I. General
Adequate supervision of bridge deck construction is critical to insure a durable product, particularly in view of its high cost for construction and maintenance. The following inspection guidelines, along with all provisions covered in Section 555 of this manual, should be studied carefully by the E.I.C. and all inspectors well in advance of the work.

A properly constructed bridge deck should be durable, safe and ride well. This means it should be of the best quality construction, true to line and grade, ride smoothly, and have the proper surface texture. The structure should perform its intended function throughout its design life with little or no maintenance. The construction phase is even more demanding when integral wearing course design is used, because you only get one chance.

Some of the more common failings of integral wearing course bridge decks have been cracking, delaminating and spalling. Often the riding surface is rough, with improper texturing. These problems can be minimized or eliminated by following proper construction practices and procedures.

All operations in the construction of a bridge deck have their effect on the final product. Before any concreting operation commences, proper preparation must be performed. This primarily relates to the organization and planning of the Contractor. Proper planning should be undertaken by both the Contractor and the inspection force in advance of actual construction (see Exhibit 557-D). Such planning includes a required Pre-Placement Meeting (see Exhibit 557-E) 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 concrete delivery and sufficient placing equipment to insure that the placement be accomplished. In addition, an agreement should be reached on contingency plans to handle unanticipated equipment breakdowns or interruptions in concrete supply.

As an Engineer or inspector, make sure that you are completely familiar with the specifications for the work, including any special specifications, special notes, addenda to the specifications, appropriate Materials Methods, and all related information.

II. Structural Steel Welding Operations
A. The specifications and the Steel Construction Manual should be reviewed.

B. Tension Zones
Plans for steel bridges contain the following note: "No welding shall be allowed within the tension zones shown, unless specifically noted. The attachment of forming devices or other construction aids by welding within the tension areas shown is prohibited." (See CIM Section 557 IV - D. 2 Welding.)

Failure to comply with this requirement may lead to serious fatigue cracking of steel stringers, results in a shortened bridge life and/or high repair costs.

III. Reinforcing Steel Operations
A. Handling and Storage - See subsection 555-II.A of the "Construction Inspection Manual".

B. Installation of Reinforcing Bars - In addition to the following, see subsection 555-II.B of the "Construction Inspection Manual".

Use only approved chairs to support reinforcing steel as defined in the specification. They should be the proper height to provide the correct spacing, clearance and cover. The chairs should be coated or provided with a rubber tip at their end. They should be used in sufficient numbers to insure adequate and proper support, and to insure that proper clearance and spacing will be maintained when the concrete is placed. Bar mats should not
SECTION 557 - SUPERSTRUCTURE SLABS AND STRUCTURAL APPROACH SLABS

sag excessively when walked on. Remember that at least four or five workers will be standing on the bar mat during placement operations. The reinforcing steel should be checked to confirm that it is adequately secured, to insure that it will follow the forms as the camber comes out of the beams, thereby insuring the proper cover on the bars. This is especially important in the area of maximum dead load camber (mid-span for simple beams). Mats should be tied together and may be tied to forms and/or structural steel or shear studs to achieve the above results.

C. Maintaining Proper Position of Reinforcement Bars
Make sure that bars are supported at transverse joints so they will not flex down into the end haunch area when walked upon. A plywood walkway placed over the reinforcing steel at joints and heavy traffic areas will prevent excessive sag. Chairs should be placed at points of cross slope change.

D. Plan Clearances
The Engineer should ensure 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.

IV. Forming Operations

A. Forms
Forms should be adequately braced and provide sufficient support for the loads to be applied. Minor movements in forms or brackets can cause an unacceptable change in dimension X in Exhibit 557-A. The stability of dimension X is essential to the final riding quality and reinforcement bar cover of the finished deck. The forms are the Contractor's responsibility, but be alert to any obvious weaknesses in the installation and call them to the Contractor's attention. Other criteria are shown in Exhibit 557-A.

B. Support Systems
The Engineer should check commercially manufactured support system installations for conformance to the manufacturer's recommendations. Support systems should be checked for good workmanship.

C. Haunch Depths
The Engineer and Contractor must be in agreement on haunch depths before setting forms. This is especially critical on stay-in-place forms since the support angles which control the haunch depth are permanently attached or clamped to the beams (See Section II.D). Check and record haunch depths on the As-Built Record Plans after installation of forms.

D. Permanent Corrugated Metal Forms For Concrete Bridge Slabs
1. Approval
The Contractor shall submit to the Engineer for acceptance the Manufacturer's certification that all forms meet all design requirements stated in Specification Section 736-01 and all detail requirements shown on the Contract Plans.

2. Welding
Construction personnel involved in construction inspection shall insure that the Contractor is aware of the prohibition against welding in the area of stringers designated with "tension zones". Welding for the attachment of forms, ties, etc. shall not be permitted other than what is detailed on the Contract Plans. In those areas where welding is not permitted, strapping is commonly used over and around the flange, which is attached to angles used to adjust for the haunch. If the plans for any bridge being constructed under your direction appear ambiguous or incomplete with regard to the
SECTION 557 - SUPERSTRUCTURE SLABS AND STRUCTURAL APPROACH SLABS

Definition of the "tension zone", contact the Deputy Chief Engineer, Structures (D.C.E.S.) at (518) 457-7677 for clarification or interpretation of the plans. Only welding for the purpose of repairing a steel stringer will be allowed in the "tension zone", and this welding will only be allowed in conjunction with a Repair Procedure and a Welding Procedure Specification (WPS) approved by the Deputy Chief Engineer, Structures (D.C.E.S.).

