Adequate supervision of concrete construction is critical to insure a safe and durable product, particularly in view of its high cost for construction and maintenance. The following inspection guidelines should be studied carefully by E.I.C.'s and their inspectors well in advance of the work.

One of the more common failings of our concrete substructures has been improper placement of reinforcing resulting in insufficient cover. This can lead to early corrosion of the reinforcing if not epoxy coated, causing concrete delaminations and spalling. Maintaining proper air entrainment is another problem. Proper conveyance of the concrete from the truck discharge point to the placement location is critical in maintaining adequate air entrainment in the finished product. Another problem is cracking of structural elements. The method of placement and more commonly the effort exerted to ensure good consolidation and curing are critical in minimizing cracking. These, and other problems, can be minimized or eliminated by following proper construction practices and procedures.

I. General
Proper planning should be undertaken by both the Contractor and the Engineer and the inspection force in advance of actual construction. Such planning should include a job meeting to discuss in detail, the equipment and procedures that will be employed by the Contractor. A major point of discussion should be the provision of adequate delivery of concrete and sufficient placing equipment to insure that the placement can be effectively accomplished. This should include a contingency plan to handle unanticipated equipment breakdowns or interruptions in concrete supply.

The Engineer and the inspectors, must be completely familiar with the specifications for the work, including any special specifications, special notes, addenda to the specifications, appropriate Materials Methods, and all other related information.

II. Reinforcing Steel Operations
A. Handling and Storing Reinforcing Bars
Reinforcing bars must be properly handled, stored, and placed. Bars will normally be specified as being uncoated, or coated with a protective coating for corrosion resistance. Rebars with a fusion bonded, electrostatically applied epoxy protective coating (Materials Specification 709-04) are often specified for coated rebars.

Fusion bonded epoxy coatings are susceptible to damage if the bars are improperly stored and handled. Before shipment to the project site, epoxy coating applicators, and rebar fabricators are required to repair all damaged areas of coating. However, shipments of epoxy coated rebar should still be carefully inspected for coating damage after their arrival at the project site.

During unloading by the Contractor at the job site, careful handling procedures can reduce the potential for coating damage. Suitable lifting equipment and slings should be used to unload bundles of coated bars. Epoxy coated rebars should not be dropped or dragged during unloading or transfer for placement in the structure.

Coated bars that are stored before placement should be supported above the ground on wooden timbers or other suitable protective cribbing. The same protective measures should be used for stacking bundles of bars.

Extended periods of exposure to ultraviolet rays may result in deterioration of the protective epoxy coating. Storage outdoors requires that epoxy coated rebars be covered (top and sides) for protection from the weather. Provisions should be made for adequate air circulation to prevent condensation under the cover. Opaque (nontransparent) waterproof covers such as black polyethylene will serve to protect the coating from direct rays of sunlight. Also, the cover will prevent water or water vapor from penetrating the coating to the steel at damaged areas or "holidays" (pinholes in the coating not visible to the naked eye).
B. Installation of Reinforcing Bars

After placement in the structure, reinforcing steel should be free of grease, dirt, mortar, and other foreign substances. Uncoated steel should have loose mill scale and rust removed. Proper bar spacing should be maintained both horizontally and vertically. This means that all straight bars must be reasonably straight. The location and stability of the reinforcing steel must be carefully checked prior to placement of the concrete.

Epoxy coated reinforcement requires more detailed inspection before the concrete placement. Ends of the reinforcement exposed from field cutting will require touch-up with a patching material. The Contractor may also have to repair damage to the coating resulting from improper handling or field bending. The specifications require repair to a coated rebar which is determined to exhibit "major" damage. "Major" damage is defined as an area greater than 6mm by 6mm. Any 3 meter length of bar should not have more than five areas of "major" damage.

Areas of "minor" damage (< 6mm by 6mm) are not required to be repaired. The average number of unrepaired "minor" damaged areas should not exceed an average of 1.8 per meter on any individual bar.

When repairs are required, the coating manufacturer's recommended patching material, normally a two-component epoxy, should be used according to the manufacturer's instructions. Technical data sheets normally list various application requirements. Damaged surfaces need to be cleaned by wire brushing before patching. Proper adhesion and performance of the patching material is dependent upon the cleanliness of the surface. Any loose material and rust must be removed.

