NEW YORK STATE | Department of Transportation

NYSDOT Concrete Standard Specification & Materials Procedures For Performance Engineered Mixtures

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NYSDOT Office of Technical Services - Materials Bureau

April 2026

Empire State of Mind

In New York…Concrete jungle where dreams are made of

PEM

- Jay Z and Alicia Keyes

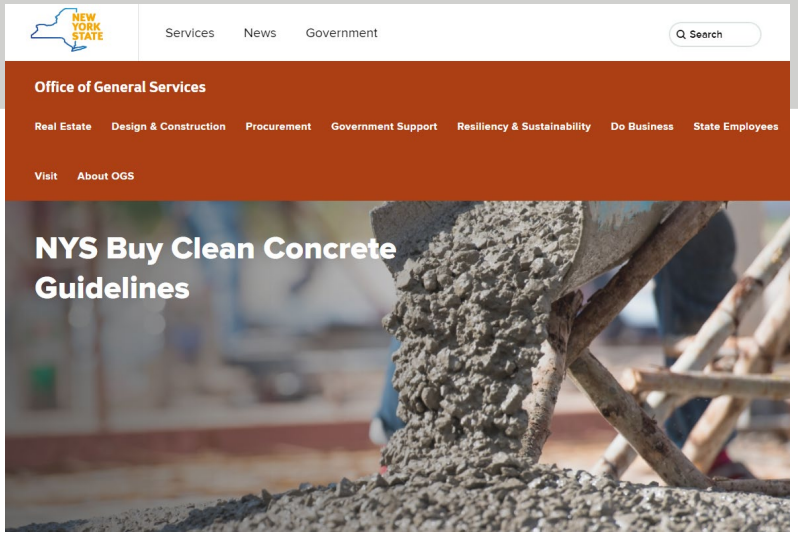
What is PEM?

PEM = Performance Engineered Mixtures

Concrete Mixtures that are engineered to meet or exceed the design requirement, are predictably durable, with increased sustainability. Designed by Contractor/Producer.

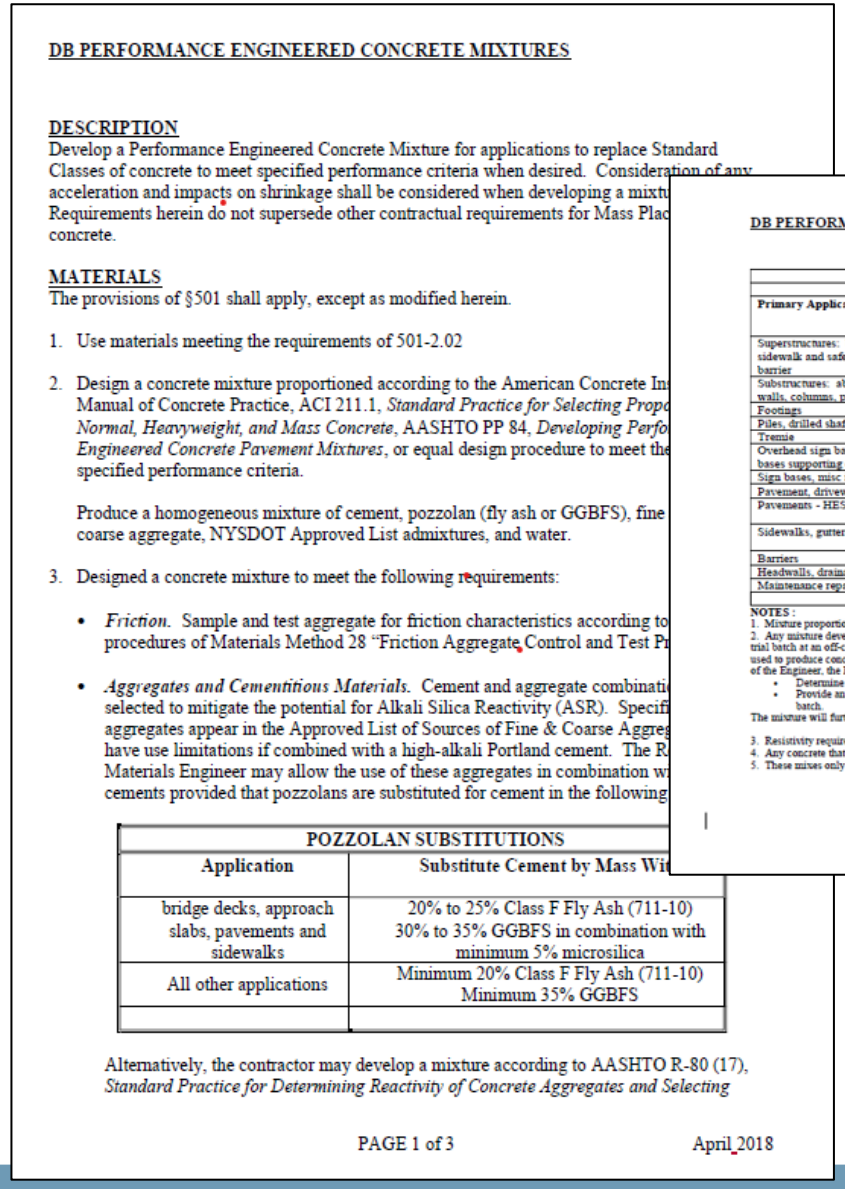
- National Concrete Pavement Technology Center (CP Tech Center)

Why PEM, why now?



- Existing Concrete Specifications (Section 501) “outdated”
  - Closer alignment with AASHTO Design standards (4000 psi design strength) and other NYS Agencies
  - Improved Long Term Concrete Performance
  - Taking better advantage of Contractor/Producer experience/innovation
  - Required Compliance with State Legislation:
    - Executive Order # 22 Required Embodied Carbon Guidance (June 2023)
    - Buy Clean Concrete Guidelines (Sept. 2023)
      - *Establishment of emissions limits on concrete used in state-funded public building and transportation projects*
      - *Portland cement is on all the greenhouse gas lists*

How PEM Started in New York



DB PERFORMANCE ENGINEERED CONCRETE MIXTURES

DESCRIPTION

Develop a Performance Engineered Concrete Mixture for applications to replace Standard Classes of concrete to meet specified performance criteria when desired. Consideration of any acceleration and impacts on shrinkage shall be considered when developing a mixtu Requirements herein do not supersede other contractual requirements for Mass Plac concrete.

MATERIALS

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

1. Use materials meeting the requirements of 501-2.02
2. Design a concrete mixture proportioned according to the American Concrete In Manual of Concrete Practice, ACI 211.1, *Standard Practice for Selecting Propo Normal, Heavyweight, and Mass Concrete*, AASHTO PP 84, *Developing Perfo Engineered Concrete Pavement Mixtures*, or equal design procedure to meet the specified performance criteria.

   Produce a homogeneous mixture of cement, pozzolan (fly ash or GGBFS), fine coarse aggregate, NYSDOT Approved List admixtures, and water.
3. Designed a concrete mixture to meet the following requirements:
   - *Friction.* Sample and test aggregate for friction characteristics according to procedures of Materials Method 28 "Friction Aggregate Control and Test Pr
   - *Aggregates and Cementitious Materials.* Cement and aggregate combinati selected to mitigate the potential for Alkali Silica Reactivity (ASR). Specifi aggregates appear in the Approved List of Sources of Fine & Coarse Aggreg have use limitations if combined with a high-alkali Portland cement. The R Materials Engineer may allow the use of these aggregates in combination wi cements provided that pozzolans are substituted for cement in the following

POZZOLAN SUBSTITUTIONS	
Application	**Substitute Cement by Mass Wit**
bridge decks, approach slabs, pavements and sidewalks	20% to 25% Class F Fly Ash (711-10) 30% to 35% GGBFS in combination with minimum 5% microsilica
All other applications	Minimum 20% Class F Fly Ash (711-10) Minimum 35% GGBFS

Alternatively, the contractor may develop a mixture according to AASHTO R-80 (17), *Standard Practice for Determining Reactivity of Concrete Aggregates and Selecting*

