
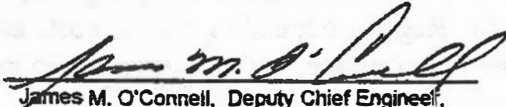


<p>MODIFIED BY EI 98-030 EFFECTIVE 1/14/99 & EI 98-037 EFFECTIVE 5/6/99 SUPERSEDED BY EI 99-002 EFFECTIVE 5/6/99</p>		<p>New York State Department of Transportation ENGINEERING INSTRUCTION</p>	<p>EI 96-024</p>
<p>Title: IMPLEMENTATION OF CLASS HP CONCRETE</p>			
<p>Distribution:</p> <p><input checked="" type="checkbox"/> Manufacturers (18) <input type="checkbox"/> Surveyors (33) <input checked="" type="checkbox"/> Main Office (30) <input checked="" type="checkbox"/> Consultants (34) <input checked="" type="checkbox"/> Local Govt. (31) <input checked="" type="checkbox"/> Contractors/AGC (39) <input checked="" type="checkbox"/> Regions/Agencies (32) <input type="checkbox"/> _____ ()</p>	<p>Approved:</p> <p> James M. O'Connell, Deputy Chief Engineer, Structures Division</p> <p style="text-align: right;">04/12/96 Date</p>		

EFFECTIVE DATE. This instruction is effective immediately.

PURPOSE. This instruction provides specifications for the use of Class HP concrete as the standard class of concrete for bridge decks.

BACKGROUND. As part of continuing efforts to improve all operations of the New York State Department of Transportation (NYSDOT), a Bridge Deck Task Force was appointed in the fall of 1994 composed of specialists in structures design, research, materials, and construction, to evaluate current bridge deck policies and find ways to provide longer-lasting bridge decks. The Task Force concentrated on three areas: design, materials, and construction. The most common failure mechanism for bridge decks in New York State has been concrete damage resulting from the corrosion of reinforcing. A significant improvement could be made if concrete permeability and the potential for cracking were reduced. The result of this work was the development of an improved, high-performance concrete for bridge decks, designated Class HP.

Class HP concrete is a modification of the standard Class H concrete, substituting 20% Class F fly ash and 6% microsilica for cement. The mix design uses a lower water-to-total cementitious ratio of 0.40. Laboratory testing was performed in the fall of 1994 followed by the placement of 1 bridge deck. In the 1995 construction season 11 bridge decks were placed using Class HP concrete. Results from these placements determined that Class HP concrete provided the following benefits:

- Permeability was reduced approximately 70% over Class H concrete.
- No cracking of the concrete was observed on any of the bridge decks placed. Laboratory test results showed a reduction in cracking of 98% compared to previous bridge deck cracking studies.
- Handling and workability is comparable to Class H concrete.
- Strength gains are sufficient for early open sequence requirements.
- Actual project water-to-total cementitious ratios averaged 0.38.

The life span of bridge decks constructed with Class HP concrete is estimated at two to three times that of decks constructed with Class H concrete. A computer model used concrete permeability and cover over reinforcing steel to determine the time to initiation of corrosion. Assuming three (3) inches of concrete cover and uncoated reinforcing steel, corrosion will commence at 23 and 62 years of age for Class H and Class HP respectively. The time to corrosion is further increased with the use of epoxy coated steel.

ITEM 18555.9605	CONCRETE FOR STRUCTURES, CLASS HP (Structural Approach Slab with Separate Wearing Surface)
ITEM 18555.96 M	CONCRETE FOR STRUCTURES, CLASS HP
ITEM 18557.0196 M	SUPERSTRUCTURE SLAB WITH INTEGRAL WEARING SURFACE, BOTTOM FORMWORK REQUIRED
ITEM 18557.0596 M	SUPERSTRUCTURE SLAB WITH INTEGRAL WEARING SURFACE, BOTTOM FORMWORK NOT REQUIRED
ITEM 18557.0796 M	SUPERSTRUCTURE SLAB WITH SEPARATE WEARING SURFACE, BOTTOM FORMWORK REQUIRED
ITEM 18557.0996 M	SUPERSTRUCTURE SLAB WITH SEPARATE WEARING SURFACE, BOTTOM FORMWORK NOT REQUIRED
ITEM 18557.2096 M	STRUCTURAL APPROACH SLAB WITH INTEGRAL WEARING SURFACE
ITEM 18557.2296 M	STRUCTURAL APPROACH SLAB WITH SEPARATE WEARING SURFACE

CONTACT PERSON. Any questions regarding the use of Class HP concrete should be directed to the Materials Bureau, Field Engineering I Section at (518) 457-5956.

