

ITEM 557.10 11 - COLD WEATHER CONCRETE – SURFACE TREATMENT OF STRUCTURAL SLABS AND STRUCTUAL APPROACH SLABS

DESCRIPTION

This work shall consist of providing appropriate protective measures to concrete placed and cured for superstructure and structural approach slabs during cold weather conditions.

MATERIALS

Use materials meeting §557-2.

CONSTRUCTION DETAILS

Apply the provisions of §557-3 and replace the current 557-3.12 provisions with the following:

Provisions for Concreting in Cold Weather. Cold-weather concreting provisions shall apply when ambient air temperature falls, or is expected to fall, below 7°C for 24 consecutive hours, or drops below 0°C at any time, during a 24 day period from the date of concrete placement.

When permission is granted in writing by the Regional Construction Engineer for cold-weather concreting of superstructure slabs, curing temperatures shall be maintained in accordance with §555-3.08C *Provisions for Curing in Cold Weather*, except as modified here:

A. Superstructure Slabs.

The curing duration shall be 14 days. Conditions may occur which prevent an entire day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur, and with the Engineer's approval, the Contractor may aggregate curing hours. A curing hour is defined as any hour during which the curing temperature remains at, or above 7°C. An aggregation of 24 curing hours will be credited as one curing day. Any aggregations of less than 24 curing hours will not be credited as a curing day.

If ambient air temperatures result in a cold weather condition as described above, materials and equipment necessary to maintain required curing temperatures shall be present on the site or readily available. External heat, protective covers and/or enclosures to maintain curing temperatures may be required, as determined by the contractor's proposed curing methods discussed at the Preplacement Meeting. If protective covers or enclosures are required, they shall be constructed in such a way that all surfaces of the fresh concrete shall be maintained between 7°C and 30°C for the curing period. On structures where bottom formwork is not required, the existing superstructure materials may be considered for their insulating values provided all curing temperature requirements are maintained. Protective covers or enclosures may be removed to progress subsequent or incidental work during periods when the ambient temperature is above 7°C. If the Contractor expects to, or will, perform work when ambient temperatures are below 7°C, an enclosure shall be constructed in such a manner that work can be performed inside the enclosure without exposing any concrete to a temperature below 7°C. All concrete surfaces within heated areas shall be protected from drying by the use of live steam or use of continuously wetted burlap. All concrete surfaces within heated areas shall be protected from surface disintegration of fresh concrete due to an accumulation of carbon dioxide gas by properly venting the heated area.

Continuously recording thermometers shall be placed on both the top and underside of the deck to monitor areas where extreme cold or heat can be expected. Multiple thermometers may be required as directed by the Engineer. On structures where bottom formwork is not required and the existing superstructure materials are considered for their insulating value, temperatures shall be monitored at the interface between the existing superstructure materials and new concrete using continuously recording thermocouples and thermometers.

The temperature differential between any two locations within any form of enclosure, heated or otherwise, shall not be more than 15°C.

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When ambient temperatures are 7°C or greater, the protective covers or enclosure may be removed for access to progress additional work during the work day providing the temperature difference between the air and the surface of the concrete is not more than 15°C. If temperature difference between the air and the surface of the concrete is greater than 15°C, temperatures shall be gradually reduced at a rate not to exceed 0.5°C/hr until the temperature difference is equal to or less than 15°C. If protective covers or an enclosure is partially removed, all heating in other areas shall cease until such time that the covers or enclosure is replaced. Upon completion of the incidental work and replacement of the covers or enclosure, the Contractor shall reestablish acceptable curing temperature differentials, with a maximum temperature differential not more than 15°C between any two locations within the enclosure.

After seven (7) curing days, the Contractor may perform work on the structure to complete sidewalks, safety walks, curbs, and barriers. Work shall progress only when ambient temperatures are 7°C or greater or within an enclosure as described above. Incidental work shall not cause damage to the structure.

For all incidental work, the requirements of §557-3.14, *Loading Limitations for Superstructure Slabs*, shall apply.

B. Structural Approach Slabs, Curbs, Sidewalks and Safety Walks on Bridges.

The curing duration shall be 7 days. Conditions may occur which prevent an entire day from qualifying as a curing day, but do not prevent portions of that day from reaching temperatures that qualify as curing temperatures. If these conditions occur and with the Engineer's approval, the Contractor may aggregate curing hours. A curing hour is defined as any hour during which the curing temperature remains at, or above 7°C. An aggregation of 24 curing hours will be credited as one curing day. Any aggregations of less than 24 curing hours will not be credited as a curing day.

C. Saw Cut Grooving.

Saw cut grooving may be commenced after 7 curing days. Work shall progress only when ambient temperatures are 7°C or greater or within an enclosure as described above. Sawcut grooving shall not cause damage to the structure and no chipping or spalling of concrete shall occur at the sawcut edges.

If progressed during the curing period, saw cut grooving shall meet the requirements of §558 Longitudinal Saw Cut Grooving of Structural Slab Surface.

If progressed during or after the drying period, saw cut grooving shall meet the requirements of §558 Longitudinal Saw Cut Grooving of Structural Slab Surface except that water used for grooving or slurry clean-up operations shall be kept to a minimum. Grooving operations shall be progressed in a manner such that no area of the superstructure slab or structural approach slab will remain wet for more than 8 hours.

D. Winter Surface Treatment - Superstructure Slabs and Structural Approach Slabs.

Upon completion of the curing period, the Contractor shall have the option to progress one of the following options:

1. The top surface and fascias of the superstructure slab shall be air dried for 10 days before being sealed with a penetrating sealer or exposed to freezing temperatures. Saw cut grooving shall be completed, as described above, prior to application of penetrating sealer. . External heat, protective covers and/or enclosures to maintain drying temperatures may be required. Drying shall be achieved by the following:
 - a. Providing free air flow and maintaining temperatures between 7°C and 30°C to the top surface and fascias (vertical faces) of the superstructure slab. Fascia forms shall be removed to allow for free

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air flow. Free air flow may be provided by direct exposure to the environment if acceptable ambient temperatures exist, or within an enclosure or under protective covers if external heat is required.

- b. Drying of the underside of the structure, or of the fascias when a concrete barrier is to be placed on the superstructure slab, will not be required however, ambient temperatures shall be maintained between 7°C and 30°C to these areas for the duration of the drying period.
- c. The drying period shall be continuous except that aggregate drying hours may be allowed when a contractor ceases free air flow for any reason but protects the drying concrete from exposure to any additional water. Exposure to any additional water, beyond minor leakage thru an enclosure in limited areas, will require the drying period to re-commence for 10 days. Minor leakage shall be defined as water that dries or evaporates in less than 8 hours. Limited areas are defined as areas less than 10 m². Areas that exceed 10 m² or are exposed to additional water that does not dry or evaporate in less than 8 hours, may be dried independently to accommodate removal of the original enclosure. Any independent enclosures shall be maintained under the same temperature and air flow requirements as the original enclosure.
- d. Means of accelerating the drying process will be considered by the Director, Materials Bureau, to achieve an internal moisture content of 85% relative humidity or less, measured at a depth of 25 mm from any concrete surface.

Once the drying period is completed using an enclosure or protective covers, temperatures shall be gradually reduced at a rate not to exceed 0.5°C/hr until the temperature within the enclosure equals the temperature outside the enclosure. Application of a penetrating sealer, in accordance with other items, shall be completed before opening the superstructure slab to traffic.

2. The top surface and fascias of the superstructure slab shall be air dried for 24 hours before being sealed with an interim application of penetrating sealer or being exposed to freezing temperatures. No saw cut grooving will be required. External heat, protective covers and/or enclosures to maintain drying temperatures may be required. Drying shall be achieved by the following:

- a. Providing free air flow and maintaining temperatures between 7°C and 30°C to the top surface and fascias of the superstructure slab. Fascia forms shall be removed to allow for free air flow.
- b. Drying of the underside of the structure, or of the fascias when a concrete barrier is to be placed on the superstructure slab, will not be required however, ambient temperatures shall be maintained between 7°C and 30°C to these areas for the duration of the 24 hour drying period.
- c. After April 1st the contractor shall clean the deck of debris, and the Department will inspect the superstructure slab for freeze / thaw or scaling damage. Damage shall be defined as:
 - I. Delaminations
 - II. Surface defects as follows:
 - a. Total combined area greater than 5 m² with a scaling rating of 3 or greater as defined by ASTM C-672.
 - b. Total combined area greater than 1 m² where the surface distress is greater than 5 mm deep (loss of saw cut grooving if applicable).
 - III. Pop-outs – surface imperfections greater than 20 mm in diameter
- d. If necessary, the Contractor shall repair any damaged or defective concrete where the distress is greater than 5 mm deep using materials and methods approved by the Department.
- e. After any necessary repairs are completed, the Contractor shall perform diamond grinding to the entire superstructure slab and approach slabs, to within 300 mm of any curb or barrier. Diamond grinding shall be performed as follows:
 - I. The depth of the grinding shall be approximately 5mm to obtain a smooth texture.
 - II. In all travel lanes, use equipment having gang-mounted diamond saw blades on a multi-blade arbor specifically designed for PCC pavement or superstructure production grinding. Using equipment capable of producing a 900mm wide (minimum) grinding pass that is equipped with a vacuum system capable of removing slurry from the bridge deck surface, such as the Target

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3800, Boart-Longyear (Kushion Kut) PC 5000 or PC600, or equal as approved by the Director, Materials Bureau. Smaller diamond grinding equip shall be used as necessary to complete grinding adjacent to curbs or barriers. The Contractor shall submit requests to use other equipment at least 7 days prior to the start of grinding operations.

- III. Begin and end diamond grinding lines normal to the bridge deck centerline. Grind the bridge deck longitudinally such that at least 95% of the bridge deck surface is ground and the bridge deck is in the same plane across a joint or crack when measured with a 1.0 m (minimum) straightedge. When steel joints are specified, joints shall be placed to allow for the required grinding of 5 mm. Feathering of the grinding operation at steel joints shall be kept to a minimum. Provide surface drainage by maintaining the proper cross-slope on the finished surface and by blending adjacent passes. Regrind the bridge deck if an acceptable surface is not being obtained.
- IV. Continuously remove slurry from the bridge deck using the vacuum system on the grinding equipment. If required, provide equipment capable of transporting the slurry from the job site to an acceptable waste area or facility, without spilling.
- V. After diamond grinding is complete, concrete shall be saw cut grooved and air dried for 24 hours before being sealed with a penetrating sealer. Penetrating sealer application shall be in accordance with contract documents and specifications for penetrating sealers.

E. Winter Surface Treatment –Curbs, Sidewalks and Safety Walks on Bridges.

Upon completion of the curing period, concrete shall be air dried for 24 hours by providing free air flow and maintaining temperatures between 7°C and 30°C to all concrete surfaces. The drying period shall be continuous. Upon completion of drying, curbs, sidewalks and safety walks shall be sealed with a penetrating sealer. Penetrating sealer application shall be in accordance with contract documents and specifications for penetrating sealers.

METHOD OF MEASUREMENT

Cold Weather Concrete - Surface Treatment of Superstructure Slabs and Structural Approach Slabs will be measured for payment as the number of square meters of superstructure and approach slab, measured to the nearest 0.1 square meters, satisfactorily treated by either of the following:

- Completion of an acceptable drying enclosure system
- Air drying for 24 hours, interim sealer application, deck cleaning, followed by diamond grinding after 1 winter season. No deductions will be made for isolated low areas that are not diamond ground, provided that 95% of the surface is satisfactorily diamond ground.

BASIS OF PAYMENT

The unit price bid for work performed for Cold Weather Concrete - Surface Treatment of Superstructure Slabs and Structural Approach Slabs shall include all labor, materials and equipment necessary to satisfactorily complete the work. The cost for interim penetrating sealer applied under §557-3.12C2, prior to the concrete being exposed to freezing conditions, shall be included in this item. The cost for saw cut grooving and final application of penetrating sealer will be paid for under separate items and paid for only once.