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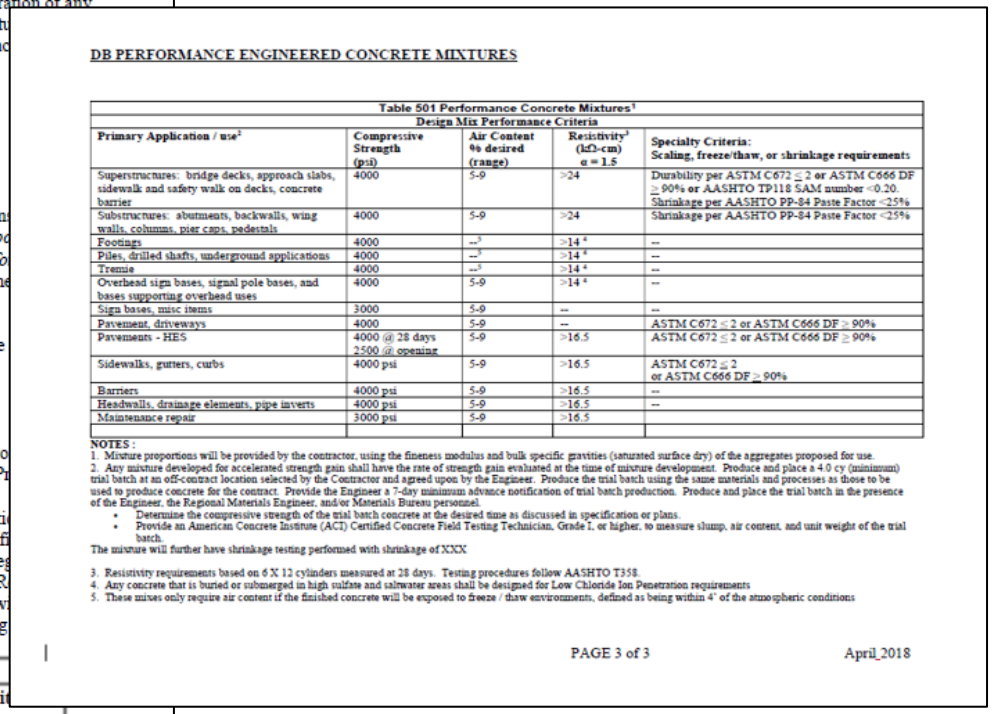

DB PERFORMANCE ENGINEERED CONCRETE MIXTURES

Table 501 Performance Concrete Mixtures[1]
Design Mix Performance Criteria

Primary Application / use[2]	Compressive Strength (psi)	Air Content % desired (range)	Resistivity[3] (kΩ-cm) α = 1.5	Specialty Criteria: Scaling, freeze/thaw, or shrinkage requirements
Superstructures: bridge decks, approach slabs, sidewalk and safety walk on decks, concrete barrier	4000	5-9	>24	Durability per ASTM C672 ≤ 2 or ASTM C666 DF ≥ 90% or AASHTO TP118 SAM number <0.20. Shrinkage per AASHTO PP-84 Paste Factor <25%
Substructures: abutments, backwalls, wing walls, columns, pier caps, pedestals	4000	5-9	>24	Shrinkage per AASHTO PP-84 Paste Factor <25%
Footings	4000	--[5]	>14 [4]	--
Piles, drilled shafts, underground applications	4000	--[5]	>14 [4]	--
Tremie	4000	--[5]	>14 [4]	--
Overhead sign bases, signal pole bases, and bases supporting overhead uses	4000	5-9	>14 [4]	--
Sign bases, misc items	3000	5-9	--	--
Pavement, driveways	4000	5-9	--	ASTM C672 ≤ 2 or ASTM C666 DF ≥ 90%
Pavements - HES	4000 @ 28 days 2500 @ opening	5-9	>16.5	ASTM C672 ≤ 2 or ASTM C666 DF ≥ 90%
Sidewalks, gutters, curbs	4000 psi	5-9	>16.5	ASTM C672 ≤ 2 or ASTM C666 DF ≥ 90%
Barriers	4000 psi	5-9	>16.5	--
Headwalls, drainage elements, pipe inverts	4000 psi	5-9	>16.5	--
Maintenance repair	3000 psi	5-9	>16.5	

NOTES :
1. Mixture proportions will be provided by the contractor, using the fineness modulus and bulk specific gravities (saturated surface dry) of the aggregates proposed for use.
2. Any mixture developed for accelerated strength gain shall have the rate of strength gain evaluated at the time of mixture development. Produce and place a 4.0 cy (minimum) trial batch at an off-contract location selected by the Contractor and agreed upon by the Engineer. Produce the trial batch using the same materials and processes as those to be used to produce concrete for the contract. Provide the Engineer a 7-day minimum advance notification of trial batch production. Produce and place the trial batch in the presence of the Engineer, the Regional Materials Engineer, and/or Materials Bureau personnel.
   - Determine the compressive strength of the trial batch concrete at the desired time as discussed in specification or plans.
   - Provide an American Concrete Institute (ACI) Certified Concrete Field Testing Technician, Grade I, or higher, to measure slump, air content, and unit weight of the trial batch.

The mixture will further have shrinkage testing performed with shrinkage of XXX

3. Resistivity requirements based on 6 X 12 cylinders measured at 28 days. Testing procedures follow AASHTO T358.
4. Any concrete that is buried or submerged in high sulfate and saltwater areas shall be designed for Low Chloride Ion Penetration requirements
5. These mixes only require air content if the finished concrete will be exposed to freeze / thaw environments, defined as being within 4' of the atmospheric conditions

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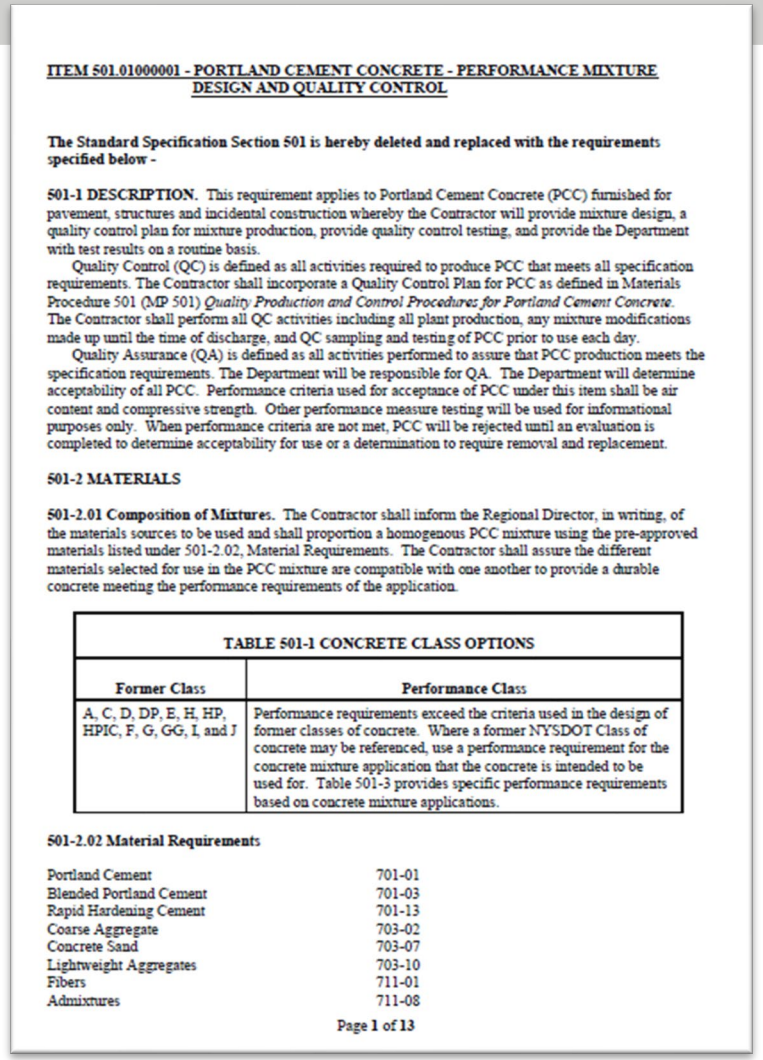
Design Build Project – Special Provisions (SP-9)

- To address design strength needs greater than 3000 psi & longer service life
  - Kew Gardens
  - Hunts Point
  - Van Wyck Expwy
  - Grand Central Parkway

501 Pilot Project Initiative

- Special Specification
  - Supersede Standard Concrete Specifications
  - Standard Construction items
  - Both Structural and Pavement
- PEM Mixture design requirements & performance criteria
- Contractor/Producer QC requirements for production and supply
- Acceptance based on Strength/Air Content
  - Informational testing of SAM & Surface Resistivity
  - Found design SAM Number < 0.2 rarely above 0.3 in field
- Lump Sum Pay Item
  - For Mix Design, QC Plan development, and Plant/Field QC Testing for production and delivery of PCC



ITEM 501.01000001 - PORTLAND CEMENT CONCRETE - PERFORMANCE MIXTURE DESIGN AND QUALITY CONTROL

The Standard Specification Section 501 is hereby deleted and replaced with the requirements specified below -

501-1 DESCRIPTION. This requirement applies to Portland Cement Concrete (PCC) furnished for pavement, structures and incidental construction whereby the Contractor will provide mixture design, a quality control plan for mixture production, provide quality control testing, and provide the Department with test results on a routine basis.

