

ITEM 557.0498-11M - CEMENT CONCRETE WITH NON-CHLORIDE ACCELERATOR FOR FULL DEPTH SLAB REPLACEMENT

ITEM 557.04980111M - CEMENT CONCRETE WITH NON-CHLORIDE ACCELERATOR FOR FULL DEPTH SLAB REPLACEMENT (WHERE & WHEN USAGE)

DESCRIPTION

This work shall consist of the construction of a bonded structural full depth slab using Portland cement concrete with a non-chloride accelerator added. Removable or permanent formwork system will be required to form the underside of the slab. Repair areas shall be where indicated on the plans.

MATERIALS

Materials used in this work shall conform to the following requirements:

Portland Cement	Type III	701-01
Fine Aggregate		703-07
Coarse Aggregate	Type CA 2	501-2.02B
Water		712-01
Air Entraining Agent	(Neutralized vinsol resin based only)	711-08
Membrane Curing Compound	White	711-05
Polyethylene Film		711-04
Non-Chloride Accelerator		Approved List
Concrete Cylinder Curing Box		735-01

The maximum allowable total chloride content in concrete shall not exceed 0.10% by weight of cement. Testing shall be done in accordance with written procedural directives of the Department.

Fibers:

Use synthetic fibers where required by the Contract Plans. The fibers shall be manufactured for use as secondary concrete reinforcement. Fibers shall be of the type as indicated on the Contract Plans, or as directed by the Department.

Insulating Materials:

The insulating materials shall be 50 mm thick closed cell extruded polystyrene insulation board conforming to the requirements of ASTM C578 and having a certified total R-value of not less than ten.

Stockpiling Aggregates:

The requirements of Para. 501-3.02A-Stockpiles shall apply, with the following modifications for mobile mixer units:

- A. Unless otherwise approved by the Regional Director, the fine and coarse aggregates shall be stockpiled at the work site.
- B. The stockpiles shall be covered.
- C. The free moisture of each aggregate type, at the time of batching, shall not exceed 7% of the saturated surface dry weight of the fine or coarse aggregate or 8% total for both aggregates.

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Proportioning concrete:

- A. The Contractor shall design and furnish a durable mix design for High Early Strength concrete with non-chloride accelerator to the Department's Regional Materials Engineer at least 21 days prior to use. The mix will use the following parameters:
1. Cement content 490 kg./m³
 2. Air content, 6.0%
 3. The final water cement ratio, by weight, (including water in the accelerator solution and aggregate free surface moisture) shall be a maximum of 0.39 for mobile mixers or a maximum of 0.41 for truck mixers.
 4. Synthetic fibers, where required, shall be introduced into the concrete mix at a dosage rate as indicated on the Contract Plans, or as directed by the Department.
 5. Compressive strength, 21 MPa in a maximum of twenty-four hours under an acceptable temperature range (between 10°C and 35°C) to be maintained during and after placement of concrete throughout the entire duration of curing. The field Engineer will determine the acceptable temperature range after field cylinder testing.
- B. Based upon trial batches and material tests performed by the Contractor, the following information will be submitted to the Department's Regional Materials Engineer at least 21 days prior to use:
1. Mix design material sources.
 2. Aggregate information including gradation, FM, etc.
 3. Mixture design batch masses.
 4. Air, slump, concrete temperature, and ambient temperature at time of trial.
 5. Compressive strengths at 12 and 24 hours, and 3, 7, and 28 days.

The materials used for trials shall be from the same source and of the same type as those proposed to produce concrete for actual work. The mix design, furnished by the Contractor, will be reviewed for acceptance by the Director, Materials Bureau. Final acceptance of in-place concrete will be based on conformance with these specifications and satisfactory test results on field samples taken during placement.

- C. The slump and air content placement limits shall be as follows:

	Min.	Desired	Max.
Slump, (mm)	38 mm	50mm	89*
Air Content, Percent	4.5	6.0	7.5

*100 mm for truck mixers

EQUIPMENT

All equipment proposed for use shall have the Engineer's approval prior to the start of the work. The specific method and equipment that the Contractor proposes to use for finishing will be subject to the approval of the Regional Construction Engineer. Specific equipment requirements follow:

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Blastcleaning. This shall meet the requirements of Para. 584-3.02.