Welding and welds shall be in accordance with Specification Section 557-3.03B, Repair Procedure and the WPS. Welding shall be performed by a NYS Department of Transportation Certified Welder and in accordance with the provisions of the New York State Steel Construction Manual (NYS SCM).

Welding is required to tack down galvanized stay-in-place forms to their galvanized form supports prior to securing to form supports by self tapping screws. This welding usually produces a small whitish spot on the exposed side of the form and, occasionally, may even burn through leaving a minute deposit of weld material exposed. These imperfections are not a significant aesthetic consideration and do not worsen appreciably with time. Therefore, field touch-ups of this type of spot should not be required.

Form (strap) welding in "tension zones" shall be considered critical welding. This work shall be inspected as frequently as necessary to assure that burn through and arc strikes are not incorporated into the completed work. A burn through has the potential of fusing the strap to the flange. The Contractor shall be directed to repair these deficiencies by a procedure approved by the D.C.E.S. before progressing with any deck work. Exhibit 557-B outlines the "special inspection zone".

3. Lap in Corrugated Metal Forms
The direction of lap in the forms is governed by the direction of concrete placement (see CIM Section 557 V. - A. 2 and 3). The form section being loaded with concrete (if not securely fastened) should lap over the unloaded section of the form in order to prevent separation of the overlap.

E. Joints
At bridge joints, the forms at the end of the deck slab must be supported solely on the superstructure steel for the span being formed. There should be no form work support or connection across a joint between independent spans or between an abutment and the span, unless otherwise detailed. This allows the joint forms to move with the top of the girders through dead load application and temperature movement. Section 555-II.B "Joints" of the Construction Inspection Manual should be thoroughly reviewed.

F. Drainage
Weeps should exist, or be drilled, in corrugated metal form joints as required by the specifications.

V. Concreting Operations
A. Prior to Placing Concrete
See Exhibits 557-D & 557-G.

1. Finishing Machine Preparation - see Exhibits 557-I & 557-J
The finishing machine must be approved by the Regional Construction Engineer (R.C.E.) and it must be in satisfactory operating condition. It would be beneficial to obtain a list of at least 3 of the last jobs where the finishing machine was used, along
with the inspection personnel and their phone numbers. This would allow the Region to check on past performance of the machine.

The Engineer should obtain a copy of the machine's operating instructions and become familiar with it before making the dry run (see Exhibit 557-F) to ensure proper set up and operation. It is the Contractor's responsibility to adjust and operate the machine, but inspector familiarization is beneficial.

Screed rail positioning and support is one of the critical factors in deck construction. "Eyeball" the screed rail prior to the "dry run." Once the dry run is complete and proper clearances have been established, no adjustments to the rail supports should be made. Rails should not sag or wobble under the weight or action of the finishing machine. Use the recommended screed rail support spacing as shown in the manufacturer's manual or 600 mm whichever is less. It is recommended that rail cups be placed at shorter intervals. If screed rails are to be supported on the fascia forms, bracing should be supplied to properly resist both the deflection under the load of the finishing machine and the later movement caused by the oscillation of the machine. Check distance X (See Exhibit 557-A) before, during, and after the dry run of the machine.

The longitudinal wheelbase of the finishing machine must be considered when adjusting screed rails on multi-span structures. In setting the rails, take into account that, with a long wheelbase finishing machine, one end will be on the adjacent unloaded span while the other end will be on the loaded span (where the dead load camber has or will come out) as you load the span with fresh concrete.

In setting up the finishing machine and making the dry run, be sure possible differences in dead load deflection characteristics between the fascia girders and interior girders is considered. This is particularly important for deck replacements. It is recommended that finishing machines be oriented parallel to the skew of the bridge up to a skew of 35°. For greater skew angles, the machine should be operated at a skew angle of 35°.

Check clearances in a dry run over the entire span the day before the placement. It is recommended that the adjustment controls be locked or sealed in some manner so they will not be altered before placement begins. Some last minute clearance checks just before placing may be good insurance and reassuring to all involved. If it is necessary to raise the machine to back it off the span after the dry run, record this change so that the machine can be reset when moved back on the span for finishing.

If the finishing machine has hydraulically operated actions, take care to see that they do not leak fluid onto or into the concrete. The machine should be monitored for hydraulic fluid leaks throughout the placing and finishing operations as well. The same holds true for grease or fuel that may drip onto or into the concrete. See that gobs of excess grease are removed before they get into the concrete.

2. 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 (Structures). If changes are made, make sure that all interested parties are aware of them in advance. If there is no placing sequence shown for a continuous deck of two or more spans, the D.C.E.S. should be contacted at (518) 457-7677 for guidance.