Miscellaneous items such as chairs, tie wires, and other devices that are used in connection with the placement of reinforcing steel should meet the specification requirements. For uncoated reinforcement, chairs should have high density, polyethylene tips. Stainless steel chairs or epoxy coated chairs without, plastic tips are also acceptable. Chairs, tie wires, and other devices used to fasten epoxy coated reinforcement should be coated with, or made of a dielectric material. Epoxy or plastic (vinyl) coated products are generally used for these items.

After epoxy coated rebars are placed in the structure, care should be taken so that construction equipment or worker operations do not damage the coating.

C. Plan Clearances

Make sure that plan clearances are maintained between bars, joint assemblies and side forms. This is particularly important near scuppers, rail supports, etc., where additional reinforcing is used and clearances are small.

III. Forming Operations

A. Forms

Forms should be properly supported and adequate to support the loads to be applied. Minor movements in forms can cause an unacceptable change in the dimensions of the final product; stability is essential to achieve proper reinforcement bar cover. The forms are the Contractor's responsibility, but the Engineer should be alert to any obvious weaknesses in the installation and call them to the Contractor's attention. The Engineer should compare commercially manufactured support system installations for conformance to the manufacturer's recommendations. Other support systems should be checked for good workmanship.
B. **Joints**

Joints must be properly constructed in conjunction with form, reinforcement, and waterstop placement as required.

Joints are classified as construction, contraction, or expansion and are described by the following:

1. **Construction Joints**
   a. **Definition**
   Construction joints are interruptions in the concrete placement provided to facilitate construction. In some cases, vertical construction joints are introduced in abutment stems and backwalls to reduce the possibility of cracks forming due to shrinkage of the concrete during curing, thus performing the function of a contraction joint as well.

   b. **Reinforcement**
   Reinforcing steel will always pass through construction joints. All construction joints are provided with keyways, unless otherwise specified.

   c. **Sealing**
   All construction joints will be sealed with a waterstop as indicated on the plans, unless otherwise indicated. Waterstops are required where leakage through the joint is likely and staining due to that leakage would be objectionable.

2. **Contraction Joints**
   a. **Definition**
   Contraction joints are interruptions in the concrete placement introduced to reduce the possibility of cracks forming due to shrinkage of the concrete.

   b. **Reinforcement**
   Reinforcement will not extend through a contraction joint. The object of a contraction joint is to allow sections of a large placement to act independently. The continuation of reinforcement through the joint would bond the segments together and defeat the purpose of the joint. All contraction joints will be provided with a keyway.

   c. **Sealing**
   All contraction joints are provided with a waterstop as indicated on the plans, except where leakage through the joint is unlikely or where staining due to leakage was deemed to be unobjectionable.

3. **Expansion Joints**
   a. **Definition**
   Expansion joints are interruptions in the concrete placement provided to allow for movements due to thermal expansion.

   b. **Reinforcement**
   No reinforcement extends through the expansion joint. Reinforcement would act to tie adjacent sections together and hinder the free movement of the joint. Expansion joints in walls and footings are provided with a keyway.
SECTION 555 - STRUCTURAL CONCRETE

c. Sealing
All expansion joints are sealed with a waterstop as indicated on the plans.

d. Footings
The requirements for expansion joints in footings are the same as stated in 3b and 3c above, except waterstops are not required.

C. Wall Layout to Accommodate Waterstops
At locations where a waterstop is to be installed, the walls should be laid out so that the rear faces of the two adjoining walls are to be flush at the joint in order to accommodate the waterstop.

D. Construction Joints Shown on Plans
All joints required will be shown on the plans. In the event of omission, the Engineer should bring it to the attention of the Regional Construction Supervisor for advice from the Structures Division.

IV. Concrete Operations
A. Prior to Placing Concrete
Prior to commencing the placement of concrete, all the following conditions must be resolved in a pre-placement meeting:

1. Placing Sequence
Check the placing sequence, if any, on the plans and follow it. Don't deviate from it without prior approval from the Deputy Chief Engineer of the Structures Division (518) 457-7677. If changes are made, make sure that all interested parties are aware of them in advance.