Placing and Finishing. This shall meet the requirements of Para. 584-2.04B except finishing machine shall be required only for pour areas exceeding 46 m².

Surface Texturing Equipment. The specific equipment to be used shall be approved by the Engineer. Prior to approval the Contractor shall demonstrate to the Engineer's satisfaction that the equipment is capable of providing the required surface texture.

The Contractor shall have a limited option of using Truck Mixed Concrete or Mobile Mixed Concrete. If Mobile Mixed Concrete is to be placed in an area exceeding 28 m² the Contractor shall request approval of the Regional Construction Engineer in writing. The Contractor shall be required to supply additional Mobile mixers to ensure continuous production by two Mobile Mixers operating simultaneously. The Contractor shall also supply sufficient equipment and personnel to ensure prompt placement of the concrete produced. The mixing method shall be selected by the Contractor, prior to concrete placement. No change in mixing method will be allowed once the Engineer has been informed of selection.

Truck Mixed Concrete

Section 501 of the Standard Specifications shall apply, together with the following modifications:

A. Physical Requirements:

1. Flow Meters. Truck mixers shall be equipped with in line water flow meters capable of being easily reset to "0", of withstanding water temperatures of up to 93° C and have a manufacturer's certified flow rate capacity of 265 liters per minute. The flow meters shall be mounted in such a manner as to allow the Engineer easy access for reading the meter.

The flow meters will be inspected and approved by the Regional Materials Engineer prior to their being approved for contract work. The batching delivery tolerance for the water flow meter shall be 1% by weight or volume. The actual flow rate as measured by the Regional Materials Engineer shall not be less than 190 liters per minute. The flow meters shall be equipped with air strainers capable of removing all trapped air in the system.

2. Air Pressurized Tanks for Accelerator Solution. Truck mixers shall be equipped with air pressurized tanks having a capacity sufficient to meet the accelerator solution design needs of the mix. The air pressurized tank shall be capable of discharging the design quantity of accelerator solution into the truck mixer drum in less than 1 minute. The tank's output hose leading into the truck mixer drum shall be made of clear plastic. The air pressurized tank shall be equipped with a properly working relief valve.

B. Quantity:

The maximum quantity of concrete to be produced at any one time by truck mixer shall be 5.0 cubic meters.

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C. Batching and Mixing:

The Contractor shall batch and operate their truck mixers in accordance with Para. 501-3.03E Truck Mixed Concrete. The prescribed amount of accelerator solution to be used shall be introduced into the air pressurized tank at the batch plant.

Immediately prior to the batching of each truck, the Contractor shall make a determination of the total moisture content of the coarse and fine aggregate and compute the quantity of water contained by both aggregates in liters per cubic meter of concrete. That quantity, as well as the quantity of water present in the accelerator solution, shall be subtracted from the design water. After completion of water content data, the Contractor shall submit the data and calculations to the State representative at the concrete plant for review and approval.

Upon approval, the Contractor shall indicate in writing on the delivery ticket the exact number of liters of water to be added to the mix at the job site. Upon arrival at the job site, the driver shall give the delivery ticket to the Engineer. Before the addition of water into the truck mixer, the Contractor shall execute 20 dry revolutions and reset the flow meter to zero.

The water shall be added in one complete uninterrupted operation. No water is to be removed from the truck mixer for any purpose whatsoever, while water is being added to the drum. The accelerator solution shall be discharged into the truck mixer drum after the water quantity designated on the delivery ticket has been added to the concrete.

The mixing cycle shall be executed at the rate of twelve to eighteen rpm.

Mobile Mixer Units:

Para. 501-2.04C shall apply, together with the following:

A sufficient number of mobile mixers shall be supplied to provide for placement of concrete without formation of cold joints. Delays during placement greater than ten minutes shall be considered that time in which a cold joint will form. Concrete with cold joints shall be replaced or repaired as determined by the Engineer, at the Contractor's expense.

Test Equipment

The Contractor shall furnish a recording thermometer to monitor batch temperature. No contract work under this item will be permitted until the Engineer possesses the thermometer. This shall meet the requirements of Para. 584-2.04C, except that it shall be capable of recording temperatures in the -1°C to 77°C range.