Quality Control (QC) is defined as all activities required to produce PCC that meets all specification requirements. The Contractor shall incorporate a Quality Control Plan for PCC as defined in Materials Procedure 501 (MP 501) *Quality Production and Control Procedures for Portland Cement Concrete*. The Contractor shall perform all QC activities including all plant production, any mixture modifications made up until the time of discharge, and QC sampling and testing of PCC prior to use each day.

Quality Assurance (QA) is defined as all activities performed to assure that PCC production meets the specification requirements. The Department will be responsible for QA. The Department will determine acceptability of all PCC. Performance criteria used for acceptance of PCC under this item shall be air content and compressive strength. Other performance measure testing will be used for informational purposes only. When performance criteria are not met, PCC will be rejected until an evaluation is completed to determine acceptability for use or a determination to require removal and replacement.

501-2 MATERIALS

501-2.01 Composition of Mixtures. The Contractor shall inform the Regional Director, in writing, of the materials sources to be used and shall proportion a homogenous PCC mixture using the pre-approved materials listed under 501-2.02, Material Requirements. The Contractor shall assure the different materials selected for use in the PCC mixture are compatible with one another to provide a durable concrete meeting the performance requirements of the application.

TABLE 501-1 CONCRETE CLASS OPTIONS

Former Class	Performance Class
A, C, D, DP, E, H, HP, HPIC, F, G, GG, I, and J	Performance requirements exceed the criteria used in the design of former classes of concrete. Where a former NYSDOT Class of concrete may be referenced, use a performance requirement for the concrete mixture application that the concrete is intended to be used for. Table 501-3 provides specific performance requirements based on concrete mixture applications.

501-2.02 Material Requirements

Portland Cement	701-01
Blended Portland Cement	701-03
Rapid Hardening Cement	701-13
Coarse Aggregate	703-02
Concrete Sand	703-07
Lightweight Aggregates	703-10
Fibers	711-01
Admixtures	711-08

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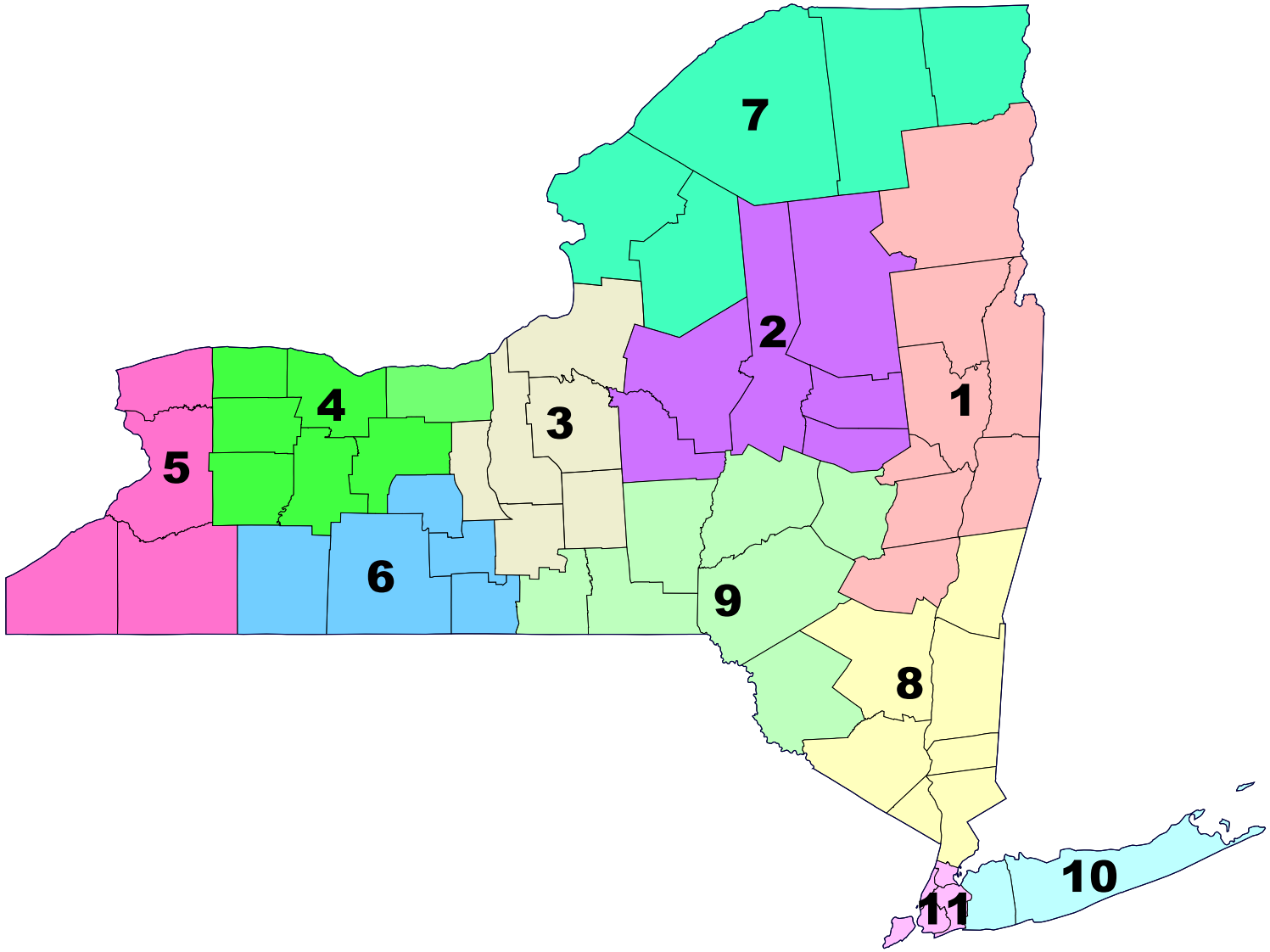
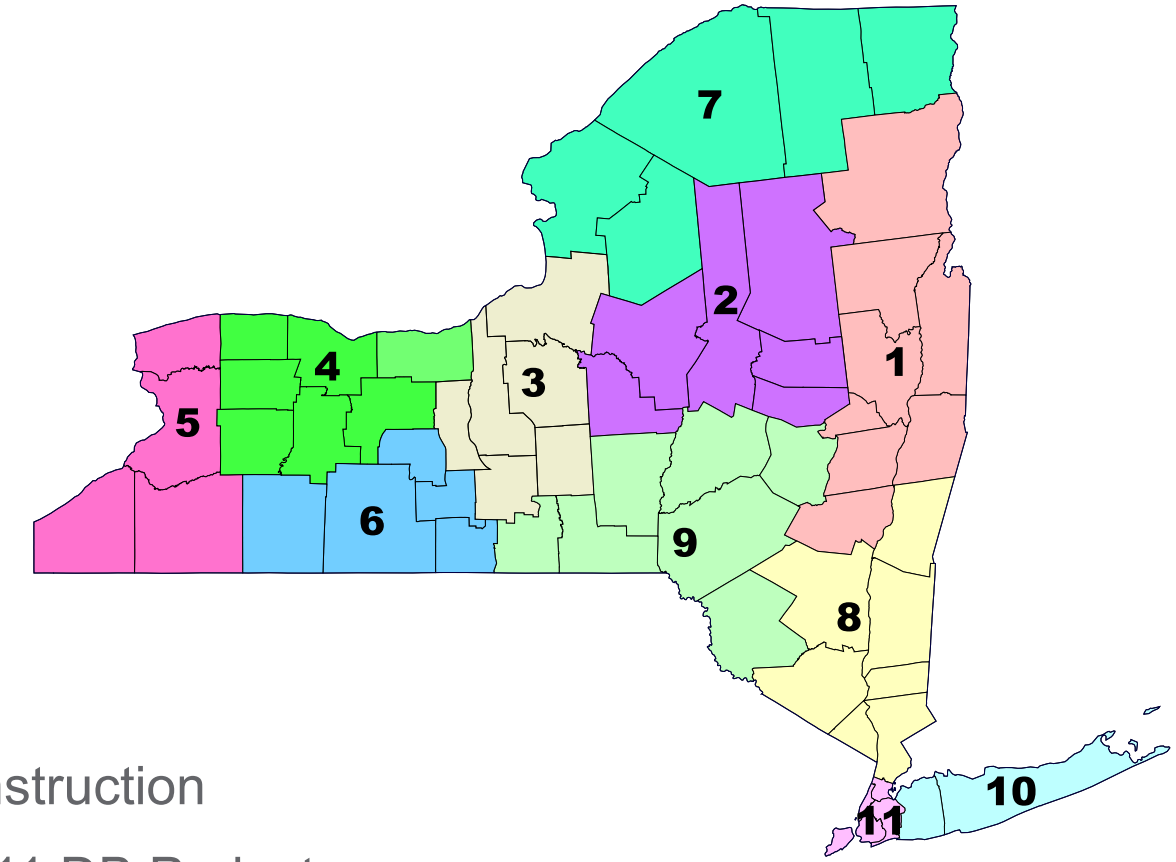
NYSDOT Regions