**ITEM 16555.0496 - STRUCTURAL SLAB CONCRETE, CLASS HP
(OPTIONAL FORMING SYSTEMS)**

DESCRIPTION. The work shall consist of furnishing and placing portland cement concrete and reinforcing steel to construct a structural slab. The concrete shall contain fly ash and microsilica pozzolans.

Unless otherwise noted on the plans, the contractor may use any of the following forming systems to form the underside of the structural slab:

1. Removable forms
2. Permanent corrugated metal forms
3. Prestressed concrete form units.

The following restrictions shall apply:

- A. Fascia overhangs shall be formed with removable forms. The forms used shall leave the resulting concrete flat surfaced.
- B. A bay, constructed in stages such that a longitudinal joint is required, shall be formed with removable forms.
- C. A haunch which rests upon an end diaphragm shall be formed with removable, or permanent corrugated metal, forms.
- D. Prestressed concrete form units shall not be used where the design span is less than 5'-0" nor greater than 10'-9". The design span is equal to the beam spacing minus one-half the top flange width.
- E. Prestressed concrete form units may be restricted at the ends of some skewed spans. Refer to the plans for details.

The furnishing and installing of reinforcing steel will be part of this work.

MATERIALS.

1. **Concrete.** All the material requirements of §555-2 shall apply. In addition, the microsilica admixture shall be supplied in either a densified powder or slurry form.

The microsilica admixture shall be one appearing on the Department's Approved List. Only one brand shall be allowed for any structural element. The Manufacturer shall provide written certification that the supplied material meets the requirements of the procedural directives of the Materials Bureau. For each shipment supplied this certification shall list fineness, silica content, total chloride ion content, solids content for slurries, and moisture content for densified powders. Additionally, the Regional Materials Engineer shall take a minimum sample of one quart directly from the storage container, for each days placement of Class HP concrete, for testing by the Department.

**ITEM 16555.0496 - STRUCTURAL SLAB CONCRETE, CLASS HP
(OPTIONAL FORMING SYSTEMS)**

If the microsilica admixture is supplied in the slurry form the slurry shall be maintained in storage above the temperature of 32°F. Slurries exposed to temperatures of 32°F or less shall be removed and replaced at no cost to the Department. The slurry shall be homogeneous and agitated as necessary to prevent separation.

Class HP concrete shall consist of a homogeneous mixture of cement, fly ash, microsilica admixture, fine aggregate, coarse aggregate, air entraining agent, set retarding water reducing admixture and water which meets the requirements of the MIX CRITERIA table given below.

MIX CRITERIA

Cement content (lbs./c.y.)	500
Fly ash content (lbs./c.y.)	135
Microsilica content (lbs./c.y.)	40
Sand percent total aggregate (solid volume)	40
Designed water/total cementitious content of 675 lbs. (weight)	0.40
Desired air content (%)	6.5
Allowable air content (%)	5.0 - 8.0
Desired slump (inches)	3½
Allowable slump (inches)	3 - 4
Type of coarse aggregate gradation	CA 2

NOTE: The criteria are given for design information and the data is based on a fine aggregate fineness modulus of 2.80. The mixture proportions shall be determined using actual conditions for fineness modulus and bulk specific gravities (saturated surface dry for aggregate). The proportions shall be computed according to Department written instructions.

The requirements of §501 shall apply, except as modified herein.

- A. If a densified powder is used, the densified powder shall be weighed cumulatively with the cement and fly ash. The densified powder shall be last in the weighing sequence and the tolerance for each material draw weight shall be based upon the total weight of cement plus fly ash plus densified powder. The batching tolerance for the cement plus fly ash plus densified powder shall be ±½% by weight.
- B. If a microsilica slurry is used, the slurry shall be added using proportioning equipment approved by the Regional Materials Engineer. The microsilica slurry admixture shall be added through an existing automation system or a two stop off-line automated batching system. The automated batching system shall meet the following requirements:

**ITEM 16555.0496 - STRUCTURAL SLAB CONCRETE, CLASS HP
(OPTIONAL FORMING SYSTEMS)**

Delivery accuracy of $\pm 1\%$ (by volume)
Program quantity (gallons, nearest tenth)
Batching tolerance $\pm 2.0\%$ (by volume)
System interlocks

Print requirements:

- a. Date and time
- b. Truck number (or alternate method relating microsilica to batch ticket)
- c. Delivered quantity (gallons, nearest tenth)

The control box/printer for a two stop off-line batching system shall be located at the batch plant operator's work station unless otherwise approved by the Regional Materials Engineer.