CONSTRUCTION DETAILS

General

All the requirements of Subsection 584-3 Construction Details shall apply except where modified in

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this specification.

The locations to be repaired shall be shown on the Contract Plans or will be designated by the Engineer. Repairs shall conform to the details shown on the drawings.

A 0.102 mm polyethylene film shall be installed to act as a bond breaker where required by this item, or where directed by the Engineer.

Structural Slab Wetting

Structural slab surfaces and all existing concrete surfaces to which the new concrete will be bonded, prior to the application of bonding grout, shall be pre-wetted continuously for a minimum of 60 minutes, to a saturated surface dry condition but free of standing water, immediately prior to placement of the fresh concrete.

Forms

Forms shall meet the requirements of Para. 557-3.03A and 557-3.13.

Concrete Placement

Immediately prior to concrete placement, but after wetting, the receiving surfaces shall be coated with a thin coating of 1:1 mortar, or neat cement paste, thoroughly brushed into the surface. It will not be necessary to brush the mortar into surfaces made inaccessible by the presence of forms or closely spaced reinforcement.

The temperature of the concrete at the point of discharge shall be between 29°C and 35°C. The Contractor shall heat the mixing water as necessary to achieve this discharge temperature.

The maximum time permitted from the end of mixing to the completion of concrete discharge shall be twenty minutes. All concrete remaining in the drum after that time interval shall be rejected and removed from the work site.

Prior to the placement of concrete, during the concrete testing operations, if the initial measured slump is less than 50 mm, and in the opinion of the Engineer the concrete cannot be placed and finished in an acceptable manner, the Contractor may, with a written request to the Regional Materials Engineer, be allowed to use a high-range water-reducing admixture in accordance with Department procedures.

Concrete shall be finished with equipment meeting the requirements of Para. 584-2.04 B. Finishing shall be done in accordance to Para. 557-3.07 in addition to Para. 584-3.06B for pour areas exceeding 46 m² or Para. 584-3.06 A.1. for pour areas less than 46 m².

The Contractor is advised that the design of this concrete will be such that initial set will take place within thirty to fifty minutes from the time of mix completion. To insure that the concrete is discharged and placed in the shortest possible time, the Contractor is advised to have a sufficient labor force available to insure the rapid and expeditious incorporation of the concrete into the project. No cold joints shall be allowed.

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Under no circumstances shall the Contractor use more than one truck per repair area unless the second truck is standing by and has commenced its mixing cycle.

Cylinder Testing

During the first day of production, six 150 x 300 mm cylinders will be taken by the Engineer during placement of a representative repair area and immediately placed in autogenous (insulated) curing boxes furnished by the Contractor. The repair areas represented by the cylinders shall have a minimum size of 7 m².

The cylinders will be tested by the Engineer for compressive strength, while simultaneously recording the temperature of the repair area. From these cylinders, the Engineer will determine at what corresponding repair temperature a cylinder compressive strength of 21 MPa has been achieved. The approximate strength of future repairs will be determined by this temperature. In addition to the initial set of six cylinders, the Engineer reserves the right to require additional cylinders to be taken for testing.

Weather Limitation

Concrete placement operations may be started only when the air temperature is in the range of 10°C to 35°C and when the minimum and maximum temperatures for the 48 hours immediately after placement of concrete shall be within the range of 4°C to 35°C based upon national weather service reports which the Contractor shall obtain on a daily basis. All temperatures shall be measured in the shade. No placement of concrete will be permitted if the air temperature is or can be expected to lie outside these ranges. During concrete placement the maximum and minimum temperature readings and general weather conditions in each 24-hour period shall be recorded by the Contractor. A copy of the temperature readings shall be included in permanent records of the job. No concrete shall be placed when it is raining or when rain is expected within 2 hours of placement.

If at any time during the curing period, the air temperature falls outside the range specified for curing, the concrete shall be inspected for damage. Concrete damaged by temperature as determined by the Engineer shall be removed and replaced by the Contractor at no cost to the State.