PEM Pilot Project experience

- Region 1 – (2) pilot projects
- Region 2 – (2) pilot projects
- Region 3 – (1) pilot project
- Region 4 – (1) pilot project - PCC Pavement
- Region 5 – (1) pilot project
- Region 6 – (1) pilot project
- Region 7 – (2) pilot projects
- Region 8 – (1) pilot project - PCC Pavement
- Region 9 – (2) pilot projects done, (1) still in construction
- Region 10 – R10 Producer supplying PEM to R11 DB Project
- Region 11 – (5) DB projects



PEM Trial Project Experience: Compressive Strength

- Compressive strength w/ reduced paste content and optimized aggregate gradation compared well to Standard Class mixtures - *Cement content typically reduced by 10-15% (roughly 40-75 lbs/cy depending on the application).*
- Mixes consistently demonstrated ability to achieve 5000+ psi in 28 days
  - D264040 – 5500 psi (92% above 4000 psi)
  - D264350 – 5550 psi (96% above 4000 psi)
  - D264561 – 5455 psi (100% above 4000 psi)
  - D264366 – 5760 psi (100% above 4000 psi)
  - D264331 – 7260 psi (100% above 4000 psi)
- NYSDOT Standard Class HP over the 3 years before PEM:
  - 5278 psi - 99.5% above 3000 psi

PEM Trial Project Experience: Surface Resistivity

- NYSDOT initially tested over 1400 sets of Standard Class HP cylinders that showed an average 28-day age Surface Resistivity of 39 kΩ-cm.
- For PEM pilot projects:
  - Average Surface Resistivity testing conducted at 28-day age (sub/superstructure application)
    - 34.5 kΩ-cm avg
  - In some instances, the 28-day age Surface Resistivity results did not meet the 30 kΩ-cm requirement, however when carried out to 56 day-age the results met and/or exceeded the requirement.

PEM Trial Project Experience: Sustainability Benefit

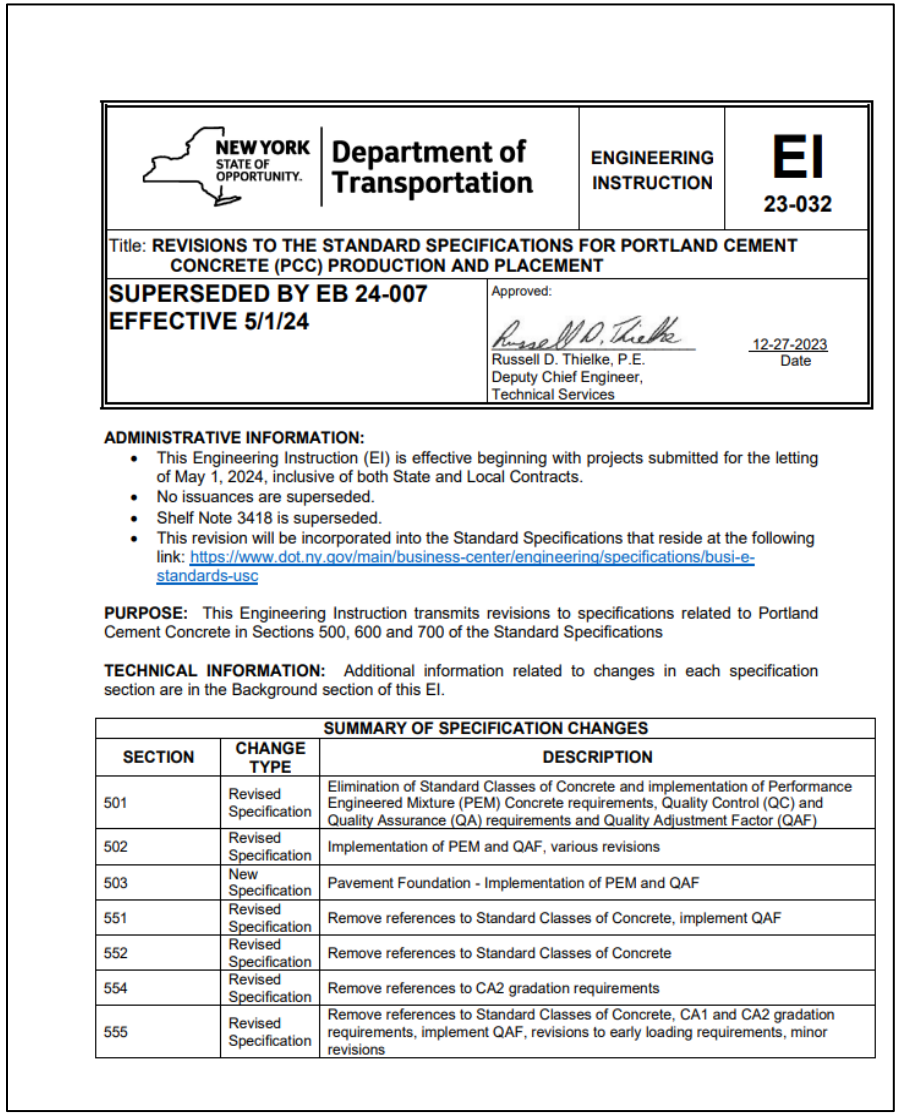
- Optimized aggregate gradation and reduced cement demand per cubic yard add up to significant reductions on a project level.
  - D264040: 38,850lb or 19.4 ton reduction in cement vs. Standard Class Mixes
  - D264331: 17,064lb or 8.5 ton reduction in cement vs. Standard Class Mixes
  - D264350: 82,860lb or 41.4 ton reduction in cement vs. Standard Class Mixes
  - D264366: 27,300lb or 13.7 ton reduction in cement vs. Standard Class Mixes
  - D264564: 49,440lb or 24.7 ton reduction in cement vs. Standard Class Mixes
  - D264561: 61,080lb or 30.5 ton reduction in cement vs. Standard Class Mixes
  - D264630: 70,618lb or 35.3 ton reduction in cement vs. Standard Class Mixes
  - D264871: 42,551lb or 21.3 ton reduction in cement vs. Standard Class Mixes
  - D264882: 255,821lb or 127.9 ton reduction in cement vs. Standard Class Mixes
  - D264988: 16,308lb or 8.2 ton reduction in cement vs. Standard Class Mixes

Lessons Learned

- Gaining familiarity and understanding of Spec requirements and roles/responsibilities of Contractor/Producer/DOT.
- Need to account for longer timeframe to develop initial mix design and perform trial batches, obtain test results etc.
- Contractor acclimation to new mix workability/finishing (witnessing trial batching).
- Coordination of QC activities between Batch Plant / Project Site and Testing Firms.
- Curing and handling of cylinder test samples is very important.