3. Placing Direction
When grades exceed 3%, concrete is generally placed from the low point to the high point. When grades are less than 3%, concrete can be placed in either direction but, is
generally placed from the fixed end towards the expansion end.

4. Admixtures
   a. Set Retarding Water Reducers
      Set retarding water reducers are required to be used for all deck placements. Careful review of their use should be discussed with the Contractor, during the Pre-Placement Meeting. Retarders slow the setting of concrete, allowing the concrete to remain plastic for longer durations. Retarders, by nature, will increase slump and can also affect the air content of concrete. The first few batches of concrete delivered to the project should be checked for air content and water to total cementitious ratio, with adjustments made as necessary on subsequent loads at the batch plant. Often a Contractor will request to reduce the dosage of set retarding water reducer on a deck placement as the placement progresses and less retardation is required. Never reduce the amount of set retarding water reducer once the placement begins. Changes to admixture dosages will change the air content, slump, and consistency of the concrete, altering the workability. Class HP concrete requires a set retarding water reducer to achieve workability while maintaining the desired water to total cementitious ratio. Consult the Regional Materials Engineer for admixture dosages and determination of water to total cementitious ratio.

   b. Water Reducers
      Only normal range water reducers should be used on bridge decks to reduce the mix water while achieving the desired slump. Class HP concrete may need a normal range water reducer along with 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.

5. Work Bridges
   Two work bridges are the minimum necessary to properly complete the work: one for finishers and one for cure application.

6. Expansion Bearings
   Prior to placing concrete, make sure that all expansion bearings are clear and free to move as the dead load camber comes out. Forms at the expansion end of a span or bridge shall be made to allow for expansion before, during, and after the placement.

7. Prestressed beams or girders-surface preparation (see also EB 97-040)
   Wet concrete placed over dry concrete beams cause shrinkage cracks. This results from the extraction of water from the wet concrete to the dry concrete, thereby reducing the design water requirements in the concrete mix. In order to minimize shrinkage and ensure proper bond prior to placing concrete the tops of the prestressed units must be:

   - Thoroughly wetted
   - Free from latence and dirt

   In order to be considered to be “thoroughly wetted” the tops of the prestressed units should be continuously wetted for a minimum of 12 hours prior to the start of a deck placement. Immediately prior to the deck placement the tops of the units must be visibly wet but without any standing water.

   Within 24 hours of the start of the deck placement the tops of the prestressed beams shall receive a high pressure water wash to “remove latence and dirt”. The high
pressure water wash shall be sufficiently strong to remove dirt and latence but not so strong that it damages the prestress beams, reinforcing mesh, or epoxy coating on the composite reinforcing. The pressure wash equipment shall be capable of providing pressure of 21-35MPa.

B. Placing Concrete
All operations in the construction of structural concrete elements have an effect on the final product. Refer to Section 555-IV.B of this manual for concrete placing recommendations. Placement may only commence when proper weather conditions exist. The placement and Curing Flow Chart (See Exhibit 584-A) should be helpful in determining if a placement should commence. Concrete placement may only begin after a Pre-Placement Meeting has been held, environmental conditions are favorable, and the Contractor has established means of protecting the concrete from adverse environmental conditions both during placement and curing. Additional recommendations for bridge decks follow.

1. General - see Exhibit 557-H
Deck slabs on continuous structures are subject to transverse cracking during construction. The cracking is found in areas where the deck has already been placed and is caused by tensile elongation of the extreme fibers of the beams supporting those areas. The elongation is in response to the downward deflection of the structural support system in the remaining deck areas as the deck is being placed there. The frequency of the cracking can be reduced if proper construction methods are used, and strict control over the timing and sequencing of the deck placement operation is exercised, specifically: proper consolidation, paving train remaining close and immediate texturing and curing.

2. Placement Rates
a. Effects of Slow Placements
When the concreting operation progresses slowly, some of the previously placed concrete may take its “initial set” prior to full deflection of the steel. As additional concrete is placed during the same placement operation, cracks will occur in concrete which has set. To prevent this from happening, either the duration of the placement should be decreased, or the time to initial set of the concrete should be lengthened.

b. Responsibility
The time required to complete a placement depends on its size, complexity, concrete delivery logistics, available rate of supply, and Contractor efficiency. Responsibility for attaining the highest practical rate of placement, and the shortest possible placement time, at any particular project location, rests with the Contractor.

c. Setting Time
The setting time for concrete can vary widely. It depends on many factors, such as mix design, use of admixtures, and atmospheric conditions. Retarding admixtures lengthen the initial set time of the concrete and are required in all bridge deck placements.

