

**ITEM 01502.6029 M - CEMENT CONCRETE WITH NON-CHLORIDE  
ACCELERATOR FOR  
RIGID PAVEMENT SLAB REPAIRS**

**DESCRIPTION**

Construct a high early strength portland cement concrete (PCC) pavement repair using non-chloride accelerator. Repair areas shall be indicated on the plans or as ordered by the Engineer.

**MATERIALS**

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 Vinsol Resin based only)	711-08
Membrane Curing Compound	White Pigmented	711-05
Polyethylene Film		ASTM C171
Non-Chloride Accelerator		Approved List

**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, or insulating blankets found in Section 29a of the Approved List.

**Stockpiling Aggregates:** The requirements of Subsection 501-3.03A-Stockpiles will apply, with the following modifications for mobile mixer units and/or truck mixers.

- 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.

**Proportioning Concrete:**

**Mix Design and Trial Batch.** Develop a mix design and prepare a trial batch using those materials to be used on the project. Demonstrate the mix's ability to achieve the specified properties to the Regional Materials Engineer's satisfaction. Changes other than minor fluctuations in admixture dosage rates will require a new mix design. The Engineer may halt placement and order additional trial batches whenever the specified properties are not achieved.

The mix must meet the following requirements:

- A. Cement content 490 kg/m<sup>3</sup>
- B. 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.

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C.

	<b>Min.</b>	<b>Desired</b>	<b>Max.</b>
Slump, millimeters	51	77	103*
Air Content, percent	4.0	6.0	7.5
*113 mm for truck mixers			

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

Alternate mix designs will be considered provided the contractor demonstrates the ability to meet the requirements of this specification to the Regional Materials Engineer’s satisfaction.

**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:

**Placing and Finishing.** This shall meet the requirements of Subsection 502-3.06 except a finishing machine shall be required only for pour areas exceeding 46 m<sup>2</sup>.

**Surface Texturing Equipment.** The specific equipment to be used, if this is to be the finished surface 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, otherwise a float finish shall be provided.

**Concrete Mixing, Transporting and Discharge.** The Contractor shall have the option of using Central Mixed Concrete, Truck Mixed Concrete or Mobile Mixed Concrete. If Mobile Mixed Concrete is to be placed in an area exceeding 28 m<sup>2</sup> 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.

**Central Mixed Concrete.** Section 501 of the Standard Specifications shall apply, together with the following modifications:

**Quantity:** The maximum quantity of concrete to be delivered to the project shall not exceed 8.0 m<sup>3</sup>.

**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.

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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.
- C. **Batching and Mixing:** The Contractor shall batch and operate their 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 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.** 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.

Mobile mixing units shall appear on the Department's Approved List and be subject to the following requirements:

- A. Each unit shall be self-propelled. Each unit shall be capable of carrying sufficient unmixed material to produce on site, no less than 4.5 cubic meters of specialized concrete.

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B. Each unit will be inspected by the Engineer. Units not functioning in a manner the Engineer considers acceptable shall be repaired. If repair is impractical, the unit shall be replaced. All costs associated with delays attributable to mobile mixer replacement shall be borne by the Contractor. No extensions of time, for the purpose of replacing unacceptable mixers, will be granted. Conditions which will automatically designate a unit unacceptable are: hydrated cement deposits; broken, bent, loose or scalloped mixing paddles; mixing paddles worn 20 percent in any dimension; mixing paddles heavily caked with mortar; and admixture or water delivery system out of tolerance.

C. Proportioning devices shall deliver the materials within the following tolerances (by weight):

Coarse Aggregate	+/- 2%
Fine Aggregate	+/- 2%
Cement	0% to +4%
Other Admixtures	+/- 3%
Water	+/- 1%

The quantity of cement introduced into the mix shall be measured by a meter which is clearly visible and kept clean at all times. The quantity of cement shall be recorded by a ticket printer. The recordation may consist of a print of the number of revolution counts of the cement feeder.

D. There shall be positive control of the flow of water into the mixing chamber. Water flow shall be indicated by a flowmeter and readily adjustable to provide for minor variations in aggregate moisture. The system shall be equipped with a bypass valve, or hose, for determining proportioning accuracy.

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.

E. The units shall be capable of combining aggregates, cement, admixtures and water into a thoroughly mixed and uniform mass. Discharging the mixture shall be accomplished without segregation.

F. The units shall be made available to the Regional Materials Engineer for calibration tests in accordance with Department written instructions. The Materials Engineer shall have at least two working days for the calibration of each unit the Contractor proposes to use. The Contractor shall notify the Engineer and Materials Engineer, in writing, at least one week in advance of the dates each unit will be available for calibration. No calibration shall be performed while it is raining.

**Mixer Unit Testing.** Calibration and yield tests shall be performed by the Regional Materials Engineer according to the Department's written instructions, with the cooperation of the Contractor as required:

A. The Contractor shall supply sufficient quantities of cement, fine aggregate, coarse aggregate, water and

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admixture for the tests. Materials supplied shall be of the same type and size as well as from the same source as those materials which will be used to produce the concrete.

The Contractor shall supply 900 mm x 900 mm x 225 mm container to be used for a yield test.

The Contractor shall supply a portable scale of at least 25 kg capacity, and 2 containers of sufficient capacity to obtain cement samples of as much as 85 kg each. Two 25 kg weights for determining scale accuracy shall also be supplied.

- B. The Regional Materials Engineer will supervise proportioning and yield tests as part of the calibration tests. The proportioning test will consist of weighing each component to verify the proposed gate settings and the implementing of any necessary adjustments.

After this initial calibration additional fill or partial calibrations may be required by the Engineer as follows: whenever major maintenance operations occur in the mobile mixing unit, whenever the unit leaves and returns to the job site, or whenever material proportioning becomes suspect.

**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, it shall be capable of recording temperatures in the -1° C to 77 °C range.

**CONSTRUCTION DETAILS**

**General.** All the requirements of Subsection 502-3 Construction Details shall apply except where modified in this specification.

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.

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. On concrete repair areas greater than 5.0 meters in length, a 12.5 mm piece of bituminous expansion material shall be placed at one end of the repair area.

**Forms.** Forms shall meet the requirements of Subsection 502-3.04 or shall be approved as ordered by the Engineer.

**Concrete Placement.**

**General.** The temperature of the concrete at the point of discharge shall be between 35° C and 40° 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 sixty 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 51 mm, and in the opinion of the Engineer the concrete cannot be placed and finished in an acceptable manner, the Engineer 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 12 to 18 rpm.

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Concrete shall be placed meeting the requirements of Subsection 502-3.06. 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 502-3.06 Vibrating.

Concrete shall be finished with equipment meeting the requirements of Subsection 502-3.09. Finishing shall be done in accordance to Section 502-3.09.

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.

**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 Engineer.

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 14 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.

**Curing.** 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.

The polyethylene and insulated blankets and/or insulating boards shall extend a minimum of 300 mm beyond the edges of the placement. They 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 blankets and/or 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.

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.

**Opening to Traffic.** When the repair area has achieved the temperature requirement established by the cylinder testing, approximately 60° C, the polyethylene vapor barrier and polystyrene insulation boards shall be removed.

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.

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**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 finishing 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.

This specification is  
DisApproved