Newly Updated Standard Specifications

- Transmitted via Engineering Instruction 23-032 - *Revisions to the Standard Specifications for Portland Cement Concrete (PCC) Production and Placement*
  - Signed December 2023
  - Effective for all projects let on/after 5/1/24



NEW YORK STATE OF OPPORTUNITY. Department of Transportation | ENGINEERING INSTRUCTION | EI 23-032

Title: REVISIONS TO THE STANDARD SPECIFICATIONS FOR PORTLAND CEMENT CONCRETE (PCC) PRODUCTION AND PLACEMENT

SUPERSEDED BY EB 24-007
EFFECTIVE 5/1/24

Approved:
Russell D. Thielke, P.E.
Deputy Chief Engineer,
Technical Services
12-27-2023
Date

ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective beginning with projects submitted for the letting of May 1, 2024, inclusive of both State and Local Contracts.
- No issuances are superseded.
- Shelf Note 3418 is superseded.
- This revision will be incorporated into the Standard Specifications that reside at the following link: https://www.dot.ny.gov/main/business-center/engineering/specifications/busi-e-standards-usc

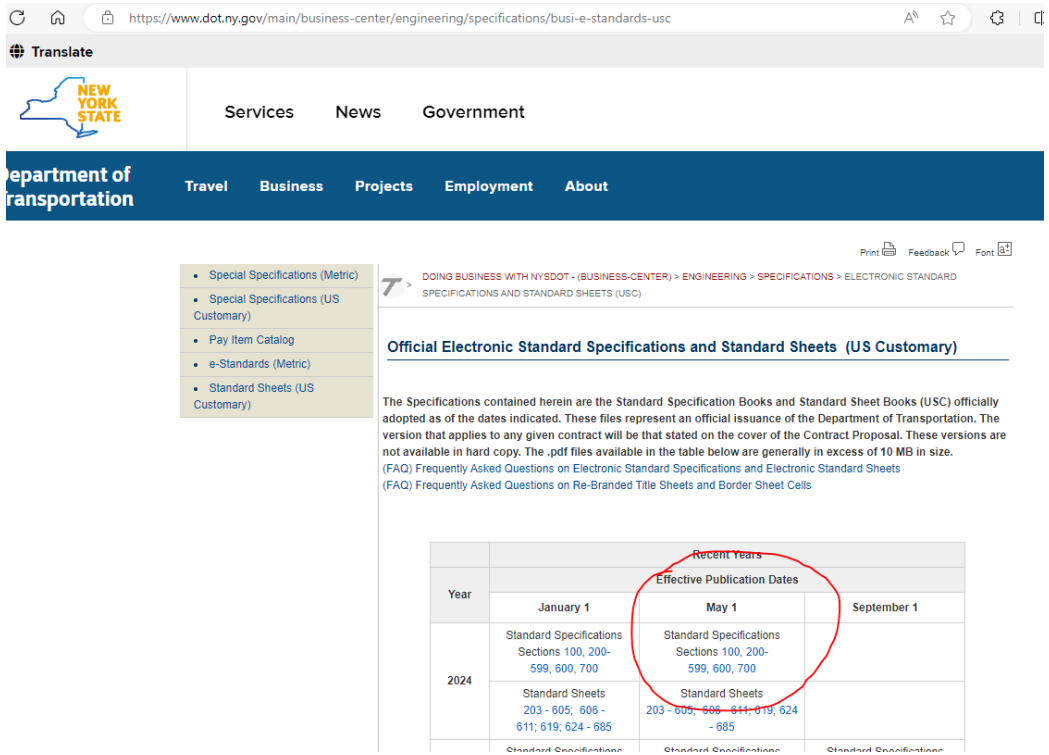
PURPOSE: This Engineering Instruction transmits revisions to specifications related to Portland Cement Concrete in Sections 500, 600 and 700 of the Standard Specifications

TECHNICAL INFORMATION: Additional information related to changes in each specification section are in the Background section of this EI.

SUMMARY OF SPECIFICATION CHANGES

SECTION	CHANGE TYPE	DESCRIPTION
501	Revised Specification	Elimination of Standard Classes of Concrete and implementation of Performance Engineered Mixture (PEM) Concrete requirements, Quality Control (QC) and Quality Assurance (QA) requirements and Quality Adjustment Factor (QAF)
502	Revised Specification	Implementation of PEM and QAF, various revisions
503	New Specification	Pavement Foundation - Implementation of PEM and QAF
551	Revised Specification	Remove references to Standard Classes of Concrete, implement QAF
552	Revised Specification	Remove references to Standard Classes of Concrete
554	Revised Specification	Remove references to CA2 gradation requirements
555	Revised Specification	Remove references to Standard Classes of Concrete, CA1 and CA2 gradation requirements, implement QAF, revisions to early loading requirements, minor revisions

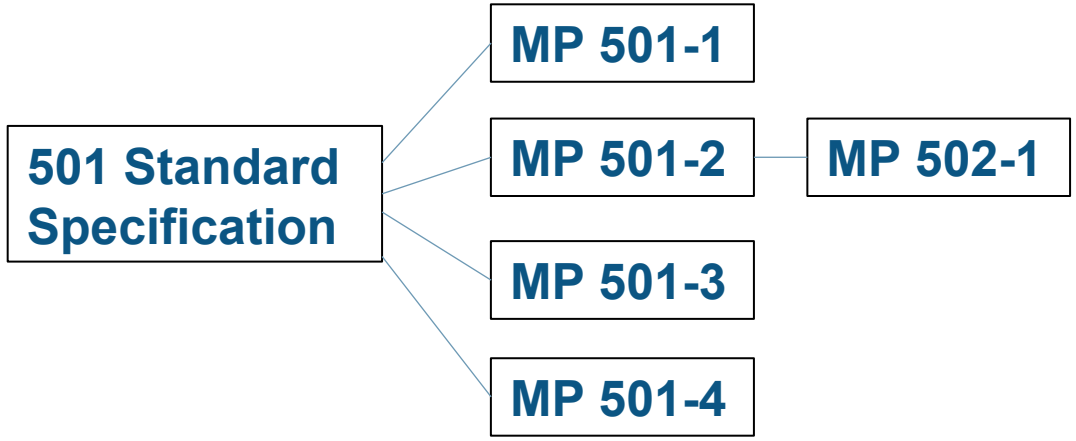
Updated Standard Specification Sections



501 - PORTLAND CEMENT CONCRETE - GENERAL
502 - PORTLAND CEMENT CONCRETE PAVEMENT
503 - PORTLAND CEMENT CONCRETE FOUNDATION FOR PAVEMENT
551 - DEEP FOUNDATION INSTALLATION AND TESTING
552 - EXTERNALLY STABILIZED CUT STRUCTURES
554 - FILL TYPE RETAINING WALLS
555 - STRUCTURAL CONCRETE
557 - SUPERSTRUCTURE SLABS, SIDEWALKS ON BRIDGES, AND STRUCTURAL APPROACH SLABS
562 - REINFORCED CONCRETE THREE-SIDED STRUCTURES
567 - BRIDGE JOINT
569 - PERMANENT CONCRETE TRAFFIC BARRIER FOR STRUCTURES
579 - STRUCTURAL SLAB RECONSTRUCTION PREPARATION
582 - REMOVAL AND REPLACEMENT OF STRUCTURAL CONCRETE
584 - SPECIALIZED OVERLAYS FOR STRUCTURAL SLABS
602 - REHABILITATION OF CULVERT AND STORM DRAIN PIPE
604 - DRAINAGE STRUCTURES
606 - GUIDE RAILING, MEDIAN BARRIER, AND CONCRETE BARRIER
607 - FENCES
608 - SIDEWALKS, DRIVEWAYS, BICYCLE PATHS, AND VEGETATION CONTROL STRIPS
609 - CURB AND CURB & GUTTER
619 - WORK ZONE TRAFFIC CONTROL
624 - PAVED GUTTERS
625 - SURVEY OPERATIONS
644 - OVERHEAD SIGN STRUCTURES
645 - SIGNS
654 - IMPACT ATTENUATORS - PERMENANT
663 - WATER SUPPLY UTILITIES
670 - HIGHWAY LIGHTING SYSTEM
680 - TRAFFIC SIGNALS
701 - HYDRAULIC CEMENTS
704 - MASONRY UNITS
710 - FENCE AND GUIDE RAIL
718 - PRESTRESSED CONCRETE UNITS
729 - TEMPORARY TRAFFIC CONTROL DEVICES

