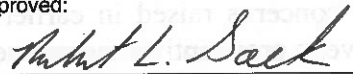


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| <b>SUPERSEDED BY</b><br><b>EB 15-031</b><br><b>EFFECTIVE 9/28/15</b>                                                                                                                                                                                                                                                                                                              |  | New York State<br>Department of<br>Transportation<br><b>ENGINEERING</b><br><b>INSTRUCTION</b>                                                                                          | <b>EI</b><br><b>09-022</b> |
| <b>Title: REVISED STANDARD SPECIFICATION – §557-3.12. PROVISIONS FOR CONCRETING IN COLD WEATHER</b>                                                                                                                                                                                                                                                                               |                                                                                   |                                                                                                                                                                                        |                            |
| <b>Distribution:</b><br><input type="checkbox"/> Manufacturers (18)<br><input checked="" type="checkbox"/> Local Govt. (31)<br><input checked="" type="checkbox"/> Agencies (32)<br><input type="checkbox"/> Surveyors (33)<br><input checked="" type="checkbox"/> Consultants (34)<br><input checked="" type="checkbox"/> Contractors (39)<br><input type="checkbox"/> _____ ( ) |                                                                                   | <b>Approved:</b><br><br>Robert L. Sack, P.E.<br>Deputy Chief Engineer, Research<br>18 Nov 09<br>Date |                            |

#### ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective for the letting of May 6, 2010.
- This EI supersedes EI 06-029.
- This revision will be incorporated into a future update of the Standard Specifications.

#### PURPOSE:

- This EI issues a revision to §557-3.05 and §557-3.12. of the Standard Specifications.

#### TECHNICAL INFORMATION:

- This revision to §557-3.12 *Provisions for Concreting in Cold Weather*, provides new requirements that further describe the details to progress work during cold weather. It also provides quantifiable measures and optional surface treatment applications when concrete is placed in cold weather conditions. The revisions to §557-3.12 resulted in the need to make minor revisions to §557-3.05 *Handling and Placing Concrete*.
- The cost for work progressed during cold weather has historically been included in the bridge deck concrete items. Separating this cost out will now provide a more accurate cost for the bridge deck placement. Further, the cost associated with cold weather protections will reflect actual project needs and only apply when winter provisions are justified. Until an average bid price can be established, Designers should use an estimate of \$5000 plus \$8.00 per square yard which covers either equipment mobilization and all operating costs for grinding or an enclosure depending on the option selected for use. Designers should also consider the amount of work to be completed as well as geographic location and adjust estimates accordingly.

#### IMPLEMENTATION:

- Main Office Design Quality Assurance Bureau will insert the standard specification shelf note beginning with projects submitted for the letting of May 6, 2010.
- Designers may incorporate these changes into projects let prior to May 6, 2010 and the inclusion of the shelf note. If Designers chose to incorporate these changes, then they shall submit the revised standard specification shelf note to MO Design Quality Assurance Bureau with the PS&E package.
- Engineers-in-Charge may incorporate these changes into ongoing construction contracts via Order-on-Contract. A Copy of this EI should be provided to the Contractor and a file copy included in the contract records as documentation of the change in accordance with the Contract Administration Manual (CAM) §104-02.

**TRANSMITTED MATERIALS:**

This EI transmits shelf note *Provisions for Concreting in Cold Weather*, for both Metric and U.S. Customary units.

**BACKGROUND:**

Section 557 of the Standard Specifications was revised in its entirety in 2004. While a number of changes were made, particular effort was focused on cold weather concreting provisions that addressed concrete performance concerns raised in earlier years. This specification was later revised under EI 06-029 that imposed very prescriptive requirements. These prescriptive requirements have resulted in acceptable performance as the Department has not observed any significant scaling distress to superstructure slabs. However, the direct cost of protecting concrete placed late in the season, and the indirect cost of delayed completion have been deemed extensive. The current specification requirements have limited contractor operations and resulted in use of costly cold weather concreting protective measures, even when good environmental conditions exist.

To provide for reduced costs while maintaining minimal risk of potential concrete scaling distress, §557-3.12, *Provisions for Concreting in Cold Weather*, is being further revised. The new specification provides performance measures that a contractor must meet while allowing the contractor to use the most appropriate yet most economical methods for cold weather concrete practices to complete the work. While true performance based requirements are not possible, the specifications allow contractors greater latitude in the methods and materials used to protect concrete during cold weather. Included are optional means for a contractor to progress work, performance requirements of temperature management, defined limits of allowable distress, and defined remediation methods should distress occur. A separate pay item for either a drying period or diamond grinding has been developed.

