ITEM 502.4FRM 11 M – PARTIAL DEPTH CONCRETE REPAIR USING OPTIONAL MATERIALS

DESCRIPTION. Prepare an existing portland cement concrete (PCC) pavement surface and place a very high early strength (VHES) concrete or rapid hardening concrete repair material where indicated in the contract documents.

MATERIALS AND EQUIPMENT.

Aggregates 501-2.02B
Admixtures 501-2.02C
Concrete Batching Facility Requirements 501-2.03
Concrete Mixer and Delivery Unit Requirements 501-2.04
Handling, Measuring, and Batching Materials 501-3.02
Concrete Mixing, Transporting, and Discharge 501-3.03
Coarse Aggregate 703-02
Premoulded Resilient Joint Filler 705-07
Rapid Hardening Concrete Repair Material 701-09
Membrane Curing Compound 711-05
Water 712-01

Use friction aggregate meeting §501-2.02B2, Friction, that corresponds to the item specified. See Basis of Payment. Use non-reactive aggregate, as identified in the *Approved List of Sources of Fine & Coarse Aggregate,* with high alkali cementitious products.

Fibers. When specified, use fibers approved by the Director, Materials Bureau, that are specifically designed for use as secondary concrete reinforcement. See Basis of Payment.

Transit Mixed and Truck Mixed VHES Concrete. Use trucks calibrated and approved by the Regional Materials Engineer. Apply a total of 100 – 200 mixing revolutions before discharge. Apply the following in addition to the standard specification sections listed above.

A. Accelerating Admixtures. Accelerating admixtures may be batched into transit mixed concrete at the plant in accordance with §501-2.03F, Admixture Dispensing Systems, or added at the site during or after any water addition. For truck mixed concrete, accelerating admixtures are always added at the site and after the water is added.

When adding accelerating admixtures at the site, equip trucks with an air pressurized tank that:

- Contains the correct volume of admixture (for the volume of concrete in the truck) dispensed through the plant's Admixture Dispensing System.
- Discharges the admixture into the mixer drum in less than 1 minute.
- Has a clear plastic tank output hose that leads into the mixer drum.
- Has a properly working relief valve.

Add the entire accelerating admixture into the mixer drum in 1 uninterrupted operation in 1 minute or less.

B. Aggregate Moisture Content. Twice daily, or more frequently if weather conditions change significantly as determined by the Engineer, determine the aggregate moisture content in accordance with

Materials Method 9.1, *Plant Inspection of PCC.* Compute the corresponding water added to the concrete in the truck from aggregate moisture. Subtract that quantity, as well as the water portion of the admixture in the tank and water added at the plant from the design water for the truck. Submit these calculations to the NYSDOT plant inspector for approval. Upon approval, write the maximum volume of water to be added to the truck at the site on the delivery ticket. Upon arrival at the site, provide the delivery ticket to the Engineer. Do not add more water than the maximum volume indicated on the delivery ticket.

C. In-Line Water Flow Meter. Equip trucks with an in-line water flow meter that:

- Resets easily to "0".
- Is mounted to allow easy reading.
- Withstands water temperatures up to 93°C.
- Is equipped with air strainers capable of removing entrapped air within the system.
- Has a batching delivery tolerance of 1% by weight or volume.
- Has a manufacturer's certified flow rate capacity of 265 l/min.
- Has a minimum actual flow rate of 190 l/min.

The Regional Materials Engineer will measure the actual flow rate and inspect the flow meter prior to use. Reset the flow meter to 0 before adding any water at the site.

For truck mixed concrete, execute 20 dry revolutions at 12 to 18 rpm before adding water. Add water in 1 uninterrupted operation. No water is to be removed from the truck for any purpose while water is being added to the drum. After the required water designated on the delivery ticket has been added, add the entire accelerating admixture, if any, as described above in Accelerating Admixtures.

VHES Concrete Trial Batch. Design the mix to satisfy Table 1, VHES Concrete Mix Requirements. Submit the mix design to the Engineer. Include admixture brands and dosages as well as mixing, transporting, placing, paving, curing, and anticipated strength gain details.

Produce and place a 2.3 m^3 (minimum) trial batch at an off-project location approved by the Engineer. Produce the trial batch using the same materials and processes as those to be used to produce the project concrete. Provide the Engineer a 7 day minimum advance notification of trial batch production. Coordinate trial batch production to ensure the presence of the Engineer, the Regional Materials Engineer, and Materials Bureau personnel.

Provide an American Concrete Institute (ACI) Certified Concrete Field Testing Technician, Grade I, or higher, to:

- Measure slump, air content, and unit weight.
- Cast cylinders compressive strength and freeze-thaw resistance.