d. Avoiding Cracking - see Exhibit 557-H
To avoid cracking caused by the occurrence of initial set prior to completion of the placement, the duration of each placement shall be kept to a minimum, and no concrete shall be placed without sufficient retarding admixture. To avoid shrinkage cracking, prewetting of existing concrete surface or prestressed units shall be performed. Also, timely placement of curing to prevent evaporation is
3. Loading Sequence - see Exhibit 557-H
   a. Importance
      Some continuous structures require a total volume of concrete too large to be placed prior to the occurrence of initial set at some point in the deck. The Contract Plans will divide the placement into a sequence of placements when the placement exceeds 275 cubic meters.
   b. Location of First Placement
      When a sequence of placements is used, the location of the first placement (positive moment areas) is critical. Concrete cannot be placed in negative moment areas first, because subsequent placements will impose tensile stresses on this concrete, resulting in transverse cracking.
   c. Avoid Upward Deflections
      If any placement results in the upward deflection of concrete previously placed in a positive moment area, the concrete in that area may crack. Consequently, it is necessary to place concrete in each positive moment area during the initial placement. If the volume of concrete required to fully place all positive moment areas is very large, this may be difficult. Initial set could occur before placement is completed. This shall be avoided. The placement rate can be modified. In some cases, the placement rate can be increased by the use of an additional finishing machine.
   d. Skewed Structures
      On skewed structures, placement of the concrete and operation of the finishing machine should parallel the skew angle up to a 35° skew. Loading the structure in this manner equalizes steel deflections. It may be necessary to operate the finishing machine at a reduced skew angle on certain very wide, highly skewed structures. For skews greater than 35°, the machine should be operated at a skew angle of 35° while the concrete is loaded parallel to the bridge skew, to ensure the stringers are loaded equally.

4. Early Application of Loads
   Immediately after initial set, concrete has little or no compressive strength. At this time, minor loads or deflections can cause serious cracking in the new deck. However, compressive strength increases rapidly to a point where moderate stresses (due to loads or deflections) can be resisted. For this reason, deck concrete or machine operation, which will have any measurable effect on recently placed concrete, shall not be placed until adequate early strength may be assumed. Thus, subsequent placements will require a minimum 72 hour cure time between placements.

C. Finishing Concrete
   1. Keep Off Finishing Machine
      Do not permit workers to walk on, or climb upon, the finishing machine during a placement (except for the necessary operators). The extra weight can increase the deflection of the finishing machine and rails, and cause insufficient cover and/or deck thickness as well as ripples in the deck.
   2. Concrete Roll in Front of Machine
      Make sure that the proper roll of concrete is maintained on the screed. For full width screeds that oscillate transversely, it should be more or less uniform across its full length. Don't let the roll disappear.
When a single operation (strike-off and finishing) machine of the revolving cylinder or cone type is employed, the manufacturer's recommendation should be followed as to the roll of concrete in front of the cylinder or cone. In general, it should probably extend about two-thirds of the length of the cylinder or cone, beginning at the front end. The roll should not reach the back end of the cylinder or cone.

3. Depth of Cover/Slab Thickness
Again check the thickness of the concrete slab and the depth of cover on reinforcing steel after passage of the finishing machine. Record these checks on the inspector's report. If the cover or slab thickness is found to be deficient, the Contractor should be immediately notified and appropriate remedial action taken.

4. Deck Finishers
   a. Required Number
      An adequate number of finishers should be available, based on the contract plans, the deck width and amount of finishing required, to finish the deck.
   b. Timing of Work
      The finishers should be alert to the fact that the timing of their operation, relative to passage of the finishing machine, will change due to changes in weather conditions. On a hot summer day, excessive air temperature changes between early morning and early afternoon can occur, and together with changes in wind intensity, these affect the drying of the concrete surface. The finishers must adjust their operations to cope with these changes. Don't let the finishing lag far behind the concrete placement. This will result in a delay in the application of curing which is not acceptable. This also applies to placement during cold weather.

5. Amount of Finishing
   Try to keep hand finishing to a minimum. Do just enough to close up the small surface voids and secure a smooth surface within 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. Furthermore, excessive finishing destroys proper air entrainment at the surface, resulting in scaling and poor freeze/thaw resistance. Do not permit the application of water by the finishers. This changes the water/cement ratio of the surface layer and will also result in weaker surface concrete that will probably scale or wear early. The goal is sound concrete from top to bottom over the full expanse of the deck. It is not desirable, but preferable, to have a rough deck rather than a watered down one. Remember the finished deck will have turf drag and saw cut grooving. A perfectly smooth floated surface is not necessary. Pay particular attention to the straight-edge checks at the beginning and end of placements and at end joints.

6. Surface Texturing
   Artificial turf drag texturing is to be applied immediately after finishing. The turf drag texturing is applied manually and cannot be attached to the finishing machine. The turf drag texture shall stop 0.3 meters from the curb. The artificial turf drag must be cleaned or replaced when dirty or clogged with hardened concrete.

   Difficulties can occur with the turf drag texturing application which has been known to tear the surface concrete, produce an excessively rough texture, and/or pull coarse aggregates up from the surface. Application of the turf drag texturing is somewhat of an “art form” and takes a certain amount of skill and practice to properly perform. With the use of “stickier mixes” such as microsilica concrete and high-performance (HP)
concretes, texturing has become more difficult but not impossible. To achieve the best results, texturing should:

a. Be applied as quickly as possible. Concrete which has been exposed to the environment and allowed to dry will not texture easily.

b. Be done with the artificial turf “attached loosely” to whatever is used as a handle. Wrapping the artificial turf tightly around a bullfloat will cause variations of pressure during placement to be evident in the surface.

c. Be applied using a uniform down pressure. Sometimes the weight from the artificial turf and attached handle are too heavy for the application and a slight uplift is required.