Calibration shall be in accordance with the procedures approved by the Regional Materials Engineer. Whenever any part or all of the off-line system is moved the entire system shall be recalibrated.

2. Other Materials. These shall meet the following requirements:

Epoxy coated bar reinforcement	§ 709-04
Prestressed concrete form units	§ 718-05
Chairs, tie wires, and other devices used to position reinforcing steel	§ 556-2.01 § 556-2.02

CONSTRUCTION DETAILS.

1. Concrete Manufacturing and Transportation. The requirements of subsection 555-3.01 shall apply.

2. Falsework. The requirements of subsection 555-3.02 shall apply.

3. Forms.

A. Removable Forms: The requirements of 555-3.03A and 555-3.03B shall apply.

B. Permanent Corrugated Metal Forms: The requirements of 555-3.03A and 555-3.03C shall apply.

C. Prestressed Concrete Form Units: The requirements of 555-3.03A; 557-3.01; 557-3.02; 557-3.03A and 557-3.03B shall apply.

Form supports shall be placed in direct contact with the flange of the stringer. All attachments shall be made by permissible welds, bolts, or other means approved by the Engineer. The welding of form supports to steel not considered weldable, or to portions of flanges subject to tensile stresses will not be permitted. Welds and welding shall be in accordance with those portions of the New York State Steel Construction Manual concerned with fillet weld design, fillet weld details, general workmanship

**ITEM 16555.0496 - STRUCTURAL SLAB CONCRETE, CLASS HP
(OPTIONAL FORMING SYSTEMS)**

and technique, except that 1/8 inch fillet welds will be permitted. All welding shall be performed by a New York State Department of Transportation Certified Welder whose qualifications permit him to do the work.

4. Placing and Fastening Reinforcing Steel.

A. Removable Forms and Permanent Corrugated Metal Forms. The requirements of subsection 556-3.01 and 556-3.02 shall apply.

B. Prestressed Concrete Form Units. The requirements of subsections 556-3.01 and 556-3.02 shall apply, except that the second paragraph of 556-3.02E which begins with "The structural..." and ends with "...of concrete." shall not apply. The following shall apply instead: "The top reinforcing steel mat shall be securely connected to the forms and the stud shear connectors. Connections shall be placed no farther apart than 4'-0" on centers. Connections to the forms may be made to the form lifting devices, reinforcing steel projecting from the forms, or devices in the form supplied for this purpose. Hold down devices shot into the form will not be permitted. Connections shall neither deflect the reinforcing steel, nor interfere with the smooth flow of concrete."

5. Handling and Placing Structural Slab Concrete. The requirements of 555-3.04 shall apply.

6. Provisions for Concreting in Cold Weather. The requirements of 555-3.06A and 555-3.06B shall apply.

7. Cold Joints. "Cold Jointing," that is, the bonding of fresh concrete to set concrete, will be allowed only where indicated on the plans, or where approved by the DCES. For the purpose of this specification, the plane formed between prestressed concrete form units, and subsequent portland cement concrete placements, is not considered a cold joint.

When cold jointing, the concrete in place shall have its surface cut over with a suitable tool to remove all loose and foreign materials. This surface shall be scrubbed with wire brooms and kept clean. Immediately before placing the new concrete, the forms shall be drawn tightly against the concrete in place. The existing concrete surface shall be coated thoroughly with a thin coating of 1:1 mortar, or neat cement paste, thoroughly brushed into the surface.

The mortar shall be worked into the prepared surface by means of stiff brushes, or other methods acceptable to the Engineer. Mortar shall not be allowed to begin to dry. If drying does begin to occur, as evidenced by a light grey color, prior to concrete placement, the Engineer shall order the mortar to be completely removed and new mortar placed at no additional cost to the State.

8. Finishing Integral Wearing Surfaces: The requirements of subsection 555-3.08D shall apply.

9. Finishing Surfaces to be Overlaid with Portland Cement, or Asphalt, Concrete: Finishing of these surfaces shall be done by mechanical means except in areas which are inaccessible to a mechanical screeding operation. The equipment shall be approved by the Engineer prior to use.

**ITEM 16555.0496 - STRUCTURAL SLAB CONCRETE, CLASS HP
(OPTIONAL FORMING SYSTEMS)**

Surfaces shall be screeded to a surface tolerance of 3/8 of an inch in ten (10) feet. The surface tolerance shall be verified by the Engineer with an approved straight edge not less than ten (10) feet long. The straight edge shall be furnished by the Contractor who shall maintain it in good condition at the paving site at all times.