The pay item for "Winter Surface Treatment" shall be included in all projects. Contractors would have to decide at the time of bidding which option will be used and to bid accordingly. A contractor may decide to complete work early in the season such that there is no need for cold weather provisions and the item would not be used. The contractor may decide that cold weather work is unavoidable and will decide if a drying period will be completed or if diamond grinding will be used and then the bid for Winter Surface Treatment would reflect costs accordingly. Actual payment for the Winter Surface Treatment will only be made if cold weather occurs, as defined in specifications, requiring the contractor to provide temperature and/or moisture protections after completion of the curing period.

The above item and process will provide a more accurate description of optional work and distinguish those costs associated with cold weather construction progressed under the Winter Surface Treatment item separate from standard curing operations. The cost of protecting concrete during the wet curing period remains as part of the concrete deck item and is not part of the winter surface treatment item.

**CONTACT:** Direct questions regarding this EI to Jose Rivera of the Office of Construction via email at [jrivera@dot.state.ny.us](mailto:jrivera@dot.state.ny.us) or at (518) 457-0758 or to Don Streeter of the Materials Bureau via e-mail at [dstreeter@dot.state.ny.us](mailto:dstreeter@dot.state.ny.us) or at (518) 457-4593.

## PROVISIONS FOR CONCRETING IN COLD WEATHER

Make the following changes to the Standard Specifications of May 4, 2006:

### Page 355

Under §557-3.05 *Handling and Placing Concrete*, **Delete** line 1 and **Replace** it with the following: For placements proposed between October 1<sup>st</sup> and April 1<sup>st</sup> the Pre-placement Meeting should additionally review cold weather concreting operations including, but not limited to, the following:

Line 4; under §557-3.05 *Handling and Placing Concrete*, **Delete** the 3<sup>rd</sup> bullet "Engineers permission to progress cold-weather concreting"

Line 8; under §557-3.05 *Handling and Placing Concrete*, **Delete** "September 15" and **Replace** it with "October 1".

### Page 360

**Delete** §557-3.12. *Provisions For Concreting In Cold Weather* and **replace** it with the following:

**557-3.12 Provisions for Concreting in Cold Weather.** Cold-weather concreting provisions shall apply when the ambient air temperature drops below 7°C for 24 consecutive hours, or drops below 0°C at any time, during the curing or drying periods of the concrete.

When cold-weather concreting of superstructure slabs is progressed, curing 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 (336 hours). Conditions may occur which prevent an entire 24 hour 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, the Contractor may aggregate curing hours. An aggregation of 24 curing hours will be credited as one curing day based on the Engineer's acceptance of monitored temperature data. Any aggregations of less than 24 curing hours will not be credited as a curing day. A curing hour is defined as any hour during which the curing temperature remains at, or above 7°C. Curing temperature is defined as the temperature of the air measured at the surface of the curing concrete.

Curing temperatures shall be maintained in accordance with the requirements of Table 555-2, *Cold Weather Curing Requirements*. If ambient air temperatures are expected to fall below 7°C, materials and equipment necessary to maintain required curing temperatures shall be present on the site or readily available. The Contractor shall provide protection in a timely manner to maintain acceptable curing.

External heat and enclosures to maintain curing temperatures may be required, as determined by the contractors proposed curing methods documented at the Pre-placement Meeting. Enclosures are defined as those materials, combinations of materials, or systems that provide for uniform temperature and curing management of the concrete. If 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 25°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. If the Contractor expects to, or will, perform work when ambient temperatures are below 7°C, the 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 enclosure or use of non-combustion type heating systems.

## PROVISIONS FOR CONCRETING IN COLD WEATHER

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.

A maximum temperature differential of 15 °C between any two locations within any form of enclosure, heated or otherwise, shall be maintained at all times.

When the ambient temperature is 7°C or greater, an enclosure may be removed for access to progress additional work providing there is a temperature difference of 15 Celsius degrees or less between the air and the surface of the concrete. If the temperature difference between the air and the surface of the concrete is greater than 15 Celsius degrees, 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 Celsius degrees. If an enclosure is removed, all heating in other areas shall cease until such time that the enclosure is replaced. Upon completion of the incidental work and replacement of the enclosure, the Contractor shall reestablish acceptable curing temperature differentials, with a maximum temperature differential not more than 15 Celsius degrees 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 provisions of 557-3.12 A *Superstructure Slabs* shall apply except the curing duration shall be 7 days (168 hours). After three (3) curing days, the Contractor may perform work on approach slabs 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 structural approach slabs, the requirements of §557-3.15, *Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges*, shall apply.