7. Delays in Placing/Finishing

If delays occur to placing and finishing of concrete, protection of placed but unfinished concrete must be performed. Cover in-place concrete with plastic to prevent evaporation. Class HP concrete is particularly sensitive to evaporation and cannot be easily finished if evaporation occurs.

D. Curing of Concrete

Curing is to commence as soon as possible after the finishing operation is complete, without causing any significant damage to the surface. The foregoing time period shall not exceed 30 minutes. The specifications require a minimum cure time of 14 days for superstructure slabs and 7 days for structural approach slabs. The Placement and Curing Flow Chart, Exhibit 557-C, should be helpful when making placement decisions and determining which provisions apply for the placement and curing of concrete during cold conditions. Many Engineers believe the texture of the wet burlap on the surface is cause for alarm. Beginning the curing process quickly is of greater concern than the burlap pattern being left on the deck. Curing should be achieved according to the methods allowed in the specifications.

1. Considerations When Using Burlap
   a. Saturation

   Burlap must be saturated just prior to its placement and it is important to ensure that the burlap is maintained uniformly wet over its entire surface area. Burlap does not have sufficient wicking ability to transfer moisture to isolated areas. Because of this, 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. Potential Safety Hazards

   When wet burlap is used on reconstruction projects, where traffic is maintained on the structure, the possibility exists that the travel lane may become continuously wet or, in cold weather, covered with ice as a result of the curing operation. You should be alert to such potential safety hazards and discontinue wet curing if it appears that a safety problem will be created. Also, if the ambient temperature falls to 0°C or below, and freezing water creates a safety hazard, wet curing should be discontinued. If wet curing must be discontinued, immediately cover the burlap with curing covers and continue the appropriate curing for the specified time interval. Follow winter concreting requirements.
SECTION 557 - SUPERSTRUCTURE SLABS AND STRUCTURAL APPROACH SLABS

2. Timing

Apply approved curing covers at the proper time. 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 period of cure. Do not "tent" the covers.

3. Exposed Reinforcing Steel

Special care should be given to insure proper curing of the deck concrete in the fascia area when the reinforcing steel protrudes. Fit wet burlap covers tightly in and around the protruding reinforcing steel and keep it properly wetted down. These covers should be in place within the first 30 minutes after placement (Ref. EI 98-037).

Other potential trouble spots are the cavities which result from the removal of the pipe sleeve screed rail supports. When filling these cavities, be aware that any water trapped in them, not removed, which may freeze, will damage the concrete. When the pipe sleeve screed rail support fits over a stud that is welded to the top of the girder, the annular space formed around the stud is particularly susceptible to entrapment of water and subsequent freezing damage.

4. Traffic

Another factor that contributes to the cracking of concrete, with stage construction particularly with respect to decks, is traffic. The vibrations produced by traffic on bridges during the initial set of concrete may cause cracking.

The work zone, its approaches and traffic controls, should be laid out with the intent to minimize acceleration and deceleration, and if practical, speed on the bridge. The lane shift, merge or two way traffic tapers should be far enough from the bridge section to allow traffic flow to stabilize before reaching the bridge. A smooth riding surface, particularly the approaches to the bridge, and a uniform cross section is also recommended to maintain stable, uniform traffic flow. Low operating speeds are desirable, but difficult to obtain. If operating speeds can be safely reduced to 56 kph or less on the approaches to the work zone, a narrowed but uniform section across the bridge may help maintain desirable lower speeds. Flaggers signaling traffic to slow down can also be used. Reduced speeds should be maintained for a minimum of 24 hours.

E. Saw Cut Grooving

The saw cut grooving can be performed after the required curing period, but not before 7 days have elapsed. The grooving must be cut according to all specifications and approved by the Engineer in Charge. Grooving is important for maintaining surface friction during wet weather. Engineers should ensure that the debris or slurry from the saw cuts is being controlled and disposed of in an environmentally safe manner. For further explanation and details on saw cut grooving see Section 558 of the Construction Inspection Manual.

F. Sealing

Sealer should be applied after sawcut grooving operations, but prior to allowing traffic on the deck. This is particularly important for late season placements to protect new concrete from chloride ingress of early salt applications.

VI. Cold Weather Concreting Operations
A. Background
All subjects covered in Section 555-V of the Construction Inspection Manual, apply to structural bridge decks. In addition to those general concerns, there are many concerns specific to structural bridge decks. The minimum cure time is 14 days. Remember if 3 days are required, for instance before a closure pour is placed, there must be 3 days of “acceptable” cure time.

B. 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, under §555-3.06 of the New York State Department of Transportation Standard Specifications, is granted by the Engineer in writing. Regardless of written permission, curing and temperature must be maintained as required by the specifications.

C. Special Requirements for Structural Bridge Decks - see Exhibit 557-H
1. Thermometers
When the temperature for bridge slab placements is expected to drop below 7°C, the Contractor is required to supply continuously recording thermometers. The recordings of these thermometers will be used to determine the actual number of curing hours undergone by the concrete.