Hand screeding, when required, shall be performed in such a manner as to produce the same surface quality and uniformity as that produced by mechanical screeding. Finishing screeds shall be 10 inches, or more, in width and the contacting surfaces shall be steel. Hand-operated equipment shall be used in such a manner as to duplicate the action of a mechanical screed. Hand-screeding shall be performed in the same sequence and manner as mechanical screeding unless otherwise directed by the Engineer.

10. **Curing:** The requirements and allowances of subsection 555-3.09 shall apply.
11. **Damaged or Defective Concrete:** Damaged, or defective, concrete shall be defined by, and repaired in accordance with, the requirements of Section 502, Portland Cement Concrete Pavement, and subsection 502-3.15, Defective or Damaged Concrete. Epoxy mortar made from Item 721-05, Epoxy Repair Paste, shall be used for patching vertical or overhead surfaces.

METHOD OF MEASUREMENT. The requirements of subsection 555-4.02 shall apply.

BASIS OF PAYMENT. The terms of subsection 555-5.03 shall apply with the following modifications:

1. The cost of furnishing and placing bar reinforcement will be paid for under this item.
2. Partial payment, in accordance with the terms of subsection 109-04, may be made for bar reinforcement in the cast-in-place concrete portion of the structural slab. Partial payment may be made for Precast concrete form units, provided they have received the Inspector's stamp of approval, as required under "Basis of Acceptance" under subsection 718-01.
3. Progress payments will be made on a per-span basis as follows:
 - A. Forty (40) percent of the estimated square footage (less the cost of partial payments made for materials) will be paid for after all reinforcing is properly placed, to the satisfaction of the Engineer.
 - B. An additional fifty (50) percent of the estimated square footage (less the cost of partial payments made for materials) will be paid for after the concrete has been placed and curing applications have been instituted. Both placement and curing operations shall meet with the approval of the Engineer prior to payment authorization.
 - C. The remainder will be paid for after completion of all curing, and necessary corrective work.

STRUCTURAL SLAB CONCRETE, CLASS HP (OPTIONAL FORMING SYSTEMS)

ITEM 718-05 - PRESTRESSED CONCRETE FORM UNITS (continued)

SCOPE:

This specification contains the requirements for prestressed concrete form units.

These units are used to form the lower portion of a structural slab. They act compositely with the cast-in-place portion of the slab and become an integral part of the structural slab.

GENERAL:

Materials specification 718-01, Prestressed Concrete Units (Structural) shall apply with the following modifications:

Under REINFORCEMENT AND PRESTRESSING STEEL, Page 7-152, add the following as the last paragraph on page 7-152:

“Devices which will be used as hold-down points for outside reinforcing steel shall be placed prior to concrete placement in the forms. Devices used to lift the units are acceptable for this purpose. The maximum spacing between hold-down devices shall be 4'-0" center-to-center of device.”

Under FINISHING, Page 7-152, first paragraph, fourth line: The words “...the tops of units shall be magnesium float finished...” shall not apply.

Under CONCRETE STRENGTH REQUIREMENTS:

1. Test Cylinders, subsection “A”, second paragraph, Page 7-153. Add the following as the last sentence: “All cylinders used to test for concrete strength shall be cured in the same manner as the units they represent unless otherwise indicated on the Working Drawings.”

2. Testing For Concrete Strength, page 7-154, delete this section in its entirety and substitute the following:

The strength requirements for each day's production shall be certified by the Contractor before that day's production is accepted for strength. Certification shall be done in accordance with the terms of this subsection. All cylinders cast shall be cast in sets of three. One set shall be cast from the first concrete placement of the day. One set shall be cast from the last concrete placement of the day. In addition to those, there shall be a set cast for each ten cubic yards of concrete, or major fraction thereof, placed in any one day.

A. Transfer Strength: Three cylinders from each day's production shall be tested in immediate succession to verify prestress transfer strength. One cylinder shall be taken from the first set cast; one cylinder shall be taken from the last set cast. The strength of each cylinder shall be at least 95 percent of the required prestress transfer strength. The average strength of the three cylinders shall be equal to, or greater than, the required prestress transfer strength.

