ITEM 502.6029--10 M - CEMENT CONCRETE FOR PAVEMENT REPAIRS

DESCRIPTION

This work shall consist of the construction of Cement Concrete for Pavement Repairs consisting of portland cement concrete with calcium chloride added as an accelerator, where indicated on the plans.

MATERIALS

Portland Cement Concrete

The materials used to produce the cement concrete shall conform to the following sections unless modified by this specification:

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)	711-05
Polyethylene Film		ASTM C171
Calcium Chloride		712-02

If Type A Solid Flake Calcium Chloride is used it shall be made into a solution having a specific gravity of 1.290 to 1.295 at 15°C.

If Type B Liquid Calcium Chloride solution is used it shall consist of calcium chloride and water. Any solution containing any other admixture besides calcium chloride will not be acceptable.

Welded Wire Fabric

Wire Fabric for the cement concrete pavement repairs shall meet the requirements of Subsection 709-08.

Insulating Materials

The insulating material 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

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The requirements of Subsection 501-3.02A 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 stockpile 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 weight 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. The mix will use the following parameters:

1. Cement content 490 kg/m^3
2. Air content, 6.0%
3. The final water cement ratio, by weight, (including water in the calcium chloride 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. 2% of the pure compound $CaCl_2$ (Calcium Chloride) by weight of cement. When high alkali cements and/or aggregates are used, up to 2% additional calcium may be required (4% maximum). The need for additional calcium chloride will be determined during trial batching and testing.

B. The Contractor shall supply the Regional Materials Engineer with three bags of cement, 227 kg each of fine and coarse aggregate, one liter of each admixture, and 4.5 kg of calcium chloride flake or 7.5 liters of calcium chloride liquid 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	40	50	90*
Air Content, Percent	4.5	6.0	7.5

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***100 mm for truck mixers**

EQUIPMENT

The Contractor shall have the option of using Truck Mixed and/or Mobile Mixed Concrete.

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 up to 93°C and having a manufacturers certified flow rate capacity of 4.5 liters per second. 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 used 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 3 liters per second. The flow meters shall be equipped with air strainers capable of removing all trapped air in the system.
2. Air Pressurized Tanks For Calcium Chloride Solution. Truck mixers shall be equipped with air pressurized tanks having a capacity sufficient to meet the calcium chloride solution design needs of the mix. The air pressurized tank shall be capable of discharging the design quantity of calcium chloride solution into the truck mixer drum in less than one minute. The tanks 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 amount 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 his truck mixers in accordance with Section 501-3.03E Truck Mixed Concrete. The prescribed amount of calcium chloride solution to be used shall be introduced into the air pressurized tank at the batch plant.
As stated in 501-3.03D Transit Mixed Concrete, the drum shall be drained of wash water before charging with the constituents of the concrete mixture. 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 amount of water in each aggregate in liters per cubic meter of concrete. That quantity, as well as the quantity of water present in the calcium solution shall be subtracted from the design water. Upon doing so, the Contractor shall submit the data and calculations to the state representative at the Concrete Plant for review. Upon approval the Contractor shall indicate in writing on the

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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 calcium chloride solution shall be discharged into the truck mixer drum after the water amount 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 for a minimum of 100 revolutions. The mixing period shall not exceed ten minutes. The minimum mixing revolutions shall be 120 (20 dry plus 100 mixing cycle) prior to discharge.

Mobile Mixer

Mobile Mixers shall meet the requirements of Section 501-2.04 C -Mobile Concrete Mixing Units and 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. To join fresh concrete to that which has already set the face shall be chipped to leave a rough irregular surface, the face shall be sandblasted clean, and a bonding grout meeting the requirements of § 705-22 -Portland Cement Mortar Bonding Grout shall be thoroughly brushed into the face immediately before placing and consolidating the fresh concrete.

The system shall introduce the calcium chloride and the air entraining agent at two separate points in the mixing auger. The calcium chloride 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 calcium chloride percentage.

Test Equipment. The Contractor shall furnish a surface thermometer to monitor patch temperature. It shall be capable of recording temperatures in the 38-77°C range.

CONSTRUCTION DETAILS

General

The areas to be repaired shall be shown on the plans or will be designated in the proposal or by the Engineer. Repairs shall conform to the details shown on the plans or be in accordance with the directions of the Engineer.

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The reinforcement shall be placed as shown on the plans in a manner approved by the Engineer.

A 0.10 mm polyethylene film shall be installed to act as a bond breaker where shown in the plans, or as directed by the Engineer.