Begin compressive strength testing of the trial batch concrete 1 hour after discharge. Unless otherwise noted in the contract documents, use an agency accredited by the AASHTO Accreditation Program (AAP) in the field of construction materials testing of portland cement concrete to perform compressive strength testing. Cast and test in the presence of the Engineer, or the Engineer's representative. Provide acceptable proof of ACI Certification and AASHTO Accreditation to the Engineer before placing any concrete.

Cast a minimum of 12 cylinders in accordance with Materials Method 9.2, *Field Inspection of Portland Cement Concrete.* Determine the concrete compressive strength in accordance with ASTM C39, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.* The mix will be considered acceptable for use if 3 cylinder pairs (6 total) meet the following strength criteria:

- Average compressive strength of all cylinder pairs exceeds 17.2 MPa in 3 hours.
- Average compressive strength of each cylinder pair exceeds 13.8 MPa in 3 hours.

Cast a minimum of six (6) 100 mm x 200 mm cylinders for freeze-thaw testing. Materials Bureau personnel will transport the cylinders and conduct freeze-thaw testing.

Changes other than minor fluctuations in admixture dosage rates require a new mix design and trial batch. The Engineer may halt paving and order additional trial batches whenever the specified properties are not achieved.

TABLE 1 VHES CONCRETE MIX REQUIREMENTS

Property	Minimum	Desired	Maximum
Opening Compressive Strength	17.2 MPa	-	-
Freeze-Thaw Loss	-	-	10 %
Slump[1]	25 mm	-	200 mm

NOTES:
1. Minimum slump provided the mix consolidates and finishes properly. Maximum slump provided the mix is nonsegregating.

Rapid Hardening Concrete Repair Material. Provide the Engineer the Manufacturer's written instructions for mixing, bonding, placing, and curing the material. Follow the Manufacturer's instructions. Do not exceed the prescribed water amount. Extend with coarse aggregate having a 1A gradation. Use a maximum aggregate extension rate of 60% of the dry, pre-packaged weight of repair material.

Coring Equipment. Use trailer or truck mounted core rigs with diamond impregnated bits capable of coring 100 mm into the pavement. Use a core rig shaft capable of moving in multiple directions to readily position the bit over the removal area. Use a bit of sufficient diameter to remove the entire repair area to sound concrete. Maintain equipment and supplies to ensure uninterrupted operation. Supply a template equal in diameter to the bit outer diameter to mark removal areas prior to coring. Supply a steel sleeve having an outer diameter equal to the core bit outer diameter that is inserted into the core to protect the surrounding pavement during Concrete Removal described below.

Saw Cutting Equipment. Use diamond blade saws capable of making straight, 100 mm deep, saw cuts. Use saws equipped with cutting guides, blade guards, water cooling systems, dust control, and cut depth control. Maintain equipment and supplies to ensure uninterrupted operation

Chipping Hammers. Use chipping hammers weighing no more than 13.6 kg (including bit and muffler) equipped with sharp spade bits. Provide the Engineer hammer specifications from the Manufacturer before sawing. Use a maximum air pressure of 690 kPa (measured at the compressor) to power the hammer. Supply an air pressure gauge at the compressor that allows the Engineer to easily monitor air pressure. Maintain equipment and supplies to ensure uninterrupted operation. The Engineer may halt operations if concrete to remain in place is damaged by the hammers.

Milling Machines. Use a milling machine with a 300 mm (minimum) wide milling head and equipped with a mechanism that maintains the milling operation at a preset depth.

Vibrators. Use hand-held vibrators having a maximum diameter of 25 mm and capable of operating through a frequency range of 6000 - 9000 vibrations per minute.

CONSTRUCTION DETAILS. Meet with the Engineer as soon as practical to coordinate all aspects of removal, preparation, and material placement including mixing, transport, and discharge, material requirements and testing, and personnel requirements.

Determine Repair Boundary - Coring Method. Sound the area surrounding the repair with a 1 – 1.5 kg hammer to identify delaminated areas and include them within the repair boundary. Place the template described above in Coring Equipment over the damaged and delaminated area and mark the boundary. If a joint or crack crosses the repair boundary, position the template such that the joint or crack crosses through the middle ⅓ of the repair boundary. If the template can not be positioned such that the repair boundary extends completely into sound concrete, or a joint or crack can not be accommodated in the middle ⅓, determine the repair area in accordance with Determine Repair Boundaries - Saw Cut Method.

Determine Repair Boundary – Saw Cut Method. Sound the area surrounding the repair with a 1 – 1.5 kg hammer to identify delaminated areas and include them within the repair boundary. Extend repair areas 75 – 150 mm beyond the visible deterioration or delaminations, whichever is larger. Combine repair areas within 150 mm of each other into one repair. Keep repair areas as square as possible. Avoid irregular repair shapes. Mark the repair boundary outlines.