### **C. Saw Cut Grooving.**

When concrete is placed, cured, or dried under cold weather provisions, and a surface treatment option requiring saw cut grooving is used, saw cut grooving may be commenced after 7 curing days and shall be completed prior to commencing the drying period. Work shall progress only when ambient temperatures are 7°C or greater or within an enclosure as described in §557-3.12 A. Care shall be taken to prevent damage to the structure and no chipping or spalling of concrete shall occur at the sawcut edges.

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

Upon completion of the curing period, the Contractor shall progress one of the following two options:

1. **Option 1.** The top surface and fascias of the superstructure slab shall be air dried for 10 days prior to 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 and 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 air flow.
  - b. Drying of the underside of the structure, and of the fascias when a concrete barrier is to be

## PROVISIONS FOR CONCRETING IN COLD WEATHER

placed on the superstructure slab, will not be required. However, ambient temperatures shall be maintained between 7°C and 25°C in 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. Any 3 hour period of time, or fraction thereof, when the concrete is exposed to minor leakage shall not be counted as part of the drying period. Minor leakage shall be defined as water that dries or evaporates in 3 hours or less. Limited areas are defined as areas less than 10 m<sup>2</sup>. The total area of allowable minor leakage shall not exceed 5% of the concrete area under drying conditions. The same area of concrete shall not be exposed to minor leakage more than twice. Areas that exceed 10 m<sup>2</sup> or are exposed to additional water that does not dry or evaporate in less than 3 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 for 10 days.

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 complete, 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. Option 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 performed. External heat and enclosures to maintain drying temperatures may be required. Work shall be progressed by doing the following:

a. Providing free air flow and maintaining temperatures between 7°C and 25°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, and 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 25°C in these areas for the duration of the 24 hour drying period. Application of interim penetrating sealer shall be completed before opening the superstructure slab to traffic.

c. After April 1<sup>st</sup> the contractor shall clean the deck of debris and provide necessary site access. The Department will inspect the superstructure slab for freeze / thaw or scaling damage. Damage shall be defined as:

(1) Delaminations

(2) Surface defects as follows:

- Total combined area greater than 5 m<sup>2</sup> with a scaling rating of 3 or greater as defined by ASTM C-672.
- Total combined area greater than 1 m<sup>2</sup> where the surface distress is greater than 5 mm deep.

(3) Pop-outs – surface imperfections greater than 20 mm in diameter.

d. If the above described damage exists, the Contractor shall repair any damaged or defective concrete greater than 5mm deep by saw cutting the perimeter of the area to a depth

## PROVISIONS FOR CONCRETING IN COLD WEATHER

of 20 mm, chipping any unsuitable material to 40 mm or sound concrete (whichever is deeper) with light, hand held, pneumatic tools, at a 45 degree angle into the repair area. Clean all repair area surfaces thoroughly by blast cleaning. Repair small areas 0.25 m<sup>2</sup> or less using approved concrete repair material that provides a permeability less than 1200 coulombs, that meets the requirements of §701-04 *Concrete Repair Material*, preparing the surface according to the material manufacturer's recommendations. Repair larger areas using Class DP concrete, preparing the surface according to §584-3.02 and 584-3.03. Cure Class DP concrete for 7 days.

e. After all 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:

- (1) The depth of the grinding shall be approximately 5mm to obtain a smooth texture.
- (2) 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 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.
- (3) 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.
- (4) 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.
- (5) Traffic may be allowed on ground areas after slurry removal is complete or on decks where only partial diamond grinding is complete.
- (6) After diamond grinding is complete, concrete shall be saw cut grooved according to contract documents and specifications for saw cut grooving, followed by penetrating sealer application placed 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 25°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 in accordance with contract documents.

**Page 361**

***Under §557-3.15, Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges, Add the following before the first sentence:***

During the curing period, approach slabs may be subjected to a vehicle load not to exceed 10 metric tons, or a wheel load not to exceed 3 metric tons.

## PROVISIONS FOR CONCRETING IN COLD WEATHER

**Page 362** **Delete** §557-4, METHOD OF MEASUREMENT, and **Replace** it with the following:

**557-4 METHOD OF MEASUREMENT.** The work will be measured for payment in square meters of superstructure slab, approach slab, or sidewalk and safety walks installed, measured to the nearest 0.1 square meters.

Winter surface treatment of superstructure and approach slabs will be measured for payment in square meters of superstructure and approach slab treated, measured to the nearest 0.1 square meters.

**Page 362** **Delete** §557-5 BASIS OF PAYMENT and **Replace** it with the following:

**557-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work. Unless otherwise provided, the unit price bid shall include the cost of furnishing and placing bar reinforcement, wire fabric for concrete reinforcement, copper flashing, flexible water stops, mechanical connectors where specified, sheet packing, water for wetting, joint sealing compounds, joint fillers, concrete curing materials, including any materials for temperature management during the curing period and the cost of screed rail supports and other brackets or braces necessary to support finishing machines.

If permanent metal forms are used, the cost of furnishing all facilities required for access, removing the permanent forms for inspection or repair purposes, painting the cut edges of the forms and repairing the concrete as required herein shall be included in the price bid for this work.

No extra compensation for corrective finishing or repairs to damaged or defective concrete will be paid.

Progress payments will be made on a per-span basis as follows:

Forty (40) percent of the area will be paid for after all reinforcing is properly placed. Forty (40) percent of the area will be paid for after the concrete has been properly placed and proper curing applications have been instituted. The remainder will be paid for after completion of all curing, and necessary corrective work.

The unit price bid for Surface Treatment of Superstructure and Approach Slabs shall include all labor, materials and equipment necessary to satisfactorily complete the work, including work zone traffic control for work associated with deck cleaning, evaluation, and diamond grinding. The cost for interim penetrating sealer applied under §557-3.12C.2., 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.

Winter Surface treatment – Superstructure Slabs and Structural Approach Slabs shall only be paid when environmental conditions related to temperature and moisture protection during the drying period require use of enclosures. No deductions will be made for isolated low areas that are not diamond ground, provided that 95% of the surface is satisfactorily diamond ground.

**Page 363** **Add** the following contract pay item to the list:

|        |                                                                               |              |
|--------|-------------------------------------------------------------------------------|--------------|
| 557.29 | Winter Surface Treatment – Superstructure Slabs and Structural Approach Slabs | Square Meter |
|--------|-------------------------------------------------------------------------------|--------------|

## PROVISIONS FOR CONCRETING IN COLD WEATHER

Make the following changes to the Standard Specifications of May 1, 2008

### Page 359

Under §557-3.05 *Handling and Placing Concrete*, **delete** line 5 and **replace** it with the following:  
For placements proposed between October 1<sup>st</sup> and April 1<sup>st</sup> the Preplacement Meeting should additionally review cold weather concreting operations including, but not limited to, the following:

Line 8; under §557-3.05 *Handling and Placing Concrete*, **delete** the 3<sup>rd</sup> bullet that begins "Engineers permission..."

Line 11; under §557-3.05 *Handling and Placing Concrete*, **delete** "September 15" and **replace** it with "October 1".

### Page 364

**Delete** §557-3.12. *Provisions For Concreting In Cold Weather* and **replace** it with the following:

**557-3.12 Provisions for Concreting in Cold Weather.** Cold-weather concreting provisions shall apply when the ambient air temperature below 45°F for 24 consecutive hours, or drops below 32°F at any time, during the curing or drying periods of the concrete.

When cold-weather concreting of superstructure slabs is progressed, curing 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 (336 hours). Conditions may occur which prevent an entire 24 hour 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 the Contractor may aggregate curing hours. An aggregation of 24 curing hours will be credited as one curing day based on the Engineer's acceptance of monitored temperature data. Any aggregations of less than 24 curing hours will not be credited as a curing day. A curing hour is defined as any hour during which the curing temperature remains at, or above 45°F. Curing temperature is defined as the temperature of the air measured at the surface of the curing concrete.

Curing temperatures shall be maintained in accordance with the requirements of Table 555-2, *Cold Weather Curing Requirements*. If ambient air temperatures are expected to fall below 45°F, materials and equipment necessary to maintain required curing temperatures shall be present on the site or readily available. The contractor shall provide protection in a timely manner to maintain acceptable curing.

External heat and enclosures to maintain curing temperatures may be required, as determined by the contractors proposed curing methods documented at the Preplacement Meeting. Enclosures are defined as those materials, combinations of materials, or systems that provide for uniform temperature and curing management of the concrete. If enclosures are required, they shall be constructed in such a way that all surfaces of the fresh concrete shall be maintained between 45°F and 80°F 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. If the Contractor expects to, or will, perform work when ambient temperatures are below 45°F, the enclosure shall be constructed in such a manner that work can be performed inside the enclosure without exposing any concrete to a temperature below 45°F. 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 enclosure or use of non-combustion type heating systems.

## PROVISIONS FOR CONCRETING IN COLD WEATHER

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.

A maximum temperature differential of 30° F between any two locations within any form of enclosure, heated or otherwise, shall be maintained at all times.

When the ambient temperature is 45°F or greater, an enclosure may be removed for access to progress additional work providing there is a temperature difference of 30 Fahrenheit degrees or less between the air and the surface of the concrete. If the temperature difference between the air and the surface of the concrete is greater than 30 Fahrenheit degrees, temperatures shall be gradually reduced at a rate not to exceed 1°F /hr until the temperature difference is equal to or less than 30 Fahrenheit degrees. If an enclosure is removed, all heating in other areas shall cease until such time that the enclosure is replaced. Upon completion of the incidental work and replacement of the enclosure, the Contractor shall reestablish acceptable curing temperature differentials, with a maximum temperature differential not more than 30 Fahrenheit degrees 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 45°F 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.

### **C. Structural Approach Slabs, Curbs, Sidewalks and Safety Walks on Bridges.**

The provisions of 557-3.12 A *Superstructure Slabs* shall apply except the curing duration shall be 7 days (168 hours). After three (3) curing days, the Contractor may perform work on approach slabs to complete sidewalks, safety walks, curbs, and barriers. Work shall progress only when ambient temperatures are 45°F or greater or within an enclosure as described above. Incidental work shall not cause damage to the structure.

For structural approach slabs, the requirements of §557-3.15 *Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges*, shall apply.

### **C. Saw Cut Grooving.**

When concrete is placed, cured, or dried under cold weather provisions, and a surface treatment option requiring saw cut grooving is used, saw cut grooving may be commenced after 7 curing days and shall be completed prior to commencing the drying period. Work shall progress only when ambient temperatures are 45°F or greater or within an enclosure as described in §557-3.12 A. Care shall be taken to prevent damage to the structure and no chipping or spalling of concrete shall occur at the sawcut edges.

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

Upon completion of the curing period, the Contractor shall progress one of the following two options:

**1. Option 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 and enclosures to maintain drying temperatures may be required. Drying shall be achieved by the following:

a. Providing free air flow and maintaining temperatures between 45°F and 80°F to the top surface and fascias (vertical faces) of the superstructure slab. Fascia forms shall be removed to allow for free air flow.

## PROVISIONS FOR CONCRETING IN COLD WEATHER

b. Drying of the underside of the structure, and 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 45°F and 80°F in 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. Any 3 hour period of time, or fraction thereof, when the concrete is exposed to minor leakage shall not be counted as part of the drying period. Minor leakage shall be defined as water that dries or evaporates in 3 hours or less. Limited areas are defined as areas less than 100 ft<sup>2</sup>. The total area of allowable minor leakage shall not exceed 5% of the concrete area under drying conditions. The same area of concrete shall not be exposed to minor leakage more than twice. Areas that exceed 100 ft<sup>2</sup> or are exposed to additional water that does not dry or evaporate in less than 3 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 for 10 days.

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 1 inch from any concrete surface.

Once the drying period is complete, temperatures shall be gradually reduced at a rate not to exceed 1°F/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. Option 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 performed. External heat and enclosures to maintain drying temperatures may be required. Work shall be progressed by doing the following:

a. Providing free air flow and maintaining temperatures between 45°F and 80°F 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, and 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 45°F and 80°F in these areas for the duration of the 24 hour drying period. Application of interim penetrating sealer shall be completed before opening the superstructure slab to traffic.

c. After April 1<sup>st</sup> the contractor shall clean the deck of debris and provide necessary site access. The Department will inspect the superstructure slab for freeze / thaw or scaling damage. Damage shall be defined as:

(1) Delaminations

(2) Surface defects as follows:

- Total combined area greater than 50 ft<sup>2</sup> with a scaling rating of 3 or greater as defined by ASTM C-672.
- Total combined area greater than 10 ft<sup>2</sup> where the surface distress is greater than 3/16 inch deep.

