

ITEM 18555.0492 M - CEMENT CONCRETE WITH NON-CHLORIDE ACCELERATOR FOR REPLACEMENT FULL DEPTH SLAB

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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. Repair areas shall be where indicated on the plans, or where designated by the Engineer.

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	501-2.02 B.2
Water		712-01
Air Entraining Agent	Neutralized Winsol (resin based only)	711-08
Polyethylene Film		ASTM C171
Non-Chloride Accelerator		Accelguard 80, Plastocrete 161 FL or D.C.I.

The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by mass of cement. Testing shall be done in accordance with written procedural directives of 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 metric R-value of not less than 1.76 (or not less than an English R value of 10).

Stockpiling Aggregates: The requirements of Subsection 501-3.03A. Stockpiles shall apply when Mobile Mixers are used, with the following modifications:

- 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 seven percent of the saturated surface dry mass of the fine or coarse aggregate or eight percent total for both aggregates.

Proportioning Concrete:

- A. A concrete mix will be furnished to the Contractor based upon trial batches to test the materials and determine proportioning. 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 mass, (including water in the accelerator solution and aggregate free surface moisture) shall be a maximum of 0.39 for mobile mixers or a

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maximum of 0.41 for truck mixers

4. Compressive strength, 21 MPa in a maximum of twenty-four hours.

B. The Contractor shall supply the Regional Materials Engineer with three bags of cement, 227 kg each of fine and coarse aggregate, 1 liter of ABA admixture, and four liters of accelerator for laboratory test batches. The materials submitted shall be of the same type and size and from the same source as those used to produce the concrete. The material shall be submitted at least twenty working days in advance of the calibration test for the self-contained mobile mixer or truck mixers. The mix design will be furnished by the Director of the Materials Bureau, who shall have twenty working days to render a decision after receipt of the material by the Regional Materials Engineer.

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

	Min.	Desired	Max.
Slump (mm)	38	50	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:

Blastcleaning Equipment. This shall meet the requirements of Subsection 584-2.05B.

Placing and Finishing Equipment This shall meet the requirements of Subsection 584-2.05F except finishing machine shall be required only for pour areas exceeding 46 m².

The Contractor shall have the 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. He 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:

Subsection 501-3.04E 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

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manufacturer's certified flow rate capacity of 2650 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 shall 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 mass or volume. The actual flow rate as measured by the Regional Materials Engineer shall not be less than 189.0 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 one 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 a truck mixer shall be 5.0 m³.
- C. Batching and Mixing: The Contractor shall batch and operate his truck mixers in accordance with Subsection 501-3.04E 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 moisture content of the coarse and fine aggregate and compute the quantity of water in each aggregate 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. Upon doing so, the Contractor shall submit his data and calculations to the State representative at the Concrete Plant for his review. 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 twenty 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

Mobile mixers shall meet the requirements of Subsection 584-2.05C Proportioning and Mixing Equipment together with the following modifications:

Add: "A sufficient number of mobile mixers shall be supplied to provide for placement of concrete

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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. To join fresh concrete to that which has already set the face shall be chipped to leave a rough irregular surface. The surface shall be wetted and grouted, as described under Construction Details hereinafter, immediately before placing and consolidating the fresh concrete."

Delete: 4a. High Density Concrete, 4b. Latex Modified Concrete and 4c. Micro-Silica Concrete and substitute the following:

"The mixers shall provide positive control of the flow of the air entraining admixture and the accelerator solution admixture into the mixing chamber. Flow meters shall be used to control the quantity of admixture added to the mix. The system shall introduce the accelerator solution and the air entraining agent at two separate points in the mixing auger. The Accelerator solution shall be introduced at the same point as the mixing water. The air entraining agent shall be separated from this point by a distance of 300 mm. This separation shall be accomplished by the extension of the tube carrying the air entraining agent in a manner satisfactory to the Regional Materials Engineer. The system shall be capable of adding admixture in the amounts necessary to achieve the required air content, and accelerator solution percentage. The system shall be equipped with a bypass valve suitable for obtaining a calibrated sample of admixture to determine batching accuracy."

Mobile mixers shall be made available for testing according to Subsection 584-2.05E Mixer Unit - Testing.

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 Subsection 584-2.05G, except that it shall be capable of recording temperatures in the 38° - 77°C range.

CONSTRUCTION DETAILS

General

Stockpiling Aggregates. The requirements of Subsection 584-3.01 shall apply.

Vehicular and Equipment Restrictions. The requirements of Subsection 584-3.02 shall apply.

Placement preconditions. The requirements of Subsection 584-3.03 shall apply.

First Stage Blastcleaning. The Requirements of Subsection 584-3.04 shall apply.

Second Stage Blastcleaning. The requirements of Subsection 584-3.05 shall apply.

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REPLACEMENT

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Structural Slab Wetting. Structural slab surfaces, prior to the application of bonding grout, shall be prewetted and free of standing water. The surfaces shall be dry to the touch.

Portland Cement Bonding Grout. The requirements of Subsection 584-3.07A, B, and C shall apply. The grout type shall be Portland Cement.

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

Forms

Forms shall meet the requirements of Subsection 555-3.03.

Concrete Placement

General. 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.

If the initial measured slump is less than 50 mm and if, in the opinion of the Engineer, the concrete cannot be placed and finished in a manner meeting with his satisfaction, he may allow the Contractor to add water to the drum. The quantity of additional water will be between 4 and a maximum of 6 liters for every cubic meter of concrete remaining in the drum at the time of the addition. No more than one addition of water shall be permitted. After this addition, the concrete shall be mixed at least thirty revolutions at a mixing speed of twelve to eighteen RPM.

Concrete shall be placed meeting the requirements of Subsection 584-3.09 F (except 584-3.09 F6, 7 & 8). Concrete may be placed directly from an approved mixer. Chutes used to place the concrete in final position shall be steel lined. The concrete shall be consolidated by internal vibration following Standard Specifications 555-3.04B "Vibrating."

Concrete shall be finished with equipment meeting the requirements of Subsection 584-3.09E for pour areas exceeding 46 m² and with equipment meeting the requirements of Subsection 584-2.05 F4 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.

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.

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Weather Limitation

Concrete placement operations may be started only when the air temperature is in the range of 10 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 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 two 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.

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 0.1016 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 barrier.

The insulation boards shall be weighted down with sand bags of a minimum mass 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.

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.

Cylinder Testing

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During the first day of production, six 150 mm x 300 mm cylinders shall be taken by the Engineer during placement of a representative repair area and immediately placed in autogenous (insulated) curing boxes furnished by the Engineer.

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The cylinders shall be tested by the Engineer for compressive strength, while simultaneously recording the temperature of the repair area. From these cylinders, the Engineer shall determine at what corresponding concrete temperature a compressive strength of 21 MPa has been achieved. The strength of future repairs shall be determined by this temperature.

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Opening to Traffic

Materials Bureau in

When the repair areas have achieved the established temperature requirements, the polyethylene vapor barrier and polystyrene insulation boards shall be removed.

a Bufile Memo

dated January 13, 1999

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

written by Patric Galarza

METHOD OF MEASUREMENT

The quantity to be measured shall be the number of square meters computed from the measured surface area shown on the plans.

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 blastcleaning. Any sawcutting and concrete removal will be paid for under their appropriate items.