STRUCTURAL SLAB CONCRETE, CLASS HP (OPTIONAL FORMING SYSTEMS)

ITEM 718-05 - PRESTRESSED CONCRETE FORM UNITS (continued)

- B. 28-Day Strength: Three (3) cylinders representing each day's production shall be tested in immediate succession at twenty-eight (28) days of age to verify the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are not met, any remaining cylinders representing the day's production shall also be tested at 28 days of age. The average strength of all cylinders representing the 28-day strength of any one day's production shall be equal to, or greater than, the required 28-day strength.
- C. Option: The Contractor may test three (3) cylinders, representing each day's production in immediate succession, prior to the 28-day age limit. Each cylinder shall have a strength of at least ninety-five (95) percent of the required 28-day strength. The average strength of the three cylinders shall be equal to, or greater than, the required 28-day strength. If these requirements are met, the cylinder test at 28 days of age shall be waived. If this option is exercised, sufficient cylinders shall be made to ensure that at least 3 cylinders are available for the 28-day test.

Under REJECTION OF UNITS, Page 7-154: Parts 1 through 4 which begin with the words, "Any unit not fabricated..." and end with the words "of an inch in width." shall not apply.

The following shall apply:

REJECTION OF UNITS: Any unit not fabricated in accordance with the Contract Documents, or displaying any of the following defects, shall be subject to rejection:

1. Strength Requirements: Any unit represented by cylinders not meeting the required strengths, as specified in Concrete Strength Requirements, of this specification.
2. Exposed Prestressing Steel: Any unit which exhibits one or more exposed prestressing strand(s) on a top or bottom surface.
3. Honeycombing: Honeycombing of the unit to such an extent that chipping away from the honeycombed concrete results in the exposure of one or more, prestressing strands on a top, or bottom, surface.

All honeycombed areas shall be chipped until sound concrete is reached. Sound concrete is defined as that point at which chipping causes fracture of the aggregates. If chipping of the honeycombed portion results in a hole more than one-half the thickness of the unit, the unit will be rejected.

4. Cracks: Any unit which exhibits a crack that is greater than one-half inch (1/2") in depth, and twenty-five ten thousandths of an inch (.0025") in width.

STRUCTURAL SLAB CONCRETE, CLASS HP (OPTIONAL FORMING SYSTEMS)

ITEM 718-05 - PRESTRESSED CONCRETE FORM UNITS (continued)

Under DAMAGED UNITS, Page 7-154 and 7-155: The subparagraph titled "Repair" shall not apply.

The following shall apply:

Repair: Repair, if allowed by the DCES, shall be made with Concrete Repair Material (701-04). Concrete repair material shall be mixed and placed in strict accordance with the manufacturer's instructions.

Form Supports: Form supports for installation of the units shall be supplied as part of this work. They shall conform to the latest specification for ASTM A446, Grades A through E. Fabrication shall be in conformance with ASTM A525, Coating Class G165.

The Contractor shall supply the Engineer with certification that the form supports meet the foregoing requirements.

Under TOLERANCES, Page 7-156. The requirements of this subsection shall not apply.

The following shall apply:

"Tolerances: All units shall be checked for compliance with the tolerances listed below, after the units have completed the FINAL CURING PHASE and within three (3) days prior to shipping. The Inspector shall document to the DCES any unit with dimensions out of tolerance. Any unit which fails to meet these tolerances shall be rejected with the concurrence of the DCES.

<u>Finished Dimensions</u>	<u>Position of Strands</u>
* Width \pm 1/4 inch	Vertical \pm 1/4 inch
Length \pm 1/2 inch	
Depth \pm 1/4 inch	Horizontal \pm 1/2 inch

* Width is defined as the dimension measured parallel to the prestressing strands.

- ITEM 18555.96 - CONCRETE FOR STRUCTURES, CLASS HP**
ITEM 18555.9601 - CONCRETE FOR STRUCTURES, CLASS HP
(Structural Slab with Integral Wearing Surface - Bottom Formwork Required)
ITEM 18555.9602 - CONCRETE FOR STRUCTURES, CLASS HP
(Structural Slab with Integral Wearing Surface - Bottom Formwork not Required)
ITEM 18555.9603 - CONCRETE FOR STRUCTURES, CLASS HP
(Structural Slab - Separate Wearing Surface)
ITEM 18555.9604 - CONCRETE FOR STRUCTURES, CLASS HP
(Structural Approach Slab with Integral Wearing Surface)
ITEM 18555.9605 - CONCRETE FOR STRUCTURES, CLASS HP
(Structural Approach Slab - Separate Wearing Surface)

DESCRIPTION. This work shall consist of furnishing and placing portland cement concrete for structures as indicated on the plans or as ordered by the Engineer. The concrete shall contain fly ash and microsilica.