PEM PCC Program Specification Documents

- New Standard Specification Section 501 - Portland Cement Concrete Production with corresponding new Materials Procedures (MP)
  - **MP 501-1** Plant Production Requirements & Procedures for Portland Cement Concrete (PCC) Facilities
  - **MP 501-2 -** Mix Design & Approval Procedure for Performance Engineered Mixtures – Structural Concrete
    - **MP 502-1** Design & Approval of Performance Engineered Mixes for Concrete Pavement
  - **MP 501-3 -** Quality Control – Plant and Field Inspection for Portland Cement Concrete (PCC)
  - **MP 501-4 -** Quality Assurance - Field Inspection of Portland Cement Concrete



Materials Procedure (MP) 501-1
PCC and Plant Production Requirements

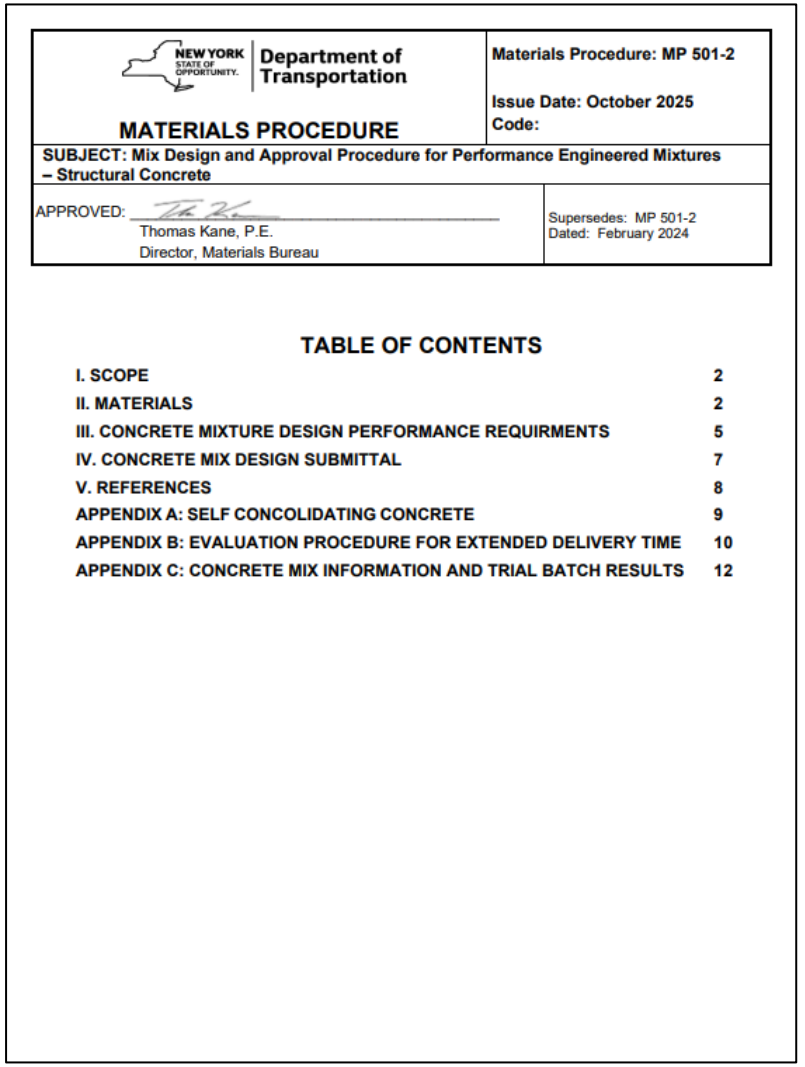
- Directed to the “Producer” and outlines their responsibilities.
- All PCC Production facility requirements are located here.
- NRMCA and/or Self Certification with DOT Audit/Verification.

Effective January 1st, 2025:

- Each permanent PCC Production Facility shall have a minimum of two approved Performance Engineered Mixtures (PEM) designed and able to supply to remain on the Department’s Approved List.
  - One mixture design shall be for a 555/557 use application (Substructure/Superstructure) and the second mixture design at the Producer’s option.
  - Producers which do not meet these requirements will only be approved to supply contracts awarded prior to 5/1/24 that utilize Standard Class Mixtures. For such projects, Department inspection will continue at both the Plant and Field / Project site.

Materials Procedure (MP) 501-2 & 502-1
PEM Mix Design & Approval (Structural & Concrete Pavement)

- Directed to the “Mix Designer” (Producer and/or Contractor)
- Mix design performance criteria and related requirements are located here
  - Mixture Design, Evaluation, and Submission Process
  - SCC Trial Criteria
  - Extended Haul Time Evaluation Procedures
    - Up to 120 min time to discharge allowed for mixtures which utilize water reducing and retarding admixture
    - Evaluation at 30 min. time increments



NEW YORK STATE OF OPPORTUNITY. Department of Transportation

Materials Procedure: MP 501-2

Issue Date: October 2025
Code:

MATERIALS PROCEDURE

SUBJECT: Mix Design and Approval Procedure for Performance Engineered Mixtures – Structural Concrete

APPROVED:
Thomas Kane, P.E.
Director, Materials Bureau

Supersedes: MP 501-2
Dated: February 2024

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Prescriptive

TABLE 501-3 CONCRETE MIXTURES Design Mix Guidelines (where sand fineness modulus = 2.80)[4]							
Concrete Class	T.C.M.[5] Content (lb/cy)	Sand % Total Agg. (solid volume)	Water/ cement-itious mat'ls (by weight)	Air Content % desired (Range)	Slump Range (in)	Type of Coarse Aggregate Gradation	Primary Use
A	606	36.2	0.46	6.5 (5.0 - 8.0)	2 1/2 - 3 1/2	CA 2	general purpose structural
C[6]	605	35.8	0.44	6.5 (5.0 - 8.0)	1 - 3	CA 2	Pavement: slipform paving, form paving
D	725	45.8	0.44	7.5 (6.0 - 9.0)	2 1/2 - 3 1/2	CA 1	thin structural applications
DP[2]	725	45.8	0.40	7.5 (6.0 - 9.0)	3 - 5	CA 1	thin structural applications, overlays
E	648	35.8	0.44	6.5 (5.0 - 8.0)	3 - 4	CA 2	structural slabs and structural approach slabs
F	716	34.6	0.38	6.5 (5.0 - 8.0)	2 - 3	CA 2	high early strength for pavement or structural applications
G[3]	727	45.0	0.45	6.0 (4.0 - 8.0)	6 - 7	CA 2	underwater
GG[3]	800	45.0	0.45	6.0 (4.0 - 8.0)	6 - 7	CA 1	underwater (special)
H	675	40.0	0.44	6.5 (5.0 - 8.0)	3 - 4	CA 2	pumping applications
HP[2]	675	40.0	0.40	6.5 (5.0 - 8.0)	3 - 5	CA 2	pumping, structural slabs, approach slabs, substructures exposed to chlorides
I[4]	640	41.0	0.44	6.0 (4.0 - 8.0)	1/2 - 1 1/2	CA 2	slip forming highway median barriers
J[4]	680	45.8	0.44	6.0 (4.0 - 8.0)	1/2 - 1 1/2	CA 1	slip forming structural median barriers, parapet walls and curbs