2. Need for Personnel and Equipment
Make sure that enough personnel and adequate equipment are on hand to perform the work and meet emergencies. The Contractor is responsible for proper progress of the work, however, the Engineer must be satisfied that a sufficient work force will be present to complete the concrete placement. Backup equipment, including spare vibrators, should be at the site.

3. Concrete Supply
Prior to placement, discuss with the Contractor the need for an adequate and timely supply of concrete to meet the specification requirements.

4. Conveyance System
The conveyance system should be tested prior to the start of the placement. If belt conveyors are being used to deliver concrete to the placement site, they should be equipped with discharge hoods at transfer points to minimize segregation and reduce spillage. Scrapers should be utilized to keep the cement paste in the mix and off the conveyor belt. If pumps are used to deliver the concrete, hoses should be kept as level as possible. Extreme rises and falls in the hoses place greater pressures on the concrete and alter the air entrainment. Discharge of the concrete from pump hoses in a horizontal position is preferred. This will maintain a steady head of concrete and reduce the potential of air loss. Conveyance systems must be tested for their ability to deliver concrete, allowing for the established variances, within the required specification limits. Where conveyance systems cross areas ready for concrete placement, some form of protection (ie. drop cloths, plywood) should be used to catch mortar leakage from transfer points, pipeline joints, etc.

5. Forms
Make sure that forms, and areas within the forms, are properly cleaned before allowing concrete to be placed. Compressed air or a vacuum cleaner should be used to clean them. All rubbish, sawdust, dirt, nails, and other foreign matter must be removed. Forms should be refaced regularly and coated with
6. Curing Materials
An adequate supply of approved curing materials must be maintained at the project site. This should include not only the curing materials for the intended curing method, but suitable substitutes in case of malfunctions or inclement weather.

7. Admixtures
When admixtures are to be used, a careful review of their use with the Contractor should be made well in advance of any placement. Generally, admixture use is at the discretion of the Contractor, however, some placement conditions require certain admixture use. At the pre-placement meeting admixture use should be discussed to determine expected results and alleviate potential problems. The Regional Materials Engineer should be contacted to provide instructions and oversight of proper use of concrete admixtures.

a. Air Entraining Agents (AEA)
Air entrainment is required for all concrete placed on Department projects. Concrete will entrain approximately 2% air without any admixture. AEA is necessary to achieve the desired air content. To determine proper dosage, concrete should be tested prior to placement. Testing should be performed at regular intervals to assure consistent air contents in the concrete. How the concrete is handled will effect the air content, as previously discussed, and testing at various locations should also be performed.

b. Set Retarding Water Reducers
Retarders slow the setting of concrete, allowing the concrete to remain plastic for longer durations. Retarders, by nature, will increase slump and can also effect the air content of concrete. Hydraulic forces on forms may increase when using retarders, as the height of concrete placement increases.

c. Water Reducers
Two types of water reducers are used by the Department: Normal Range and High Range. Both can be used to reduce the mix water while achieving the same slump, resulting in somewhat higher compressive strengths, or they can be used to achieve higher slumps without reducing mix water, improving workability.

Normal range water reducers can be used in any concrete placement, but are required for Class I and J concrete. Also, Class HP used for substructures requires a normal range water reducer and/or a set retarding water reducer to achieve a workable slump while maintaining the desired water to cement ratio. The Regional Materials Engineer should be consulted to determine appropriate admixture dosages and determination of water to total cementitious ratio.

High Range Water Reducers, also known as Superplasticizers, are generally used only for substructure repairs. Other uses may be considered, and must be approved by the Regional Materials Engineer.

d. Other Admixtures
Other admixtures such as corrosion inhibitors, coloring agents, accelerators, and others may be considered for use. The Regional Materials Engineer must be consulted prior to use any of these special admixtures.

8. Engineer's Approval
No concrete should be placed until the Engineer gives approval to do so. All checking, other than a
few last minute checks, should be done the day before the placement. The entire section to be placed should be ready before allowing the concrete placement to commence.