MATERIALS. All the material requirements of §555-2 shall apply. In addition, the microsilica admixture shall be supplied in either a densified powder or slurry form.

The microsilica admixture shall be one appearing on the Department's Approved List. Only one brand shall be allowed for any structural element. The Manufacturer shall provide written certification that the supplied material meets the requirements of the procedural directives of the Materials Bureau. For each shipment supplied this certification shall list fineness, silica content, total chloride ion content, solids content for slurries, and moisture content for densified powders. Additionally, the Regional Materials Engineer shall take a minimum sample of one quart directly from the storage container, for each days placement of Class HP concrete, for testing by the Department.

If the microsilica admixture is supplied in the slurry form the slurry shall be maintained in storage above the temperature of 32°F. Slurries exposed to temperatures of 32°F or less shall be removed and replaced at no cost to the Department. The slurry shall be homogeneous and agitated as necessary to prevent separation.

Class HP concrete shall consist of a homogeneous mixture of cement, fly ash, microsilica admixture, fine aggregate, coarse aggregate, air entraining agent, set retarding water reducing admixture and water which meets the requirements of the MIX CRITERIA table given below.

18555.XX CONCRETE FOR STRUCTURES, CLASS HP

MIX CRITERIA

Cement content (lbs./c.y.)	500
Fly ash content (lbs./c.y.)	135
Microsilica content (lbs./c.y.)	40
Sand percent total aggregate (solid volume)	40
Designed water/total cementitious content of 675 lbs. (weight)	0.40
Desired air content (%)	6.5
Allowable air content (%)	5.0 - 8.0
Desired slump (inches)	3½
Allowable slump (inches)	3 - 4
Type of coarse aggregate gradation	CA 2

NOTE The criteria are given for design information and the data is based on a fine aggregate fineness modulus of 2.80. The mixture proportions shall be determined using actual conditions for fineness modulus and bulk specific gravities (saturated surface dry for aggregate). The proportions shall be computed according to Department written instructions.

The requirements of §501 shall apply, except as modified herein.

1. If a densified powder is used, the densified powder shall be weighed cumulatively with the cement and fly ash. The densified powder shall be last in the weighing sequence and the tolerance for each material draw weight shall be based upon the total weight of cement plus fly ash plus densified powder. The batching tolerance for the cement plus fly ash plus densified powder shall be ±½% by weight.
2. If a microsilica slurry is used, the slurry shall be added using proportioning equipment approved by the Regional Materials Engineer. The microsilica slurry admixture shall be added through an existing automation system or a two stop off-line automated batching system. The automated batching system shall meet the following requirements:

Delivery accuracy of ±1% (by volume)
 Program quantity (gallons, nearest tenth)
 Batching tolerance ±2.0% (by volume)

System interlocks

Print requirements:

- a. Date and time
- b. Truck number (or alternate method relating microsilica to batch ticket)
- c. Delivered quantity (gallons, nearest tenth)

The control box/printer for a two stop off-line batching system shall be located at the batch plant operator's work station unless otherwise approved by the Regional Materials Engineer.

18555.XX CONCRETE FOR STRUCTURES, CLASS HP

Calibration shall be in accordance with the procedures approved by the Regional Materials Engineer. Whenever any part or all of the off-line system is moved the entire system shall be recalibrated.
CONSTRUCTION DETAILS. All the provisions of §555-3 shall apply.

METHOD OF MEASUREMENT. All the provisions of §555-4 shall apply.

BASIS OF PAYMENT. All the provisions of §555-5 shall apply.

Payment will be made under:

Item No.	Item	Pay Unit
18555.96	CONCRETE FOR STRUCTURES, CLASS HP	Cubic Yard
18555.9601	CONCRETE FOR STRUCTURES, CLASS HP (Structural Slab with Integral Wearing Surface, Bottom Formwork Required)	Square Foot
18555.9602	CONCRETE FOR STRUCTURES, CLASS HP (Structural Slab with Integral Wearing Surface, Bottom Formwork not Required)	Square Foot
18555.9603	CONCRETE FOR STRUCTURES, CLASS HP (Structural Slab - Separate Wearing Surface)	Square Foot
18555.9604	CONCRETE FOR STRUCTURES, CLASS HP (Structural Approach Slab with Integral Wearing Surface)	Square Foot
18555.9605	CONCRETE FOR STRUCTURES, CLASS HP (Structural Approach Slab - Separate Wearing Surface)	Square Foot

ITEM 18555.96 M - CONCRETE FOR STRUCTURES, CLASS HP

DESCRIPTION. This work shall consist of furnishing and placing portland cement concrete for structures as indicated on the plans or as ordered by the Engineer. The concrete shall contain fly ash and microsilica.