Core Repair Boundary. Do not core until the Engineer approves the repair boundary. Core 50 – 100 mm into the pavement. Core sufficiently deep to ensure sound concrete is reached and new concrete faces are exposed.

Saw Cut Repair Boundary. Do not saw cut until the Engineer approves the repair boundary. Diamond blade saw cut the repair boundaries 50 – 100 mm deep. Cut at right angles to the pavement joints and the pavement surface. Over cut intersecting saw cuts such that the entire repair area is cut to the same depth.

Concrete Removal – Saw Cut Method. Use chipping hammers or a combination of chipping hammers and milling machines to remove concrete within the saw cuts. Remove concrete such that the repair bottom is at a uniform depth, ± 25 mm, and sound concrete is exposed along all faces. Do not operate milling machines within 25 mm of the saw cuts. Use chipping hammers in these locations to establish the proper repair depth. Discontinue removal if:

- Pavement joint hardware is encountered.
- The required repair depth exceeds 100 mm.
- The PCC surrounding or below the removal area is unsound.

In this instance the Engineer will determine the required repair, typically full-depth removal and replacement.

Concrete Removal - Coring Method. Use the steel sleeve described above in Coring Equipment and a chipping hammer to remove concrete within the core. Remove concrete such that the repair bottom is at a uniform depth, ± 25 mm, and sound concrete is exposed along all faces. Discontinue removal if:

- Pavement joint hardware is encountered.
- The required repair depth exceeds 100 mm.
- The PCC surrounding or below the removal area is unsound.

In this instance the Engineer will determine the required repair, typically full-depth removal and replacement or partial-depth removal by the saw cutting method.

Clean the Repair Bottom and Vertical Faces. As close to placement as possible, thoroughly abrasive blast all concrete surfaces that will be in contact with the repair material such that they are uniformly abraded and free of any dirt, laitance, oil, or other material that may prevent bond. Immediately before placement, air blast the repair to remove any remaining debris and moisture. The Engineer will check the:

- Air stream with a clean, white cloth to ensure no oil or contaminants are in the air blast.
- Repair surfaces for dust by wiping the repair faces with a dark cloth or glove.

Re-clean the repair if dust is found on the surfaces.

Place Joint or Crack Insert. Fill joints or cracks that abut or cross the repair with a commercial caulk such that no concrete enters the joint or crack. Align premoulded resilient joint filler or commercial waxed corrugated cardboard with joints or cracks that abut or cross the repair area. Use an insert of the same thickness as the joint or crack width, ± 3 mm. Place inserts into the caulk before it sets such that no repair material enters the joint or crack. Leave the filler in place after the repair is complete.

Apply Bonding Agent. Follow the Manufacturer's instructions regarding the type and application of bonding agent. If water is used, blow excess from the repair such that no standing water remains.

Placement. Consolidate with hand-held vibrators. The Engineer may waive vibration for high slump concrete that may segregate under vibration.

Finishing. Finish repairs flush with the surrounding pavement. Keep hand finishing to a minimum. Hand trowel from the center of the patch outward toward the edges. Force material into the intersecting over cuts. Do not add any additional water to the repair surface.

Curing. Unless otherwise recommended by the manufacturer, completely coat the repair immediately after finishing using a double coat of curing compound meeting §711-05, Membrane Curing Compound.

Opening to Traffic. Open VHES to traffic based on the time the trial batch concrete achieved 17.2 MPa. The Engineer may require additional cylinder breaks if actual placement ambient temperatures vary from the trial batch ambient temperature. Open rapid hardening concrete repair material 2 hours after placement.

METHOD OF MEASUREMENT. Partial-depth placements will be measured for payment as the number of cubic meters of material satisfactorily placed, measured to nearest 0.001 m^3, based on the Engineer-approved repair area marked on the pavement prior to repair.

BASIS OF PAYMENT. Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for partial depth concrete repairs using optional material. No additional payment will be made for extra work required to repair damage to the adjacent pavement that occurred during

any operation. Additional payment will be made if the original repair area did not completely extend into sound concrete.

Payment Will Be Made Under:

Item No.	**Item**	**Pay Unit**
502.4FRM_11 M	Partial Depth Concrete Repair Using Optional Materials	Cubic Meters

F – Friction	*R – Reinforcement*	*M - Method*
1 – Type 1	*0 – No Fibers*	*1 - Coring*
2 – Type 2	*1 – Fiber Reinforced*	*2 – Saw Cut*
3 – Type 3		
4 – Type 9		