9. Prewetting
Shrinkage cracking can result when fresh concrete is placed on a dry area. For instance, when an abutment backwall is placed on an abutment stem, the “dry concrete” from the abutment stem will draw away the “design mix water” from the fresh concrete and result in shrinkage cracks. Shrinkage cracking will typically occur at a point of weakness. In the abutment backwall this will be an vertical epoxy rebar, in an abutment stem on a footing this typically occur at the weep hole and possibly other areas. When placing concrete barrier with the slip-forming method, cracking can be observed in the scored joints and other locations. This again, would typically occur at a point of weakness or at the vertical epoxy rebar. Sidewalks placed on a bridge deck would be another example. Good construction practice would be to prewet the area for a sufficient time when fresh concrete is to be placed on a dry surface in order to prevent the extraction of the mix design water. Cold weather conditions where heaters are used insure that previously placed concrete will really be dry. Providing a continually wetted area for a minimum of 12 hours prior to the start of the concrete placement will minimize shrinkage cracking.

B. Placing Concrete
All operations in the construction of structural concrete elements have an effect on the final product. Some of the most critical factors on the durability of structural concrete are

X proper concrete air entrainment
X proper concrete cover over the reinforcing steel
X proper consolidation of the concrete
X proper curing

Be sure that both the Contractor and material suppliers understand that the specifications will be followed. This includes testing of the concrete as per Materials Method 9.2. Be equally sure that, when the concrete placement is to commence, that the reinforcing steel is in its proper position. It should be adequately tied and anchored in accordance with the specifications, so that it will remain in the proper location throughout the concreting operations. It should be physically restrained from floating in the plastic concrete. The placement of concrete shall not be allowed if the above conditions are not met. Once placement of concrete has commenced, it must be handled in accordance with the specifications. The concrete should be placed as near its final position as possible. Internal vibration must be applied to achieve the proper consolidation. Vibrators should not be used to move concrete.

1. Concrete Acceptance
For concrete to be considered acceptable and function as intended, it must be placed within the proper slump and air content range. Visual inspection of the concrete should be performed as well to ensure there are no deviations in the mix and verify the proportioning of the mix. If a problem is found, the plant inspector should be notified and the mix checked. Air and slump tests should then be performed as required by the specifications and Materials Method 9.2. For a concrete to be durable, that is to withstand the weather through time, proper air entrainment and proportioning including water-cement ratio must be achieved.

Although workability is necessary, the addition of excessive amounts of water will reduce compressive strength, durability, and will increase the potential for shrinkage cracking. Water demand is increased in hot weather. Adjustments to the concrete should be made at the batch plant to ensure the concrete is produced to the desired mix criteria including water to total cementitious ratio.

2. Timing
A steady, continuous supply of concrete that meets specifications should be maintained at all times. The slump and air content should be consistent from load to load. Concrete should be placed in a uniform pattern within the forms such that no cold joints are formed.

3. Moving concrete
Concrete should be deposited uniformly within the forms. If concrete has to be moved, it should be with a shovel, hoe, or similar means such that segregation does not occur. It should not be piled in one end of the forms and allowed to flow to the other end. Concrete should be placed in uniform layers and thoroughly consolidated prior to placing the next layer. **DO NOT ALLOW CONCRETE TO BE MOVED WITH A VIBRATOR.**

4. Vibration
All concrete placed needs to be properly consolidated by vibration techniques. Internal vibration is generally the method used. Proper vibration and a good practice would be a three step process of insert, consolidation, and removal with each process taking 3 to 5 seconds to insure proper consolidation and avoiding air pockets or honeycombs. Vibrators are to be inserted vertically at all times. Do not allow vibrators to be dragged horizontally through the concrete. Although over vibration is a concern, most vibration is not performed in the proper 9 to 15 seconds per insertion. Due to the “stickiness” of certain classes of concrete such as Class HP from the use of pozzolons proper vibration is extremely important. It is important to note that the duration of vibration will depend upon the frequency of the vibration (impulses per minute), size of vibrators at the slump of the concrete. This length of time must be determined in the field.