MATERIALS. All the material requirements of §555-2 shall apply. In addition, the microsilica admixture shall be supplied in either a densified powder or slurry form.

The microsilica admixture shall be one appearing on the Department's Approved List. Only one brand shall be allowed for any structural element. The Manufacturer shall provide written certification that the supplied material meets the requirements of the procedural directives of the Materials Bureau. For each shipment supplied this certification shall list fineness, silica content, total chloride ion content, solids content for slurries, and moisture content for densified powders. Additionally, the Regional Materials Engineer shall take a minimum sample of one liter directly from the storage container, for each days placement of Class HP concrete, for testing by the Department.

If the microsilica admixture is supplied in the slurry form the slurry shall be maintained in storage above the temperature of 0°C. Slurries exposed to temperatures of 0°C or less shall be removed and replaced at no cost to the Department. The slurry shall be homogeneous and agitated as necessary to prevent separation.

Class HP concrete shall consist of a homogeneous mixture of cement, fly ash, microsilica admixture, fine aggregate, coarse aggregate, air entraining agent, set retarding water reducing admixture and water which meets the requirements of the MIX CRITERIA table given below.

MIX CRITERIA

Cement content (kg/m ³)	300
Fly ash content (kg/m ³)	80
Microsilica content (kg/m ³)	25
Sand percent total aggregate (solid volume)	40
Designed water/total cementitious content of 400.3 kg	0.40
Desired air content (%)	6.5
Allowable air content (%)	5.0 - 8.0
Desired slump (mm)	90
Allowable slump (mm)	75 - 100
Type of coarse aggregate gradation	CA 2

NOTE The criteria are given for design information and the data is based on a fine aggregate fineness modulus of 2.80. The mixture proportions shall be determined using actual conditions for fineness modulus and bulk specific gravities (saturated surface dry for aggregate). The proportions shall be computed according to Department written instructions.

ITEM 18555.96 M - CONCRETE FOR STRUCTURES, CLASS HP

The requirements of §501 shall apply, except as modified herein.

1. If a densified powder is used, the mass of the densified powder shall be measured cumulatively with the cement and fly ash. The densified powder shall be last in the measuring sequence and the tolerance for each material draw mass shall be based upon the total mass of cement plus fly ash plus densified powder. The batching tolerance for the cement plus fly ash plus densified powder shall be $\pm\frac{1}{2}\%$ by mass.
2. If a microsilica slurry is used, the slurry shall be added using proportioning equipment approved by the Regional Materials Engineer. The microsilica slurry admixture shall be added through an existing automation system or a two stop off-line automated batching system. The automated batching system shall meet the following requirements:

Delivery accuracy of $\pm 1\%$ (by volume)

Program quantity (liters, nearest tenth)

Batching tolerance $\pm 2.0\%$ (by volume)

System interlocks

Print requirements:

- a. Date and time
- b. Truck number (or alternate method relating microsilica to batch ticket)
- c. Delivered quantity (liters, nearest tenth)

The control box/printer for a two stop off-line batching system shall be located at the batch plant operator's work station unless otherwise approved by the Regional Materials Engineer.

Calibration shall be in accordance with the procedures approved by the Regional Materials Engineer. Whenever any part or all of the off-line system is moved the entire system shall be recalibrated.

CONSTRUCTION DETAILS. All the provisions of §555-3 shall apply.

METHOD OF MEASUREMENT. All the provisions of §555-4 shall apply.

BASIS OF PAYMENT. All the provisions of §555-5 shall apply.

Payment will be made under:

Item No.	Item	Pay Unit
18555.96 M	Concrete for Structures, Class HP	Cubic Meter

- ITEM 18557.0196 M - SUPERSTRUCTURE SLAB WITH INTEGRAL WEARING SURFACE, BOTTOM FORMWORK REQUIRED, CLASS HP
- ITEM 18557.0596 M - SUPERSTRUCTURE SLAB WITH INTEGRAL WEARING SURFACE, BOTTOM FORMWORK NOT REQUIRED
- ITEM 18557.0796 M - SUPERSTRUCTURE SLAB WITH SEPARATE WEARING SURFACE, BOTTOM FORMWORK REQUIRED, CLASS HP
- ITEM 18557.0996 M - SUPERSTRUCTURE SLAB WITH SEPARATE WEARING SURFACE, BOTTOM FORMWORK NOT REQUIRED, CLASS HP
- ITEM 18557.2096 M - STRUCTURAL APPROACH SLAB WITH INTEGRAL WEARING SURFACE, CLASS HP
- ITEM 18557.2296 M - STRUCTURAL APPROACH SLAB WITH SEPARATE WEARING SURFACE, CLASS HP

DESCRIPTION. All the provisions of 557-1 shall apply.