Surface Texturing

After a uniformly smooth, dense and even surface has been achieved, the surface shall be given a suitable texture with an artificial turf drag approved by the Engineer. Texturing shall be done prior to the beginning of curing operations. Only one pass of the turf drag over the finished area will be permitted. The drag shall be made of molded polyethylene with synthetic turf blades approximately 13 mm long. There shall be approximately 65,000 blades per square meter of drag. The artificial turf drag shall be of a type and brand which appears on the Department's Approved List.

The Contractor may texture in a transverse direction, or a longitudinal direction. The Engineer shall be notified of the chosen direction at least one day prior to the placement of structural slab concrete. Once begun, the direction of texturing shall not change. For pour areas less than 46 m² texturing may

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be done using a drag attached to a hand held tool. For pour areas exceeding 46 m² texturing shall be done from a work bridge placed no closer than 3 meters from the back of the finishing machine.

If texturing is done in the transverse direction, the Contractor shall texture by hand methods as soon as practicable after finishing machine passage.

If texturing is done in the longitudinal direction, the turf drag shall be a seamless strip and shall be attached to the work bridge such that the surface of the concrete is textured as soon as practicable after finishing machine passage. Small areas, otherwise inaccessible to the attached drag, may be textured by hand methods, if approved by the Engineer. Only one pass of the turf drag over the finished area will be permitted.

The finishing movement and resulting progress of the turf drag shall be done in a manner so as to prevent ridges or gouges from forming in the concrete surface. The drag shall be weighted and the contact area changed as required to produce a texture acceptable to the Engineer. The drag shall be cleaned periodically as directed by the Engineer, to remove all hardened concrete particles.

Texture resulting from the drag shall stop within 300 mm of curbs.

After the concrete surface has hardened sufficiently, the Engineer will examine it using a straight edge supplied by the Contractor. The straight edge shall be not less than 3 meters long. It shall be maintained in good usable condition, at the paving site, at all times. Surface irregularities greater than 5.0 mm in 3 meters shall be corrected in a manner acceptable to the Engineer, at the expense of the Contractor.

Curing

Upon completion of the concrete placement operation, the repair shall be allowed to cure uncovered until set has occurred. Set shall be defined as having occurred when no cement paste is lifted from the repair when it is lightly rubbed with the fingers of one's hand. This should take place in approximately thirty to fifty minutes.

As soon as set has occurred, the repair shall be covered by a 0.102 mm thick polyethylene sheet and thermal insulating board conforming with the material section of this specification.

Shrinkage cracks will be cause for rejection of the concrete. The polyethylene and insulating boards shall extend a minimum of 300 mm beyond the edges of the placement. Each board shall be securely weighted down to prevent the uncovering of the concrete.

Particular care shall be taken to ensure that the edges of the insulating material are weighted sufficiently to ensure direct contact with the existing concrete surrounding the repair and to prevent wind intrusion beneath the polyethylene vapor barriers

The insulation boards shall be weighted down with sand bags weighing a minimum of 7 kg each. The sand bags shall be placed 600 mm on center, beginning at the edges and proceeding inward in a grid pattern over the entire patch area.

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The recording thermometer shall then be placed under the insulation boards at least 300 mm inward from the repaired edge to obtain an accurate concrete surface temperature.

An enclosure subject to the Engineer's approval shall be constructed for the thermometer using the insulation boards such that the heat generated during the concrete's hydration does not escape.

Opening to Traffic

When the repair area has achieved the temperature requirement established by the cylinder testing, the polyethylene vapor barrier and polystyrene insulation boards shall be removed. The concrete surface shall be immediately coated with a minimum of two coats of white pigmented membrane curing compound at an application rate of 3.7 square meters per liter for each coat. One coat shall be applied in the transverse direction and the second coat applied in the direction of traffic flow.

When curing compound has cured sufficiently to prevent tracking, the repair area may be opened to traffic.

Concrete placement operations shall be timed within the workday such that the required temperature and curing is achieved at the time specified on the plans for opening the repaired area to traffic.

METHOD OF MEASUREMENT

Measurement will be taken as the number of square meters of field measured plan area of concrete placed.

BASIS OF PAYMENT

The unit price bid per square meter shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, including cleaning and blast cleaning. All saw cutting and concrete removal will be paid for under their appropriate items.

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