2. Enclosures
For bridge deck slab placements, curing temperatures shall be maintained through the use of a six-sided enclosure with external heat. Therefore, in this case, the application of insulated curing blankets alone to maintain adequate curing temperatures on a structural slab would not be acceptable. The bottom of the slab must be completely surrounded by the enclosure, as the bottoms of the forms can not be considered part of the enclosure. The forms must be considered as part of the slab.

VII. Hot Weather Concreting Operations
See Section 555-VI of the "Construction Inspection Manual" & Exhibit 557-H.

Contacts
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
NYS Steel Construction Manual
NYS Standard Specifications §555-3.06
EB 97-040, Surface Preparation of Prestressed Concrete Beams Prior to Deck Placement
EB 98-037, Bridge Deck Construction Specification Improvements-Implementation of Recommendations by the Bridge Deck Task Force

Related Contract Provisions
NYS Standard Specifications §736-01
Construction Inspection Manual §555
Construction Inspection Manual §558
The following should be checked by the inspection staff prior to the dry run of the concrete finishing machine.

- **Forms have been installed with the correct haunch.** Typically a 50 mm minimum haunch is required.

- **Stay-in-place forms should be installed so that the form section being loaded with concrete first, laps over the unloaded section in order to prevent separation.** Styrofoam inserts should be glued or taped in place. The pour direction is usually from fixed end to expansion end. When grades are greater than 3%, the pour should be from low end to high end.

- **For concrete beams, check the elevations of the top of beam against the camber and deflection chart to determine high points which will be the control points for the minimum deck thickness.**

- **The lower mat of the reinforcing steel should be tied to shear studs.** Both top and bottom mats should be supported to prevent sagging when walked on. Supports should be no more than 1.2 m apart, and no less than 150 mm from any finished edge. Bars should be properly supported at the transverse joints so that they will not flex down into the haunch area. The two mats should be tied together.

- **The bridge rail anchor plates and posts are installed at proper locations.** Threads of anchor bolts should be protected to prevent being spoiled by the concrete pour.

- **Check the locations of all key ways, drip edges and utility brackets.**

- **Check the elevation and location of scuppers.**

- **All outer walkways should be adequately supported and safety railings installed.** Walkways should be safely accessible from both sides of the span.

- **Check the area round all of the bearings to ensure that they are clean of debris and free to move as the dead load camber comes out during the pour.**
SECTION 557 - SUPERSTRUCTURE SLABS AND STRUCTURAL APPROACH SLABS

PRE-PLACEMENT MEETING

A Concrete Pre-Placement Meeting shall be held at least one week prior to the start of any concrete placement for superstructure slabs. All aspects of the proposed placement shall be reviewed and approved by the E.I.C. Minutes to this meeting shall be recorded and kept in the project files.

The following is a list of generic topics that should be addressed during the Pre-Placement Meeting. Project specific concerns should also be included.


2. Concrete: Quantity? Rate of placement? Number of trucks to be used? Is the plant approved? Will the Plant Rep be on site during the pour?

3. Concrete Mix Design: Allowable air content and slump. Type and quantity of admixtures to be used. (The RME should review the proposed dosage rates)
   NO WATER IS TO BE ADDED TO THE MIX ON SITE!

4. M & PT: Will lane closures be required? Flaggers? Where will trucks stage? Where will trucks wash out?

5. Concrete Placement: How will concrete be placed? (i.e. pumps, crane/bucket, mechanical buggies, etc.) What is the back up method?

6. Finishing Machine: Is the machine approved? When will the machine be dry run? Will mid-pour adjustment be required? Who will make them?

7. Curing Procedures: 14 day cure is required, except 7 days for structural approach slabs, curbs, sidewalks, and safety walks on bridges. Where will water supply come from? How will curing be monitored? Is cold temperatures anticipated? Are all materials on site? (Ref. EI 98-037)

8. Weather Conditions: No concrete shall be placed until environmental conditions are deemed favorable. The contractor shall provide the proper equipment to monitor air temp, humidity, and the evaporation rate. Table 555-3 of the Standard Specifications should also be used.

9. Work Force: Have the contractor supply a list of the work force for the day. Each person should be assigned to no more than one task.

10. Safety: Fall protection, overhead wires, vehicle backing, moving parts on the finishing machine, etc.
SECTION 557 - SUPERSTRUCTURE SLABS AND STRUCTURAL APPROACH SLABS

FINISHING MACHINE - DRY RUN

The dry run of the concrete finishing machine should be done the day before the pour.

1. Check the elevations of the end dams and bulkheads at all expansion joints.

2. Travel Rail: Typically 50 mm, schedule 80 pipe. Adjustable chairs (or cups) should be spaced no more than 600 mm inches apart. Each travel rail should maintain a constant height above the finished grade. Travel rails should always be parallel to each other.

3. Check the location of the crown, if any. A hinged joint of the finishing machine frame must be at the crown.

4. Carriage Rail: String line the carriage rail (both front and back) between breaks in grade. Any dip or bump in this rail will be reflected in the finished deck. Use a 1.2 m level or a slope board to check the pitch of the carriage rail. On skewed decks, the pitch may not be the same as the proposed pitch perpendicular to centerline.