The Engineer shall determine the slump and discharge temperature of each load of concrete delivered to the job site for incorporation. This information shall be relayed back to the concrete plant inspector via the concrete truck two-way radio and via written note on the back of the concrete supplier's delivery ticket.

Concrete Placement

The temperature of the concrete at the point of discharge shall be between 32°C and 38°C. The Contractor shall heat the mixing water and aggregates and provide insulated water tanks as necessary to achieve this discharge temperature.

The maximum time permitted from the end of mixing to the completion of concrete discharge shall be thirty 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, the Engineer may allow the Contractor to add water to the drum. The amount of additional water will be between 4 L and a maximum of 6 L 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 ten revolutions at a mixing speed of twelve to eighteen rpm.

Concrete shall be placed, spread, consolidated and struck off using methods and equipment approved by the Engineer. Placements of concrete less than 3.0 meters long shall be struck off with the screed oriented in a longitudinal direction to match any wheel track wear. The concrete surface shall be tested while plastic and shall conform to 502-3.15. Concrete may be placed on grade directly from an approved mixer. Chutes used to place the concrete in final position shall be steel lined.

The wheels of the concrete mixing and placing equipment shall not be allowed on the grade or within 0.6 meters of the sawcut ends of the existing pavement.

The Contractor is advised that the design of this concrete will be such that 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.

In no case, shall the Portland Cement, from batching to final placement, remain in contact with aggregate in excess of 70 minutes. Refer to Table 501-7, Truck Mixed Concrete, Regular Mix, except substitute 10 minutes for 15 minutes in the table for maximum mixing time after water and calcium chloride has been added. If this 70 minute maximum time can not be achieved with Truck Mixed Concrete, then a Mobile Mixer shall be used.

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Mechanical spreading and finishing will not be required. Precautions must be taken to prevent segregation of the concrete during placement and spreading.

The concrete shall be deposited from the mixer, as close to its final position as possible and shall be thoroughly consolidated with hand operated immersion spud vibrators whose head diameters shall not be less than 50 mm. Excessive movement of the concrete by use of vibrators or other means will not be permitted. The vibrators shall be held vertically and vibration shall be done full depth through the reinforcing mesh over the entire area in a uniform pattern. The Contractor shall have immediately available at all times, a second vibrator system, which will be used in the event of failure of the primary system. No work under this item will be permitted in the absence of the secondary backup system. Concrete that cannot be properly placed and consolidated shall be rejected and removed from the job site. Under no circumstances shall the Contractor use more than one truck per patch unless the second truck is standing by and has commenced its mixing cycle.

Weather Limitation. Concrete placement operations may be started only when the air temperature is above 10°C and when the minimum temperatures for the 48 hours immediately after placement of concrete shall be 4°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. 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 below the minimum 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 0.10 mm thick polyethylene sheet and thermal insulating board conforming with the material section of this specification.

Shrinkage cracks, occurring due to the Contractor's failure to cover the repair as soon as set has occurred, will be cause for rejection of the repair. The polyethylene and insulating boards shall extend a minimum of 300 mm beyond the length of the repair and 150 mm beyond its width. 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 intimate contact with the existing pavement surrounding the repair and to prevent wind intrusion beneath the polyethylene vapor barrier.

The insulation boards shall be weighted down with sand bags having a minimum mass of 7.0 kg each. The sand bags shall be placed 0.6 meters on center, beginning at the edges and proceeding inward in a grid pattern over the entire patch area.

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

A suitable enclosure for the thermometer shall be constructed using the insulation boards such that the heat generated during the concrete's hydration does not escape.

Opening to Traffic

When the repair area surface temperature has reached 65°C, 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 curing compound at an application rate of 3.5 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 the 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 is achieved at the time specified on the plans for opening the repaired area to traffic.

If the required temperature is achieved in less than the recommended times, the Engineer may allow placement operations to proceed later in the work day. If the required temperature is not achieved, the Engineer may direct concrete placement operations to be completed earlier in the workday.

METHOD OF MEASUREMENT

The quantity to be measured shall be the number of cubic meters computed from the measured surface area times the depth shown on the plans. Deductions will be made for catch basins, manholes, and other similar obstructions in the pavement repair.

BASIS OF PAYMENT

The unit price bid per cubic meter shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work, including the wire fabric for concrete reinforcement and cleaning existing concrete pavement surfaces. All work required for the repair of damages to the existing pavement caused by the Contractor's operations and all work performed to replace concrete damaged by inappropriate curing procedures shall be done at no cost to the State.

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