing concrete deck (half-soling) identified by the engineer shall be made prior to the deck wearing surface.

**5.8.3** Repairing concrete deck (half-soling) shall be in accordance with Sec 704 except that the removal is accomplished by hydro demolition and limited only to locations where the removal of concrete around the perimeter of the top transverse reinforcing steel is required.

**5.8.4** Concrete or qualified repair mortars used for repairing concrete deck (half-soling) shall be fully cured prior to the wearing surface.

**5.9 Conventional Full Depth Repair After Hydro Demolition.**

**5.9.1** Following removal of unsound original concrete by hydro demolition and hand chipping, any areas requiring a full depth repair will be identified by the engineer.

**5.9.2** For polyester polymer concrete or low slump concrete wearing surfaces on all bridge decks and all concrete wearing surfaces on voided slab bridges, all full depth repair shall be made prior to the deck wearing surface in accordance with Sec 704 except that the removal is accomplished by hydro demolition.

**5.9.3** For concrete wearing surfaces not covered by 5.9.2, full depth repair for areas greater than 5 square feet (3 square feet in areas of presstressed panels) shall be made prior to the deck wearing surface in accordance with Sec 704 except that the removal is accomplished by hydro demolition and concrete may be placed in the repair area up to one inch below the top mat of reinforcement.

**5.9.4** If the engineer determines that for concrete wearing surfaces not covered by 5.9.2, full depth repair for areas less than or equal to 5 square feet (3 square feet in areas of presstressed panels) can be made monolithic with the new deck wearing surface, the contractor shall form the bottom of the repair prior to the wearing surface. No payment will be made for forming the bottom of full depth monolithic repairs, including form removal.

**5.9.5** Concrete or qualified repair mortars used for full depth repair shall be fully cured prior to the wearing surface.

**5.10 Void Tube Replacement Requiring Conventional Deck Repair After Hydro Demolition.**

**5.10.1** Following removal of unsound original concrete by hydro demolition and hand chipping, any void tubes requiring replacement will be identified by the engineer.

**5.10.2** Deck repair required for void tube replacement shall be in accordance with Sec 704 except that the removal is accomplished by hydro demolition.

**5.10.3** Concrete or qualified repair mortars used for deck repair with void tube replacement shall be fully cured prior to the wearing surface.

**5.11 Preparation of Deck for Concrete Wearing Surface.**

**5.11.1** All areas of the deck, where further removal of concrete was performed with pneumatic hammering after the hydro demolition, shall be thoroughly sand or shot blasted to remove any loose material and micro-cracking. Containment and disposal of material shall be in accordance with Sec 202.2.

**5.11.2** After completion of sand or shot blasting and associated clean-up of debris, the entire deck surface shall be thoroughly cleaned by a minimum 7000 psi pressure water blasting to remove all debris and slurry residue within 24 hours prior to wearing surface placement begins. Water blasting shall continue until the run-off water from cleaning flows clear.

**5.11.3** After cleaning, the deck surface shall be thoroughly saturated to the point that the surface does not dry out, and any excess water removed with compressed air. Clean polyethylene sheeting shall then be used to cover the deck completely until such time as the wearing surface is poured**.**  Just prior to placement of the wearing surface, the deck shall be brought to a saturated surface dry (SSD) condition and maintained in a SSD condition throughout the pour, with no ponding of water.

**5.12 Monolithic Deck Repair.**

**5.12.1** Monolithic deck repair is defined as providing and placing the deck wearing surface material necessary to fill all depressions in the deck below the bottom of the planned deck wearing surface thickness. This material is placed monolithic during the deck wearing surface process.

**5.12.2** Any standing water on the deck or in the depressed areas shall be removed prior to placement of concrete wearing surface material. Hand vibrators shall be used in areas where concrete is being placed around reinforcement, deeper areas within the pour, and along curb lines and construction joints.

**5.12.3** For polyester polymer concrete or low slump concrete wearing surfaces on all bridge decks and all concrete wearing surfaces on voided slab bridges, shallow areas shall be filled monolithically with the deck wearing surface.

**5.12.4** For concrete wearing surfaces not covered by 5.12.3, shallow and deep areas, including approved full depth repair areas, shall be filled monolithically with the deck wearing surface. Deep areas shall be filled in advance during the wearing surface pour so that material stiffens enough that it will not roll back under the paving screed.

**5.12.5** The volume of material necessary to fill areas removed by the contractor’s negligence, including milling too deep during scarification and excessive overlap of hydro demolition passes, will be deducted from the total quantity of monolithic deck repair.

**6.0 Method of Measurement.**

**6.1** Measurement for Removal of Existing Deck Repairs will be made to the nearest square foot. For bridges without special repair zones, measurement will include all sound and unsound existing deck repairs. For bridges with special repair zones, measurement will only include all sound and unsound existing deck repairs outside special repair zones.

**6.2** Measurement for conventional deck repair will be done in accordance with the pay items called for in the contract plans.

**6.3** Measurement for Total Surface Hydro Demolition will be per square yard of the bridge deck as specified on the plans or shown in the contract. No final measurement will be made for hydro demolition except for authorized changes during construction or where appreciable errors are found in the contract quantity.

**6.4** Measurement for Monolithic Deck Repair and Very Early Strength Monolithic Deck Repair will be made to the nearest cubic yard. The quantity of monolithic deck repair will be determined by deducting the theoretical volume of material necessary to construct the deck wearing surface at plan thickness from the total volume of deck wearing surface material placed on the deck surface. Any volume of material wasted or used to fill depressed areas caused by the contractor’s negligence in scarification or concrete removal will not be included in this quantity.

**7.0 Basis of Payment**

**7.1** Payment for removal of an existing wearing surface, when required, and scarification will be as specified in Section 2.0.

**7.2** Payment for Removal of Existing Deck Repairs will be made at the contract unit price.

**7.3** Payment for conventional deck repair will be done in accordance with the pay items called for in the contract plans.

**7.4** Payment for Total Surface Hydro Demolition of the bridge deck will be paid for at the contact unit price. Payment includes all work associated with the hydro demolition process including, but not limited to, ECP, equipment calibration, hand chipping curb areas, removal of remaining unsound original concrete, clean-up of debris and slurry, forming for full depth monolithic repairs, and preparation of the deck for concrete wearing surface.

**7.5** Payment for Monolithic Deck Repair and Very Early Strength Monolithic Deck Repair will be made at the fixed unit price for the type of wearing surface material specified in the plans. Fixed unit prices shall be: $800 per cubic yard for low slump concrete, $700 per cubic yard for latex modified concrete, $800 per cubic yard for silica fume concrete, $500 per cubic yard for steel fiber reinforced concrete, $900 per cubic yard for polyester polymer concrete, $900 per cubic yard for latex modified very early strength concrete and $700 per cubic yard for CSA cement very early strength concrete. Payment includes all material, labor and equipment, and any other incidental items necessary to complete the work. Labor and equipment costs for placing the wearing surface concrete monolithically with the deck repair will be considered completely covered by the contract unit price for the concrete wearing surface.