5. Finishing Rollers: Visually inspect the rollers for cleanliness. Rollers should be parallel to each other, and to the finished grade. To check this, hold a 1.2 m level across the bottom of the rollers directly under the front carriage rail. Measure from the top of the level to the carriage rail, take measurements on both the left and the right side of the rollers. Both measurements should be identical. Repeat this under the rear carriage rail. The rear of the rollers should be 3 mm higher than the front.

6. Have the contractor start the machine. Let the carriage ride over the first end dam. The front of the finishing rollers should clear this form by less than 1.6 mm. As the machine is driven forward, this step should be repeated over all bulkheads. Deck thickness should be checked at a minimum 10 locations across the span. The cover above the top mat of steel should also be checked.

7. The carriage should be moved as close as possible to the longitudinal form. Use a straight edge across the bottom of the finishing rollers extended to the marked finish grade. The straight edge should line up with the grade mark.

8. Have the contractor set the carriage travel limits. Allow the carriage to run transversely across the deck. Watch that the carriage stops short of all forms and bridge rail supports.

9. While the machine is running, look for the following:
   Does the travel rail sag between supports?
   Does the travel rail wobble when the carriage changes direction?
      Do the augers rotate in the correct direction?
   Does the roller direction change when the carriage direction changes?
      How far does the machine advance when the carriage direction changes?
         (5 to 150 mm is preferred)
   Are there any signs of fuel leaks?
DAY OF THE POUR

- Inspectors should be equipped with and familiar with the following:
  - MURK 5 - Structural Concrete Report
  - Concrete thermometer
  - Slump cone
  - 2 Air meters
  - 2m Ruler
  - Adequate number of cylinder molds
  - Table 555-3 and worksheet

- Check that the following is on site:
  - Concrete pump and alternate
  - Backup power source for vibrators
  - Plastic and extra burlap to prevent a cold joint if the pour is delayed
  - Water supply for curing
  - Concrete supplier’s representative

- Check that the finishing machine has not been tampered with since the dry run.

- Document weather conditions and evaporation rate prior to the start of the pour, and hourly during the pour, using Table 555-3 of the Specifications. Make appropriate changes accordingly.

- All concrete trucks should have NYSDOT inspection stickers (usually inside the cab), and counters in working condition.

- Temperature, air content and slump should be tested on the first truck. Advise the plant representative of any deficiencies.

- Keep an adequate amount of concrete in front of the augers of the finishing machine, usually half the height of the auger. Do not allow laborers to try to “grade” the concrete.

- Ensure that proper vibrating techniques are being used. Do not permit laborers to use the vibrators to move the concrete.

- Watch that the drag pan is properly sealing the finished concrete. The pan may have to be weighed down to prevent “skipping”. Too much weight may cause ruts.

- Watch that finishers and laborers placing soaked burlap keep up with the concrete placement. If not, slow the machine and placement down.

- If the approach slab is to be poured continuously with the deck, construct the recess joint before placement of soaked burlap.
SPECIAL CIRCUMSTANCES

- **Hot Weather:** SIP forms should be cooled with water. Remove all excess water prior to concrete placement. Check evaporation rate often. Wet burlap should be placed as soon as concrete is finished and textured. Slow down the finishing machine if the laborers cannot keep up.

- **Cold Weather:** The ambient air temperature must be 7°C or higher. The surface temperature of all forms, steel, and existing concrete that will be in contact with fresh concrete shall be 7°C or higher. This may require insulating the area to be poured overnight prior to the pour. The contractor shall submit for approval by the E.I.C. a proposed curing procedure that will maintain the curing temperatures between 7°C and 30°C for the duration of the curing period. Refer to Specification Section 555-3.06.

- **Continuous Structure Span:** Remember, NO WELDING IN TENSION ZONES! This includes the installation of stay in place forms.

To minimize transverse cracking:

- The duration of each placement should be kept to a minimum and sufficient retarding admixture used to ensure initial set will not occur prior to the completion of the pour.

- If the volume of concrete is too large to be placed prior to the initial set, a pour sequence will be used. When a sequence of placement is used, the location of the first placement is very important. If any placement results in an upward deflection of concrete previously placed, the area of concrete will be prone to cracking. Generally a 72 hour waiting period between placements is required.

- On skewed bridge decks, it is important not only that the finishing machine be parallel to the skew, but the concrete placement should also parallel the skew.
PROCEDURE FOR APPROVAL OF ALTERNATE DECK POUR SEQUENCE ON CONTINUOUS BRIDGES

The bridge deck pouring sequence that is indicated on the contract documents is determined by the Designer in accordance with the NYSDOT Bridge Manual. During design, this pouring sequence is developed taking into account aspects such as size of pour, configuration of the bridge, potential placement restrictions, direction of placement, deck tensile stresses, and any other special circumstances that might affect the bridge deck placement. A change to the bridge deck pouring sequence shall only be progressed when there is both a clear benefit for doing so and the Contractor/supplier's technical capability exists to ensure a quality finished product.