5. Delays
Try to avoid delays in placing concrete, but if they do occur take steps to slow the drying of fresh, unfinished concrete. Wet curing blankets will help and should be readily available, but they shouldn’t be so wet that water drips from them on to the fresh, unfinished concrete. Remember the concrete must be placed, finished and have curing applied in the shortest possible time. Use good judgement and avoid the possibility of cold joints.

C. Finishing of Concrete
1. Depth of Cover
Check the depth of cover of reinforcing steel during the course of the placement to ensure reinforcing has not moved. Record these checks on the inspector's report. If the cover is found to be deficient, the Contractor should be immediately notified and appropriate remedial action taken.

2. Amount of Finishing
Try to keep hand finishing to a minimum. Over finishing of a concrete surface results in scaling. Do just enough to close up the small surface voids and secure a smooth surface within our tolerances. Try to **minimize or eliminate the use of bull floats** as they tend to build in ripples as a reflection of the reinforcing pattern when too much pressure is applied. Do not permit the application of water by the finishers. This changes the water/cement ratio of the surface layer and will result in a weaker concrete surface that will scale or wear early. The final goal is to achieve sound concrete throughout the entire structure.

D. Curing of Concrete
Curing is to commence as soon as possible after the finishing operation is complete. **Concrete curing materials and apparatus must be in place within 30 minutes from the time of placement.**

1. Considerations When Using Burlap
   a. Saturation
   It is important to ensure that the burlap is maintained uniformly wet over its entire surface area. Since burlap does not have sufficient wicking ability to transfer moisture to isolated areas, soaking hoses and
sprinklers used to keep the burlap wet should be positioned such that water is directly applied to all portions of the burlap.

b. If a steady supply of water is not available, covering the burlap with plastic will prevent the loss of moisture. Periodic checks must be made to ensure the burlap remains wet.

2. Timing
Apply approved curing methods at the proper times. Keep all covers properly overlapped. Rips or tears in the covers or loose fitting covers permit unwanted evaporation of moisture from the concrete. Keep wet type covers (burlap) wet at all times throughout the prescribed period of cure. Do not "tent" the covers.

3. Traffic
Another factor that contributes to the cracking of concrete is traffic on an adjacent stage. The vibrations produced by traffic during the initial set of concrete may cause cracking. Where vibrations are a problem, provide a smooth riding surface through the construction zone and reduce traffic speed for the first 24 hours.

V. Cold Weather Concrete Operations
A. Background
Portland cement concrete is a versatile material which can be successfully placed under a variety of weather conditions. However, the quality and durability of the finished product is greatly affected by the atmospheric conditions present during the placement, and especially during the curing period. Hot and dry weather poses particular concerns during summer, while cold weather causes different concerns in the late fall, winter or early spring.

Placing and curing of concrete during cold weather is of special concern, since the Standard Specifications require the rejection of any concrete should the curing temperature fall below 0°C at any time during the curing period. Although the Standard Specifications which address cold weather concreting have been interpreted differently by individuals, especially during periods of cool or cold but not freezing weather, often we find ourselves in the situation of needing to place concrete late in the construction season in order to complete work prior to the seasonal shutdown, and to minimize disruption and inconvenience to the traveling public. While attempting to accomplish this, Engineers should not allow exceptions to, or modifications of, the specifications, particularly regarding the requirements for cold weather concrete placements.

Commonly, the Contractor seems to rush to place concrete on a "nice" fall day, and then wait until some time during the curing period to decide if any additional measures are required to maintain adequate curing temperatures. However, in most cases, the method of cure and even the decision to place concrete should be determined before placement, based upon the expected or predicted temperatures during and after concrete placement.

The intent of this section is to reiterate the important provisions of the current specification requirements, and to clarify the application of the various cold weather provisions. All information provided in this section is based on current specifications, and we suggest that reference be made to the applicable specification section for further details. Although this section addresses all types of concrete, particular attention is called out to bridge deck placements and overlays which comprise a significant portion of our concrete work, the durability of which is of the utmost importance.

B. General Provisions for Cold Weather Concreting
1. Required Permission
Prior to placing concrete under the provisions of §555-3.06 of the NYSDOT "Standard Specifications," permission must be granted in writing by the Engineer. Curing temperatures must be maintained
between 7°C and 29°C. Continuously recording thermometers are required to document curing temperatures.