MATERIALS. All the material requirements of §557-2 shall apply except concrete shall meet the requirements herein for Class HP.

The microsilica admixture shall be one appearing on the Department's Approved List. Only one brand shall be allowed for any structural element. The Manufacturer shall provide written certification that the supplied material meets the requirements of the procedural directives of the Materials Bureau. For each shipment supplied this certification shall list fineness, silica content, total chloride ion content, solids content for slurries, and moisture content for densified powders. Additionally, the Regional Materials Engineer shall take a minimum sample of one liter directly from the storage container, for each days placement of Class HP concrete, for testing by the Department.

If the microsilica admixture is supplied in the slurry form the slurry shall be maintained in storage above the temperature of 0°C. Slurries exposed to temperatures of 0°C or less shall be removed and replaced at no cost to the Department. The slurry shall be homogeneous and agitated as necessary to prevent separation.

Class HP concrete shall consist of a homogeneous mixture of cement, fly ash, microsilica admixture, fine aggregate, coarse aggregate, air entraining agent, set retarding water reducing admixture and water which meets the requirements of the MIX CRITERIA table given below.

18557.XX M CLASS HP CONCRETE FOR SUPERSTRUCTURE AND APPROACH SLABS

MIX CRITERIA

Cement content (kg/m ³)	300
Fly ash content (kg/m ³)	80
Microsilica content (kg/m ³)	25
Sand percent total aggregate (solid volume)	40
Designed water/total cementitious content of 400.3 kg	0.40
Desired air content (%)	6.5
Allowable air content (%)	5.0 - 8.0
Desired slump (mm)	90
Allowable slump (mm)	75 - 100
Type of coarse aggregate gradation	CA 2

NOTE The criteria are given for design information and the data is based on a fine aggregate fineness modulus of 2.80. The mixture proportions shall be determined using actual conditions for fineness modulus and bulk specific gravities (saturated surface dry for aggregate). The proportions shall be computed according to Department written instructions.

The requirements of §501 shall apply, except as modified herein.

1. If a densified powder is used, the mass of the densified powder shall be measured cumulatively with the cement and fly ash. The densified powder shall be last in the measuring sequence and the tolerance for each material draw mass shall be based upon the total mass of cement plus fly ash plus densified powder. The batching tolerance for the cement plus fly ash plus densified powder shall be ±½% by mass.
2. If a microsilica slurry is used, the slurry shall be added using proportioning equipment approved by the Regional Materials Engineer. The microsilica slurry admixture shall be added through an existing automation system or a two stop off-line automated batching system. The automated batching system shall meet the following requirements:

Delivery accuracy of ±1% (by volume)

Program quantity (liters, nearest tenth)

Batching tolerance ±2.0% (by volume)

System interlocks

Print requirements:

- a. Date and time
- b. Truck number (or alternate method relating microsilica to batch ticket)
- c. Delivered quantity (liters, nearest tenth)

The control box/printer for a two stop off-line batching system shall be located at the batch plant operator's work station unless otherwise approved by the Regional Materials Engineer.

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Calibration shall be in accordance with the procedures approved by the Regional Materials Engineer. Whenever any part or all of the off-line system is moved the entire system shall be recalibrated.

CONSTRUCTION DETAILS. All the provisions of §557-3 shall apply.

METHOD OF MEASUREMENT. All the provisions of §557-4 shall apply.

BASIS OF PAYMENT. All the provisions of §557-5 shall apply.

Payment will be made under:

Item No.	Item	Pay Unit
18557.0196 M	Superstructure Slab with Integral Wearing Surface, Bottom Formwork Required, Class HP	Square Meter
18557.0596 M	Superstructure Slab with Integral Wearing Surface, Bottom Formwork Not Required, Class HP	Square Meter
18557.0796 M	Superstructure Slab with Separate Wearing Surface, Bottom Formwork Required, Class HP	Square Meter
18557.0996 M	Superstructure Slab with Separate Wearing Surface, Bottom Formwork Not Required, Class HP	Square Meter
18557.2096 M	Structural Approach Slab with Integral Wearing Surface, Class HP	Square Meter
18557.2296 M	Structural Approach Slab with Separate Wearing Surface, Class HP	Square Meter