When an alternate for the sequence shown on the documents is requested by the Contractor, the following procedure shall be followed:

The requested change must be submitted in writing to the Engineer-in-Charge. The Department will respond to any complete submission within 15 work days of receipt. The Engineer will determine if the submission is complete and promptly notify the Contractor. In order to be complete, the submission must contain the following, at a minimum:

NARRATIVE PORTION

- The benefits of the change.
- Description of the proposed pour procedure.
  - Number of placement crews.
  - Number of finishing machines.
  - Pump or conveyor description and capabilities.
  - Concrete-truck route including times.
- The effect of the proposed change on, but not limited to:
  - Personnel needs.
  - Alternate or additional equipment.
  - The concrete supplier's capabilities and intended supply rate.
  - Estimated travel time.
- Other special circumstances that might affect the bridge deck placement.

BRIDGE DECK POURING SEQUENCE CALCULATION SHEET

- Retarder manufacturer and brand.
- Retarder dosage.
- Retardation duration.
- Direction of deck placement.
- Expected concrete placement rate.
- The Contractor's experience with bridge deck pours.
The Engineer will evaluate the Contractor’s overall ability to alter the pouring sequence by reviewing the Contractor’s Bridge Deck Calculation Sheet. The Contractor’s proposal and supporting information is then forwarded to the Regional Construction Engineer (RCE) with the Engineer’s recommendation.

The RCE, in conjunction with the Regional Structures Engineer, the Regional Materials Engineer, and other appropriate Regional managers, will evaluate the overall acceptability of the Contractor’s proposal considering all appropriate information, including but not limited to: the intent of the pouring sequence shown on the plans, the benefits to the Department, and the Contractor/Supplier’s capabilities.

If the proposal is acceptable to the Region, the RCE shall forward the Contractor’s request to the DCES for review. That transmittal shall include all above referenced materials as well as the Region’s endorsement of the proposal.

If the proposal is unacceptable to the Region, the RCE shall so notify the Contractor, the Deputy Chief Engineer (Structures) (DCES), and the Engineer in writing. Proposals found unacceptable by the Region need not be sent to the DCES.

The DCES shall evaluate the structural acceptability of the Contractor’s proposal and provide the result of the review (concurrence/rejection) to the RCE. Included in the DCES response are any cautions that are appropriate for the placement of the concrete, if the proposal is deemed acceptable. The RCE will then notify the Contractor in writing of the Department’s decision on the proposal, with copies to the DCES and the Engineer.

If approved, the Contractor shall perform any necessary recalculations of the haunch and camber and also check for uplift. All recalculations and change sheets shall be signed by a Professional Engineer. The change in pouring procedure should be documented on the As-Built drawings.
### DECK PLACEMENT

<table>
<thead>
<tr>
<th>Expected Date of Placement</th>
<th>Number of Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical Temperature Data for Expected Date</td>
<td>Record: High</td>
</tr>
<tr>
<td></td>
<td>Average: High</td>
</tr>
</tbody>
</table>

### Placement Size

**Expected Placement Rate**

**Expected Placement Duration (Size ÷ Rate):**

**Direction of Placement:**

### CONCRETE SUPPLIER

<table>
<thead>
<tr>
<th>Retarder Admixture Brand:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dosage:</td>
</tr>
</tbody>
</table>

**Retarder Capabilities:**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Retarder duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
</tr>
</tbody>
</table>

The duration of the placement must be less than the retarder capabilities for the average high temperature conditions on the day of placement. This will make it possible for the deck placement to be completed before all of the concrete placed begins to set.

**CAUTION:** The review should consider potential delivery delays, equipment breakdowns, and the Contractor’s proposed backup plans before determining the acceptability of the placement proposal.
SECTION 557 - SUPERSTRUCTURE SLABS AND STRUCTURAL APPROACH SLABS

List Contractor’s and Concrete Supplier’s experience with sequential bridge deck pours by providing below their past completed bridge projects in New York with concrete deck pours that are similar in size and pour rates in chronological order starting with the most recent.

<table>
<thead>
<tr>
<th>CONTRACTOR’S EXPERIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract No or PIN</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONCRETE SUPPLIER’S EXPERIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract No or PIN</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### ACCEPTABILITY OF REQUEST TO CHANGE POURING SEQUENCE

1. **ENGINEER-IN-CHARGE**
   - [ ] ACCEPTABLE
   - [ ] NOT ACCEPTABLE
   - (Printed Name)
   - (Signature)
   - (Date)

   Comments:

2. **REGIONAL MATERIALS ENGINEER**
   - [ ] ACCEPTABLE
   - [ ] NOT ACCEPTABLE
   - (Printed Name)
   - (Signature)
   - (Date)

   Comments:

3. **REGIONAL STRUCTURES ENGINEER**
   - [ ] ACCEPTABLE
   - [ ] NOT ACCEPTABLE
   - (Printed Name)
   - (Signature)
   - (Date)

   Comments:

4. **REGIONAL CONSTRUCTION ENGINEER**
   - [ ] ACCEPTABLE
   - [ ] NOT ACCEPTABLE
   - (Printed Name)
   - (Signature)
   - (Date)

   Comments: