TO:

ENGINEERING INSTRUCTION

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

SUBJECT: PORTLAND CEMENT CONCRETE DESIGN GUIDELINES

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APPROVED: Malcolm D. Graham
Deputy Chief Engineer, Facilities Design Subdiv.

Attached are modifications to the Standard Specifications Section 501, Portland Cement Concrete - General, and some of the construction specifications that require concrete. These modifications will improve the quality of concrete in pavement, structures and incidental construction uses. These provisions will be inserted by the Final Plan Review Bureau. The Regional Design Engineers will incorporate the necessary modifications into P.S.&E's effective for the October 21, 1976 letting.

The number of standard classes of concrete have been expanded from three to eight and are shown in Table 501-3, Concrete Mixtures. In Table 501-3, the primary uses for the various classes of concrete are indicated as a guide for design. Additional information on the classes is as follows:

Class A remains as the general purpose structural concrete. However, it should not be specified for structural slabs, footings and abutments. Also Class A may be specified for most incidental uses.

Class B remains as the desired concrete class for footings and abutments.

Class C has been revised and the maximum size aggregate in the mixture is 1-1/2 inches. Class C should be specified for all concrete pavement, either formed or slipformed construction, and may be used for other slipforming applications such as median barriers.

Class D is a new standard mix suited for thin structural applications such as repair of slabs, walls and other areas where a mix with a smaller maximum aggregate size is required.

Class E is a new standard mix for structural slabs and structural approach slabs.

Class F is a new standard mix for situations where it is desired to have a compressive strength of 3000 psi in approximately 72 hours after placement. This mix is a special purpose mix and should be specified only when early compressive strength is required.

Class G is a new standard mix for tremie applications.

Class H is a new standard mix for placement by concrete pumping equipment. Class H shall not be specified on the plans except in situations where placement is permitted only by pumping equipment. Otherwise Class H may be used as a substitute for Classes A, B, or E at the Contractor's option.

Disapproved Item Number	Approved Item Number		
502.01	502.04	Cement Concrete Pavement, Reinforced, Class C	Cu. Yd.
502.02	502.05	Cement Concrete Pavement, Reinforced, Class F	Cu. Yd.
502.03	502.06	Cement Concrete Pavement, Unreinforced, Class C	Cu. Yd.
503.01	503.0101	Cement Concrete Foundation For Pavement, Unreinforced, Class C	Cu. Yd.
601.01	601.05	Concrete for Structures, Class A	Cu. Yd.
601.02	601.06	Concrete for Structures Class B	Cu. Yd.
	601.09	Concrete for Structures Class F	Cu. Yd.
601.04	601.10	Concrete for Structures, Class G (Deposited Under Water)	Cu. Yd.
	601.07	Concrete for Structures, Class D	Sq. Foot
601.0301	601.0801	Concrete for Structures, Class E (Structural Slab, with Integral Wearing Surface-Bottom Formwork required)	Sq. Foot

Disapproved Item Number	Approved Item Number	
601.0302	601.0802	Concrete for Structures, Class E (Structural Slab, with Integral Wearing Surface- Bottom Formwork not required Sq. Foot
	601.0803	Concrete for Structures, Class E (Structural Slab- Separate Wearing Surface) Sq. Foot
601.0303	601.0804	Concrete for Structures, Class E (Structural Approach Slab with Integral Wearing Surface) Sq. Foot
601.0303	601.0805	Concrete for Structures, Class E (Structural Approach Slab - Separate Wearing Surface) Sq. Foot

PORTLAND CEMENT CONCRETE

Make the following changes to the Standard Specifications of January 2, 1973, and Addendum No. 3:

Delete pages 203 thru 207 of the Standard Specifications and all references to these pages in Addendum No. 3 (pages 43 and 44), in their entirety, and substitute the following:

SECTION 500 - RIGID PAVEMENTS

SECTION 501 - PORTLAND CEMENT CONCRETE - GENERAL

501-1 DESCRIPTION. These general specifications shall apply to Portland cement concrete for pavement, structures (except prestressed units) and incidental construction. Any modifications of these general requirements will be given in the specific requirements for each item unless otherwise indicated in the contract documents. The work shall consist of furnishing Portland cement concrete in accordance with these specifications. Concrete for pipe, prestressed units and precast units will be specified in their respective items.

501-2 MATERIALS. Concrete shall be produced from Department approved materials. The Contractor shall inform the Regional Director or his representative of the sources of materials prior to mixing any of the ingredients.

501-2.01 COMPOSITION OF MIXTURES. The Portland cement concrete shall consist of a homogeneous mixture of cement, fine aggregate, coarse aggregate, water and admixtures proportioned and mixed according to these specifications.

The Portland cement concrete used in Department work shall be the class of concrete indicated in the Contract Documents. The Contractor may, however, make substitutions in the concrete class according to Table 501-1, Concrete Class Options. Any concrete mix not meeting the requirements of Table 501-3, Concrete Mixtures, shall be approved by the Deputy Chief Engineer, Technical Services.

501-2.02 MATERIALS. The requirements of the Sections indicated below shall apply unless otherwise indicated in the contract documents:

Portland Cement	701-01
Coarse Aggregates	703-02
Concrete Sand	703-07
Admixtures	711-08
Water	712-01

TABLE 501-1
CONCRETE CLASS OPTIONS

Concrete Class Specified	Allowable Class Options
A	C, E, F* or H
B	A, E or H
C	F*
D	None
E	F* or H
F	None
G	None
H	None

*Requires prior approval by the Deputy Chief Engineer, Technical Services.

A. Cement. Cement shall be Portland Cement Type 1 or Type 2, unless otherwise indicated in the Contract Documents. All cement shall be Department accepted. Any cement hardened by moisture shall be rejected and not used in Department work.

B. Aggregates.

1. Fine Aggregate. The fine aggregate shall meet the requirements of Section 703-07, Concrete Sand.

2. Coarse Aggregate. All coarse aggregate shall be either crushed stone, crushed gravel or crushed slag meeting the requirements of Section 703-02, Coarse Aggregate except that the gradation requirement for the mixture shall be as indicated in Table 501-2, Coarse Aggregate Gradations. The gradations in Table 501-2 shall be one or a combination of size designations specified in Table 703-4, Sizes of Stone, Gravel, and Slag.

Aggregates not meeting the requirements in Table 703-4, but having a uniform size, may be approved by the Deputy Chief Engineer, Technical Services. When these aggregate sizes are used in combination to meet the mixture gradation, the individual aggregate sizes shall meet all the requirements of Section 703-02 except for gradations.

Any blending of aggregate sizes prior to batching shall be accomplished by methods approved by the Regional Director or his representative.

TABLE 501-2
COARSE AGGREGATE GRADATIONS

Sieve Sizes	Type CA 1 General Limits % Passing	Type CA 2 General Limits % Passing	Type CA 3 General Limits % Passing
2-1/2"	-	-	100
2"	-	-	95-100
1-1/2"	-	100	68-100
1"	100	93-100	47-72
1/2"	90-100	27-58	14-35
1/4"	0-15	0-8	0-5

3. Aggregate Acceptance. Aggregates from Department approved sources will be accepted at the plant site based upon gradation. Samples representative of the fine and coarse aggregate will be taken at the plant site from either barges, stockpiles, conveyor belts or bins and tested. Sampling and testing will be in accordance with Department written instructions. Aggregates not conforming to the requirements will be rejected. Reprocessing or reworking rejected aggregates which meet the gradation requirements will be permitted.

C. Admixtures. Admixtures used as air-entraining, set-retarding, and water reducing agents in Portland Cement concrete shall conform to Section 711-08, Admixtures. Other admixtures shall be approved by the Deputy Chief Engineer, Technical Services.

501-3 CONSTRUCTION REQUIREMENTS

501-3.01 PROPORTIONING. Proportions of ingredients, except admixtures, for all Portland Cement concrete mixtures shall be determined by the Department according to these specifications unless otherwise indicated in the Contract documents.

A. AGGREGATES AND CEMENT. The proportions of aggregate and cement for the classes of concrete are indicated in Table 501-3, Concrete Mixtures. Proportions shall be approved by the Deputy Chief Engineer, Technical Services for either:

1. Mixes having aggregate other than those permitted by Subsection 501-2.02 B, Aggregates or

2. Non-standard concrete mixes.

TABLE 501-3
CONCRETE MIXTURES

Concrete Class	Mix Criteria: Cement lbs/cy	Sand Content % Total Agg.	Water/cement (weight)	Air Content %	Slump Range (ins.)	Type of Coarse Aggregate Gradation	Primary Use
A	606	36.2	0.46	6.0	2 1/2-3 1/2	CA 2	general purpose structural
B	517	33.2	0.46	5.0	2 - 3	CA 3	footings and abutments
C	605	35.8	0.44	6.0	1 1/2-2 1/2	CA 2	pavement and other slipforming applications
D	725	45.8	0.44	7.5	2 1/2-3 1/2	CA 1	thin structural applications
E	648	35.8	0.44	6.0	3 - 4	CA 2	structural slabs and structural approach slabs
F	716	34.6	0.38	6.0	2 - 3	CA 2	high early strength for pavement or structural slabs
G	685	36.0	0.45	5.0	7 - 8	CA 2	tremie
H	675	40.0	0.44	6.0	3 - 4	CA 2	pumping applications

NOTE: The criteria are given for design information and the data is based on 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 aggregates). The proportions shall be computed according to Department written instructions.

B. Admixtures. Admixtures shall be added in the amounts necessary to achieve the proper set-retardation, the desired water reduction, and/or the required air content. These materials shall not be considered as part of the solid volume. Other admixtures shall not be used without approval by the Deputy Chief Engineer, Technical Services Subdivision.

1. Air Entrainment. All concrete shall contain an air content within the limits specified in Table 501-4, Air Content, unless otherwise specified in the contract documents. The air content shall be determined by means of a test performed in accordance with the Department's written instructions.

2. Retardation. The setting time of concrete may be retarded when such retardation is necessary for proper placement. The quantity of admixture incorporated into the mix shall be the amount required for the minimum retardation consistant with placing conditions. Retarders shall not be used when the air temperature during placing operations is below 60°F unless unusual hydration conditions exist. Set retarding admixtures shall be used subject to the approval of the Regional Director or his representative.

3. Water Reduction. Water reducing agents shall be added to the mixture when required by the DCETS.

TABLE 501-4
AIR CONTENT

Concrete Class	Min., %	Desired, %	Max., %
A	4.0	6.0	8.0
B	3.0	5.0	7.0
C	4.0	6.0	8.0
D	5.5	7.5	9.5
E	4.0	6.0	8.0
F	4.0	6.0	8.0
G	3.0	5.0	7.0
H	4.0	6.0	8.0

Page 208

Under Subsection 501-3.02 B., Bins, delete the last sentence in the first paragraph and replace with the following:

The bins shall have adequate separations for fine aggregate and for the various sizes of coarse aggregates.

Page 209

Delete Table 501-5, SLUMP VALUES, in its entirety, and the reference to this Table on page 44 of Addendum No. 3 and replace with the following Table:

TABLE 501-5
SLUMP VALUES

Concrete Placement	Design Slump Range, Inches	Maximum Slump Inches
Pavement		
Slipform Paving	1-1/2 - 2-1/2	2-1/2
Form Paving	1-1/2 - 2-1/2	3
Structural Slabs	3 - 4	4
Footings, Headwalls greater than 18 inches in thickness	2 - 3	3-1/2
Piers, Pedestals, Rigid Frames or Arches, Box Culverts throughout Walls equal to or less than 18 inches in thickness; general purpose structural	2-1/2 - 3-1/2	4
Cast-in-Place Piles	2-1/2 - 3-1/2	5
Tremie Concrete 6 inch minimum slump	7 - 8	9
High early strength pavement slabs or structural sections	2 - 3	3
Structural placement 3 inches thick or less	2-1/2 - 3-1/2	3-1/2

NOTE: Maximum slump for pumping applications shall be 4 inches.

Page 242

In Table 502-2, Curing Periods for Cement Concrete Pavement, add "(2)" to the table heading, Curing Period - Days Minimum and add Note 2 as follows:

Note 2: When Class F concrete is used, the minimum curing period under all conditions shall be 3 days unless otherwise ordered by the Engineer.

Page 47 of Addendum No. 3

Under page 250, Subsection 502-5.01, Cement Concrete Pavement (all Types), insert the following between the first and second paragraphs:

When the Contractor elects to substitute an optional concrete class as permitted by Table 501-1, Concrete Class Options, payment will be made for the originally specified class of concrete.

Page 251

Delete the following pay items:

Item No.	Item	Pay Unit
502.01	Cement Concrete Pavement, Reinforced, Class C (Class A Optional)	Cubic Yards
502.02	Cement Concrete Pavement, Reinforced, Class A	Cubic Yards
502.03	Cement Concrete Pavement, Unreinforced, Class C (Class A Optional)	Cubic Yards

Substitute the following pay items:

Item No.	Item	Pay Unit
502.04	Cement Concrete Pavement, Reinforced, Class C	Cubic Yard
502.05	Cement Concrete Pavement, Reinforced, Class F	Cubic Yard
502.06	Cement Concrete Pavement, Unreinforced, Class C	Cubic Yard

Page 253

Under Subsection 503-4, METHOD OF MEASUREMENT, in the third line, delete "Class B."

Under Subsection 503-5, BASIS OF PAYMENT, delete the second paragraph and replace it with the following:

When the Contractor elects to substitute an optional concrete class as permitted by Table 501-1, Concrete Class Options, payment will be made for the originally specified class of concrete.

Also change the pay item to read as follows:

Item No.	Item	Pay Unit
503.0101	Cement Concrete Foundation for Pavement, Unreinforced, Class C	Cubic Yard

Page 255

Delete Subsection 601-2.02, Concrete for Structures, in its entirety, also the reference to page 255 in Addendum No. 3 (page 72) and substitute the following:

601-2.02 Concrete for Structures. The class of concrete required for the various structural concrete items will be indicated on the plans. The same source of aggregates shall be used in all faces exposed to view of a concrete structure.

Page 260

Under Section 601-3.04 Handling and Placing Concrete, A. General, delete the second and third paragraphs and replace with the following:

Concrete shall be placed so as to avoid segregation of materials and displacement of reinforcement. All equipment used for conveying the concrete mix from the input end to the discharge point shall be capable of meeting the permissible variations given in Table 501-7, Concrete Uniformity. Prior to the actual placement of concrete, the Engineer may require the Contractor to demonstrate the capability of the equipment to convey the concrete mixture. Tests according to Department written instructions will be performed by the Engineer at his discretion. No further verification of the equipment's capability will be required unless evidence of nonuniform concrete is observed by the Engineer during placement.

Concrete shall not come in contact with aluminum during conveying and placing operations. When concrete pumps are used, the lines shall have a minimum diameter of five (5) inches. The specific pumping equipment which the Contractor proposes to use shall be subject to the approval of the Deputy Chief Engineer, Structures.

The concrete mixture, prior to placement into the conveying equipment, shall meet the specified requirements for air content and slump given for the various classes and types of placement under Tables 501-4, Air Content, and 501-5, Slump Values.

Pages 262 and 263

Under Subsection 601-3.04 Handling and Placing Concrete, delete Subsection B. Pumping Concrete, in its entirety.

Page 263

Change the title "C. Vibrating." to "B. Vibrating.".

Page 264

Under Subsection 601-3.05, Depositing Structural Concrete Under Water, paragraph A. General, delete the second sentence and replace it with the following:

When concrete is so deposited, it shall be Class G concrete with an approved retarder added.

Page 277

Delete the fourth paragraph which begins "Immediately after finishing ..." and ends with "...of 0.08 inches.", and substitute the following paragraphs:

> Immediately after finishing operations have been completed and prior to the application of the curing medium, the concrete shall be textured with a wire broom, or comb, having a single row of tines. Individual tines shall be rectangular in shape, 3/16-inch wide, 1/32-inch thick and approximately 6-inches long. The center-to-center spacing of the tines will be approximately 3/4-inch. The tines shall be capable of producing striations 3/16-inch deep, ± 1/16-inch, in the plastic concrete in one pass. The capability of the tines to provide an acceptable

texture shall be demonstrated to the Engineer, for approval, prior to use.

Texturing shall be done perpendicular to the centerline of the roadway. It shall stop approximately one foot from the curb line. Only one pass of the tines, over any area, will be permitted. The broom,or comb, may be operated mechanically, or by hand. In either case, texturing shall be done with the longitudinal axis of the tines as nearly at an angle of 45 degrees to the surface as practicable. Texturing shall be performed at such time and in such manner that the required texture will be achieved with minimum displacement of the larger aggregate particles. The tines shall be kept free of hardened concrete particles.

Page 280

Change the title of Subsection 601-4.01 from "Class A and B Concrete for Structures" to "Concrete for Structures."

Page 281

Change the title of Subsection 601-4.02 from "Class A Concrete for Structures (Monolithic Bridge Slab)" to "Concrete for Structures (Structural Slab)."

also

Delete Subsection 601-5, BASIS OF PAYMENT, in its entirety, and all references to page 281 in Addendum No. 3 (page 72) and substitute the following:

601-5 BASIS OF PAYMENT

601-5.01 General. When the Contractor elects to substitute an optional concrete class as permitted by Table 501-1, Concrete Class Options, payment will be made for the originally specified class of concrete using the originally specified method of measurement.

601-5.02 Concrete for Structures. The unit price bid per cubic yard, for each class of concrete shall include the cost of furnishing all labor, materials and equipment necessary to complete the concrete work as shown on the plans or called for in the specifications, except reinforcement will be paid for separately under its appropriate item. Unless otherwise provided, the unit price bid shall include the cost of furnishing and placing copper flashing or other metal strips, flexible water stops, asbestos sheet packing, pipe drains, bituminous material, water for wetting, joint materials felt, tar paper, joint sealing compounds, joint fillers and concrete curing materials.

No extra compensation for falsework or falsework piling will be allowed. This work is included as part of the formwork.

All replacements or corrections to concrete surfaces mis-shapen by bulges or deformations shall be made at the Contractor's expense.

All additional concrete that may be ordered by the D.C.E.S. for concrete footings that are below or beyond the lines shown on the plans will be paid for at the unit price bid in the Contract.

Bridge bearings, expansion joints and anchor bolts will be paid for under their appropriate items.

No payment will be made for concrete replacement or other corrective work which the Contractor is directed to perform in accordance with the requirements of Section 602, Reinforcing Steel for Concrete Structures, Subsection 602-3.02D. Placement in Bridge Slabs.

Progress payments will be made after the concrete has been properly placed and cured. Payment will be made, at the unit price bid, for seventy five percent (75%) of the quantity, after seven (7) curing days have passed. The balance of the quantity will be paid for upon completion of the work.

601-5.03 Concrete for Structures (Structural Slab). The provisions of Subsection 601-5.02 shall apply, except that the unit of measurement shall be as indicated in Subsection 601-4.02 and that the cost of screed supports and other brackets or braces necessary to support finishing machines shall be included in the unit price bid. In addition, if permanent metal forms are called for on the contract plans, the cost of furnishing all facilities required for access, removing the permanent forms for inspection or repair purposes, painting the cut edges of the forms and repairing the concrete as required herein shall be included in the price bid for this work.

Page 282

Delete the entire table that follows "Payment will be made under:". and the reference thereto in Addendum No. 3 (pages 72 and 73) and substitute the following table:

Item No.	Item	Pay Unit
601.05	Concrete for Structures, Class A	Cubic Yard
601.06	Concrete for Structures, Class B	Cubic Yard
601.07	Concrete for Structures, Class D	Square Foot
601.0801	Concrete for Structures, Class E (Structural Slab, with Integral wearing Surface-Bottom Formwork required)	Square Foot
601.0802	Concrete for Structures, Class E (Structural Slab, with Integral wearing Surface-Bottom Formwork not required)	Square Foot
601.0803	Concrete for Structures, Class E (Structural Slab - Separate Wearing Surface)	Square Foot
601.0804	Concrete for Structures, Class E (Structural Approach Slab with Integral Wearing Surface)	Square Foot
601.0805	Concrete for Structures,Class E (Structural Approach Slab-Separate Wearing Surface)	Square Foot
601.09	Concrete for Structures, Class F	Cubic Yard
601.10	Concrete for Structures, Class G (Deposited Under Water)	Cubic Yard

Page 286

In the list of materials under Subsection 603-2, MATERIALS, make the following changes:

Add new first line:

Portland Cement Concrete 501

Change "Portland Cement-Type 2" to "Portland Cement"

Delete "Coarse Aggregate 703-02"

Delete "Concrete Sand 703-07"

Page 290

Under Subsection 603-3.06 D. Vitrified Clay and Cast Iron Pipes, in the fourth line of the first sentence change "Type 2" to "Type 1 or 2".

Pages 290 and 291

Under Subsection 603-3.07, Paving for Structural Plate Pipe, Pipe Arches and Underpasses, delete the second, third, fourth and fifth paragraphs, including Table 603-1 and reference thereto in Addendum No. 3 (page 75), beginning with "For each project..." and ending "...completed to the satisfaction of the Engineer." and substitute the following:

The concrete shall meet the requirements of Class D given in Section 501 Portland Cement Concrete - General. Pavement shall not be placed until the embankment has been completed over the pipe and settlement has been completed to the satisfaction of the Engineer.

Page 291

Delete the first sentence of the fourth paragraph beginning with "Concrete shall be..." and ending with "...specified by the Engineer."