(3) Pop-outs – surface imperfections greater than 3/4 inch in diameter

## PROVISIONS FOR CONCRETING IN COLD WEATHER

d. If the above described damage exists, the Contractor shall repair any damaged or defective concrete greater than 3/16 inch deep by saw cutting the perimeter of the area to a depth of 3/4 inch, chipping any unsuitable material to 1-1/2 inch or sound concrete (whichever is deeper) with light, hand held, pneumatic tools, at a 45 degree angle into the repair area. Clean all repair area surfaces thoroughly by blast cleaning. Repair small areas 3 ft<sup>2</sup> or less using approved concrete repair material that provides a permeability less than 1200 coulombs, Item 701-04, preparing the surface according to the material manufacturer's recommendations. Repair larger areas using Class DP concrete, preparing the surface according to §584-3.02 and 584-3.03. Cure Class DP concrete for 7 days.

e. After all necessary repairs are completed, the Contractor shall perform diamond grinding to the entire superstructure slab and approach slabs, to within 1 foot of any curb or barrier.

Diamond grinding shall be performed as follows:

- (1) The depth of the grinding shall be approximately 3/16 inch to obtain a smooth texture.
- (2) 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 3 ft wide (minimum) grinding pass that is equipped with a vacuum system capable of removing slurry from the bridge deck surface, such as the Target 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.
- (3) 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 3 ft (minimum) straightedge. When steel joints are specified, joints shall be placed to allow for the required grinding of 3/16 inch. 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.
- (4) 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.
- (5) Traffic may be allowed on ground areas after slurry removal is complete or on decks where only partial diamond grinding is complete.
- (6) After diamond grinding is complete, concrete shall be saw cut grooved according to contract documents and specifications for saw cut grooving, followed by penetrating sealer application placed 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 45°F and 80°F 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 in accordance with contract documents.

**Page 366 Under §557-3.15, Loading Limitations for Structural Approach Slabs, Sidewalks, and Safety Walks on Bridges, add the following before the first sentence:**

During the curing period, approach slabs may be subjected to a vehicle load not to exceed 10 tons, or a wheel load not to exceed 3 tons.

## PROVISIONS FOR CONCRETING IN COLD WEATHER

**Page 367 Delete** §557-4, METHOD OF MEASUREMENT, and **replace** it with the following:

**557-4 METHOD OF MEASUREMENT.** The work will be measured for payment in square yards of superstructure slab, approach slab, or sidewalk and safety walks installed, measured to the nearest 0.1 square yards.

Winter surface treatment of superstructure and approach slabs will be measured for payment in square yards of superstructure and approach slab, measured to the nearest 0.1 square yard.

**Page 367 Delete** §557-5, BASIS OF PAYMENT and **Replace** it with the following:

**557-5 BASIS OF PAYMENT.** The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to complete the work. Unless otherwise provided, the unit price bid shall include the cost of furnishing and placing bar reinforcement, wire fabric for concrete reinforcement, copper flashing, flexible water stops, mechanical connectors where specified, sheet packing, water for wetting, joint sealing compounds, joint fillers, concrete curing materials, including any materials for temperature management during the curing period and the cost of screed rail supports and other brackets or braces necessary to support finishing machines.

If permanent metal forms are used, the cost of furnishing all facilities required for access, removing the permanent forms for inspection or repair purposes, painting the cut edges of the forms and repairing the concrete as required herein shall be included in the price bid for this work.

No extra compensation for corrective finishing or repairs to damaged or defective concrete will be paid.

Progress payments will be made on a per-span basis as follows:

Forty (40) percent of the area will be paid for after all reinforcing is properly placed. Forty (40) percent of the area will be paid for after the concrete has been properly placed and proper curing applications have been instituted. The remainder will be paid for after completion of all curing, and necessary corrective work.

The unit price bid for Surface Treatment of Superstructure and Approach Slabs shall include all labor, materials and equipment necessary to satisfactorily complete the work including work zone traffic control for work associated with deck cleaning, evaluation, and diamond grinding. The cost for interim penetrating sealer applied under §557-3.12C.2., 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.

Winter Surface treatment – Superstructure Slabs and Structural Approach Slabs shall only be paid when environmental conditions related to temperature and moisture protection during the drying period require use of enclosures

**Page 367 Add** the following contract pay item to the list:

|        |                                                                               |             |
|--------|-------------------------------------------------------------------------------|-------------|
| 557.29 | Winter Surface Treatment – Superstructure Slabs and Structural Approach Slabs | Square Yard |
|--------|-------------------------------------------------------------------------------|-------------|