2. Temperature of Surroundings
When concrete is placed in contact with steel members, reinforcing steel or previously placed concrete, the temperature of the steel and concrete shall be raised to a temperature of approximately 7°C before concreting. When concrete is placed in contact with earth or rock, the temperature of the earth or rock shall be 2°C or greater. The earth or rock shall not have any snow, frost or standing water on its surface. Further, the aggregates and/or water may require heating prior to batching. Refer to the specifications for further details.

3. Maintaining a Uniform Temperature
When utilizing external heat, an effort should be given to maintain uniform heat throughout the enclosure. Localized "hot spots" can be more harmful to the concrete than cold areas. When placing thermometers to monitor temperatures, consideration should be given to areas where the most extreme temperatures may occur. When the specified curing period is complete, the heat shall be gradually reduced at a rate not to exceed ½°C per hour until the temperature within the enclosure equals the outside temperature. The Engineer shall use a continuously recording thermometer to maintain a temperature record to document compliance with this prescribed rate of heat reduction.

4. Safety Concerns
For all work employing heated enclosures, care must be given to provide sufficient ventilation to maintain adequate air quality for the safety of the workers. Additionally, adequate ventilation is needed to prevent surface disintegration of the fresh concrete from the build up of carbon dioxide gas. Further, adequate safeguards must be taken when placing heating equipment in the vicinity of flammable enclosures, materials or liquids.

5. Insulated Forms
When utilizing heat retention by insulated forms, the insulation requirements vary depending on air temperature, concrete thickness and cement content. The Standard Specifications provide details for insulation requirements. Insulated forms must be removed in a manner such that the drop in temperature of the concrete is gradual. Further details regarding insulated form removal are provided in the Specifications.

C. Critical Temperatures
Two temperatures are extremely important to cold weather concreting operations: the ambient air temperature and the curing temperature.

1. Ambient Air Temperature
The ambient air temperature is defined as the temperature of the environment at the project site. This is the temperature which determines whether or not a concrete placement should commence and what precautions the Contractor must take to protect the concrete from cold weather.

2. Curing Temperature
The curing temperature, defined as the air temperature at the concrete surface or between the concrete surface and its protective covering, typically is the same as the ambient air temperature. The curing temperature may be measured on any surface of the concrete. On deck slab pours, consideration should be given to checking curing temperatures on the bottom of the slab at the bottom forms, or at locations which represent the extreme temperature conditions.

D. Structural Concrete Placements
1. Circumstances Under Which the Cold Weather Provisions Apply
No concrete shall be placed when the ambient air temperature is below 7°C, unless the Engineer
grants permission in writing under the provisions of the Standard Specifications.

If the ambient air temperature is 7°C or greater during the placement, but is expected to fall below 0°C at any time during the curing period, the provisions of the Standard Specifications shall apply in accordance with the cold weather concreting provisions.

2. Curing Days
   a. Definition
   If the ambient air temperature is 7°C or greater during placement, and falls or is expected to fall below 7°C but remain at or above 0°C during the curing period, the provisions of the Standard Specifications, Temperatures Below 7°C, shall apply. Under curing temperatures, the Contractor shall propose a suitable method to maintain the curing temperature above 7°C. In order to assure the Contractor’s method is adequate, the Contractor shall supply maximum-minimum thermometers, and the number and placement of the thermometers shall be as determined by the Engineer. The Engineer will maintain a temperature record during the curing period. Should the curing temperature drop below 7°C, that day shall not be considered a curing day and the curing period shall be so extended until the required number of days is accumulated. A curing day is defined as any day, starting with the time the placement is completed, during which the curing temperature is 7°C or greater.

   b. Aggregating Curing Time
   Conditions may occur which prevent an entire day from qualifying as a curing day, but do not prevent portions of that day from reaching the required curing temperature, such as when the curing temperature drops below 7°C for a short period of time. In such cases, with the Engineer’s permission, 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. In order to determine curing hours, the Contractor must supply continuous recording thermometers. The number and placement of the thermometers will be determined by the Engineer, and the Engineer shall also maintain a record of the curing temperatures. The aggregation of 24 curing hours will be credited as one curing day.

3. Rejection of Concrete
   Should the curing temperature fall below 7°C for 24 consecutive hours, the remainder of the cure must then be accomplished in accordance with NYSDOT Standard Specifications §555-3.06. If the curing temperature falls below 0°C at any time during the curing period, the concrete shall be rejected. In addition, if the minimum curing temperature is not maintained for a continuous 24 hour period, the concrete shall be rejected.

E. External Heat and Enclosures
1. When External Heat and Enclosures are Necessary
   Provisions for Concreting in Cold Weather, of the Standard Specifications, requires that curing temperature be maintained between 7°C and 29°C by either the provision of external heat, or the utilization of heat of hydration by insulated forms. The bottom of an enclosure shall be below the lowest portion of the superstructure. Therefore, the stay-in-place or bottom forms, or existing substrate concrete cannot be considered as the bottom of the enclosure. For Concreting in Cold Weather, the Contractor may supply maximum-minimum or continuously recording thermometers. External heat shall be applied for the required curing period, except that structural slabs must have external heat applied for 14 curing days.

2. Permission
   The Standard Specifications are quite clear that if at time of placement, the weather prediction is for ambient air temperatures to drop below 0°C at any time during the curing period, the placement can only commence if permission to proceed is granted by the Engineer in writing.
3. Deciding What Steps are Necessary

However, confusion seems to occur when the ambient air temperature is above 7°C during placement, but may drop to near or below 0°C during the cure period. Simply stated, if the weather forecast is for temperatures below 7°C but above 32°F during the curing period, the Contractor shall propose a suitable method (such as protective covers or insulated curing blankets) to maintain curing temperatures above 7°C. Consideration should be given to providing protection for the top, bottom and sides of the slab. If the curing temperature remains above 7°C, no additional action is required. If the Contractor’s method to maintain heat fails and the curing temperature falls below 7°C, that day shall not be considered a curing day and the curing period shall be so extended. Should the curing temperature fall below 7°C for 24 consecutive hours, the remainder of the cure must than be accomplished in accordance with of the Standard Specifications. Therefore, when placing concrete during periods when the temperatures could drop to near 0°C, the Contractor must have available on the site, material and equipment so as to be prepared to enclose and heat the concrete already placed and in cure.

F. Chart

The Quick Reference Concrete Curing Chart for Cold Weather Provisions (Exhibit 501-E) should be helpful when making placement decisions and determining which provisions apply for the placement and curing of structural slab concrete during cold conditions.

VI. Hot Weather Concrete Operations

A. Problems

Particular attention must be paid to exposed concrete in flat work such as slabs, footings, etc. (Use the evaporation chart included in the Standard Specifications) Conditions of low humidity (under 10°C), high temperatures (over 29°C), and excessive wind velocity (over 24 kph) occurring together or alone will cause the evaporation rate to exceed the bleed rate. The bleed rate is the rate at which water rises to the surface of recently placed concrete by bleeding. This will cause a crust to form on the surface of the plastic concrete, even when retarders are used, and will result in screeding and finishing problems. Plastic shrinkage cracks will result when the bleed rate is excessive.

B. Solutions

When the previously noted conditions are unavoidable, curing procedures must be commenced as rapidly as possible. This must be discussed with the Contractor. The use of fog spray may be used but with caution. Water from fog sprays cannot be worked into the concrete surface during finishing. Windscreens are beneficial and should be considered if winds in excess of 24 kph are anticipated.

VII. Underwater Concrete Placements (TREMIE)

For underwater concrete placements, contact the Materials Bureau in Albany.

VIII. Contact

For any other concerns not covered here or questions dealing with portland cement concrete, please contact the Regional Materials Engineer, or the Materials Bureau in Albany at (518) 457-5956.

For general construction concerns, contact the Structures Division at (518) 457-7677.

References

Material Method 9.2, Field Inspection of Portland Cement Concrete
Construction Inspection Manual §502-00

Related Contract Provisions

Standard Specification §709-04, Epoxy Coated Bar Reinforcement Grade 400