PEM

TABLE 2 CONCRETE MIXTURES Design Mix Performance Criteria The air content shall be between 5.0% - 10.0%, and 4% - 10% when slipformed Mixes shall have a minimum compressive strength of 4000 psi Freeze-Thaw Durability by ASTM C666 (DF>90%), AASHTO T395 (SAM of 0.20 or less) or ASTM C457 (Spacing Factor ≤0.008 inches)		
Primary Application / use	Surface Resistivity (kΩ-cm) α = 1.5	Shrinkage (AASHTO R101)
557 – Internal Cure Bridge Decks, Approach Slabs, Sidewalk/Safety Walk on Decks 555 – Substructures: Abutments, Back Walls, Wing Walls, Columns, Pier Caps, Pedestals* 562 – Three Sided Structures* 567 – Bridge Joint*	≥30	Paste Factor ≤ 27%
584 – Thin structural applications, Overlays*	≥30	Paste Factor ≤ 30%
569 – Bridge Barrier* 606 – Concrete Barrier	≥21	Paste Factor ≤ 27%[1]
551 & 552- Piles, Drilled Shafts, Underground Applications, Soldier Piles[2] 554 – Fill Type Retaining Walls 555 – Footings* 579 – Structural Slab Reconstruction 582 – Remove/Replace Structural Concrete 602 – Culvert/Drain Rehabilitation 603 – Culverts and Storm Drains (Cast In Place) 604 – Drainage Structures (Cast In Place) 644 – Overhead Sign Structures 654 – Impact Attenuators 670 – Highway Lighting Systems 680 – Traffic Signal & Overhead Bases	≥18	Paste Factor ≤ 27%[1,3]
608 – Sidewalks 609 – Curb and Gutter (when casting the curb or gutter) 624 – Gutters (when casting the gutter)	≥18	Paste Factor ≤ 30%
Misc. Items including: 607 – Fences, 619-WZTC, 625 – Survey Operations, 645- Signs, 663 – Water Supply Utilities, 710 – Fence/Guide Rail, 729 – Temp. Traffic Devices, Maintenance Repair, Curb Backing	Note 4	Note 4

Notes

1. The paste factor for mixes containing a NMAS ≤ ½" may be increased to ≤ 30%.
2. 551 and 552 concrete are exempt from freeze-thaw requirements as they are subsurface placements
3. Paste Factor criteria may be increased to ≤ 33% for underwater/tremie applications.
4. The minimum 28-day compressive strength shall be 3000 psi with a maximum w/c ratio of 0.45. Freeze-Thaw Testing, Surface Resistivity and Shrinkage requirements do not apply.

*May be specified as Internal Cure Concrete in the Contract Plans

MP 502-1 For PEM Pavement

Table 1 Concrete Mixtures
Design Mix Performance Criteria

Application	Minimum Compressive Strength (psi)[1]	Flexural Strength (psi)	Air Content % (range)	56 Day Resistivity (kΩ-cm)	Freeze-Thaw Durability (ASTM C666 or AASHTO T395 or ASTM C457)[2]	Edge Slump[3] (AASHTO T396)	Surface Voids[3] (AASHTO T396)	Paste Volume (AASHTO R101)
502- PCC Pavements	3000	600	5.0-10.0[4]	≥16.5	DF ≥ 90% **or** SAM ≤ 0.20 **or** Spacing Factor ≤ 0.008"	<.25"	<30%	25%
503- PCC Pavement Foundations	3000	600	5.0-10.0[4]	N/A	N/A	<.375"	<30%	27%

1. Compressive strength will be evaluated at 28 days. The mixture shall meet the requirements of §502-3.16, *Opening to Traffic,* within the time specified in the contract for opening prior to opening to traffic.
2. Freeze-Thaw test selected is at the discretion of the producer.
3. The requirements of AASHTO T396 shall apply for slipform applications.
4. For slipformed concrete, the air content range is 4% to 10%.

Concrete Mix Design Submittal

- Trial batches are required for initial mix approval
- Approval lasts until the mix undergoes a change
- Mix design needs to be submitted 60 days prior to placement
  - Goal was to have producers with mixes on the shelf
- NYSDOT has been helping producers
  - Offering comments or advice prior to a trial
  - Assisting at the trial with SAM and SR testing

Concrete Mix Design Submittal

- Concrete mixture proportions
- Material sources. Include fineness modulus and specific gravities for all aggregates.
- Individual gradation analysis report for each coarse, intermediate, and fine aggregate and the combined aggregate gradation of mixture
- Optimized aggregate gradation method being used (ie: Tarantula curve, Shilstone, 8-18 rule, etc.) with accompanying spreadsheet or graphical assessment.
- Paste volume calculations for mixture.
- Compressive strength test results at 3, 7, 14 and 28 days and any additional age required for the intended application.
- Target slump of placement(s)
- Target air content of plastic concrete
- Slump from trial batch
- Air content from trial batch
- Super Air Meter (SAM) number results, Freeze-Thaw testing results associated with the trial mix or Spacing Factor.
- Surface Resistivity test data from trial batch
- Concrete maturity test data if applicable

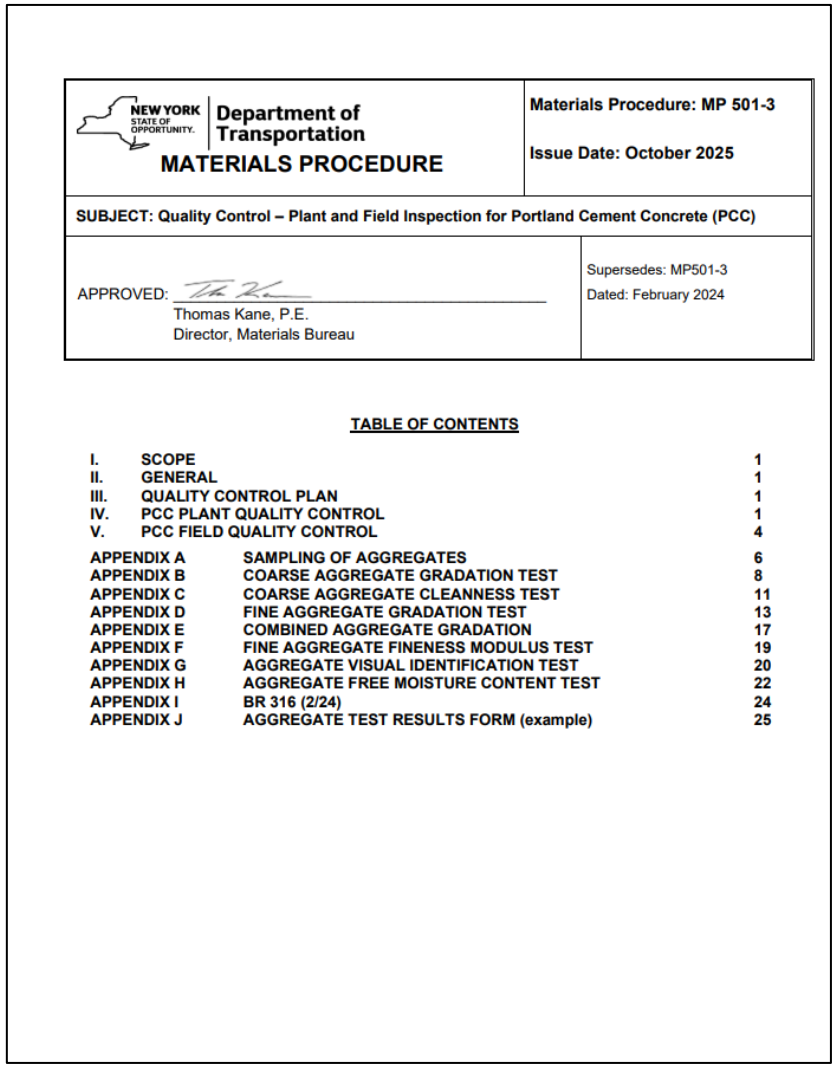
Quality Control and Quality Assurance

- Quality Control is outlined in MP501-3
  - QC at the plant
  - QC at the field
  - Job is to ensure quality concrete is being produced

- Quality Assurance is outlined in MP 501-4
  - QA is always in the field
  - QA is acceptance
  - Payment is based on QA test results

Materials Procedure (MP) 501-3
Quality Control – Plant and Field Inspection for PCC

- Directed to the “Contractor”
- QC Testing requirements are located here
  - Minimum frequencies – Same as Pre-PEM
    - Moistures / Gradations
    - Field Testing
    - QC Plan requirements



NEW YORK STATE OF OPPORTUNITY. Department of Transportation

MATERIALS PROCEDURE

Materials Procedure: MP 501-3

Issue Date: October 2025

SUBJECT: Quality Control – Plant and Field Inspection for Portland Cement Concrete (PCC)

APPROVED:

Thomas Kane, P.E.
Director, Materials Bureau

Supersedes: MP501-3
Dated: February 2024

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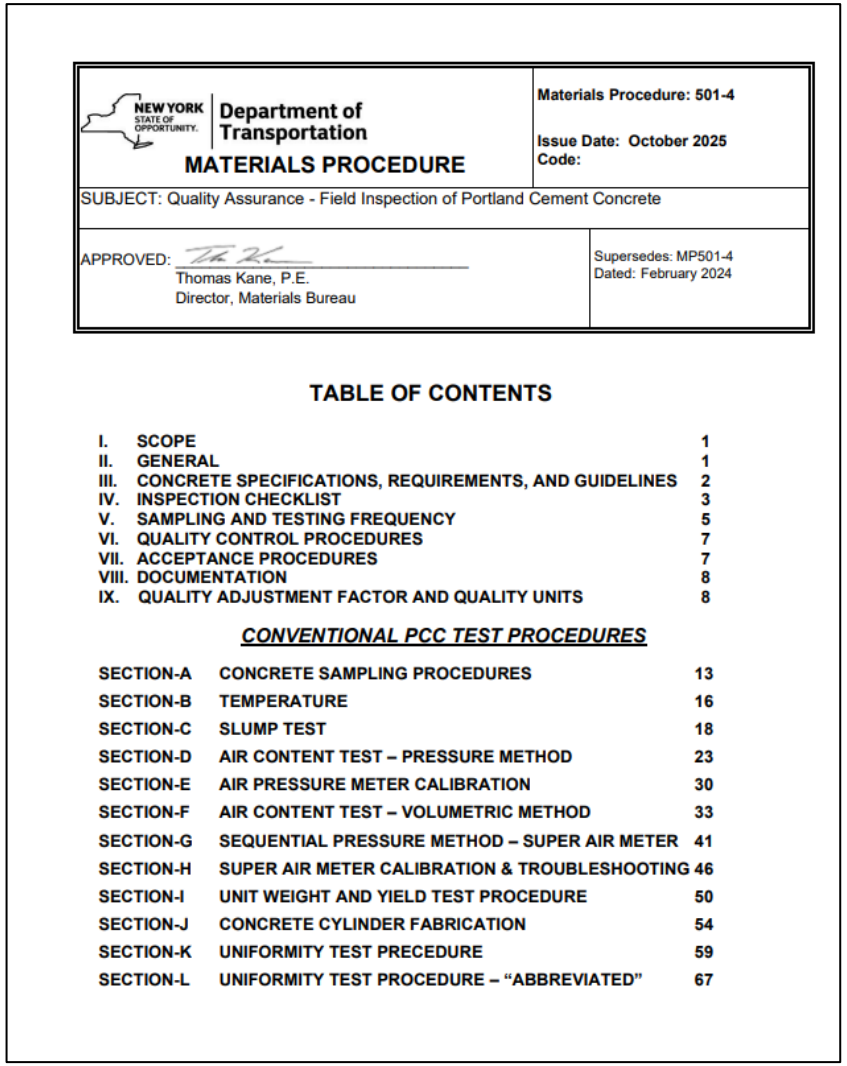
MP 501-3

- QC Site Responsibilities
  - ACI Certified
  - Truck revolutions and haul times
  - Correct mix delivered to site
  - Concrete temperature, slump, air, and unit weight
  - Cylinders if needed for early open or form removal
    - Cylinders are sets of three for 4”x8” compression

MP 501-4

- QA Site Responsibilities
  - ACI Certified or NYSDOT In-House Certified
  - Two types of acceptance
    - Cylinder Series - Air, Temperature and Cylinders (compression & SR)
    - Control Series - Air and Temperature
  - Based on the item and ability to cure properly



NEW YORK STATE OF OPPORTUNITY. Department of Transportation

MATERIALS PROCEDURE

Materials Procedure: 501-4

Issue Date: October 2025

Code:

SUBJECT: Quality Assurance - Field Inspection of Portland Cement Concrete

APPROVED: _____

Thomas Kane, P.E.
Director, Materials Bureau

Supersedes: MP501-4
Dated: February 2024

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MP 501-4 Quality Adjustment

PCC Quality Adjustments introduced – as similar to our Asphalt Program.

Compressive Strength and Surface Resistivity testing results are applicable to Quality Adjustments, in accordance with Section IX of MP 501-4 and Section 501-5 of the Standard Specifications:

IX. QUALITY ADJUSTMENT FACTOR AND QUALITY UNITS

When a PEM project is put out to bid and a quality adjustment will apply, there will be a line item included called Fixed Price Quality Adjustment. This line item will have an initial quantity of 1 that will be adjusted based on the results of concrete cylinder compressive strength testing and surface resistivity testing. The fixed price is set based on the value of the item and the amount of concrete that will be placed for that item. The concrete applications that contain a Fixed Price Quality Adjustment item are listed below.

Section 502 – Concrete Pavement

Section 551 – Deep Foundations
Section 555 - Structural Concrete
Section 557 - Superstructure Slabs
Section 562 - Reinforced Concrete
Section 567 – Bridge Joints
Section 569 - Barrier for Structures
Section 584 - Specialized Overlays
Section 644 - Overhead Sign Structures
Section 670 - Highway Lighting Systems
Section 680 - Traffic Signals

The Quality Adjustment Factor (QAF) is calculated using the formulas from Standard Specification §501-5 B, Table 501-4, QAF Determination.

501-5 DETERMINATION OF QUALITY ADJUSTMENT

A. Quality Assurance (QA) Evaluation of Test Results. Acceptance sampling and testing will be completed in accordance with §501-3.08 and Table 501-3- Quality Assurance Frequency. The values for average concrete cylinder compressive strength ($F_{C\ Average}$) and the average concrete cylinder surface resistivity ($SR_{Average}$) for that day will be used to calculate the adjustment factor.

B. Calculation of Quality Adjustment Factor (QAF). The project design strength ($F_{c\ Design}$) and design surface resistivity (SR_{Design}) values will be compared to the QA test results using the formulas given in Table 501-4, QAF Determination.

Table 501-4 QAF Determination

Quality Adjustment Factor F_c (28 Day)	Quality Adjustment Factor SR (56 Day)
$1.25 * \left(\frac{F_{C\ Average}}{F_{c\ Design}} - 1\right) * 100 = QAF\_F_C$ [1]	$0.416 * \left(\frac{SR_{Average}}{SR_{Design}} - 1\right) * 100 = QAF_{SR}$ [1]

Note 1: Quality Adjustment Factors greater than zero will be rounded down to zero for computation of quality units. Quality Adjustment Factors less than zero will be rounded to the nearest tenth.

C. Quantity of Quality Units. Quality Units will be determined using the formula shown in Table 501-5, Quantity of Quality Unit Determination. Cubic yards placed will be the total cubic yards placed per item, per day, represented by the cylinders cast during that placement.

Table 501-5 Quantity of Quality Units Determination

QAF_F_C * Cubic Yards Placed + QAF_{SR} * Cubic Yards Placed = Quantity of Quality Units[1]

Note 1. The quantity of quality units will be rounded to the nearest tenth.
Noe 2. Refer to MP 501-4 for additional information on Quality Adjustment Factor (QAF) determination.

Cost per yard

- Prices currently vary
- Need more time to develop accurate cost data
- Costs were expected to go up - price now includes QC
- Wide range of pricing similar to the roll out of Class HP
- Producers need time to get more comfortable

NYSDOT PEM Specification

How is it performing?

PEM Performance – Structural Concrete

PEM is Performing Well in Compression

- As of March 6, 1158 sets of PEM cylinders were tested
- 94.7% compression sets were above 4000 psi
- 28-Day strengths averaged 5475 psi
  Maximum: Two sets broke over 10,000 psi
  Min: 2300 psi
  Only 28 sets were below 3600 psi (97.6% pass / adjustment range)
  Other than 6 outliers, all were above 3000 psi
- Air content averaged 7.0%

PEM Performance – Structural Concrete

PEM is Performing Well in Surface Resistivity

- As of March 6, 1094 sets of PEM cylinders were tested
- 94.8% of SR sets were above targets (1037 sets)
- Of the 5.2% that did not meet the target, all but 2 were within 70% of the SR target
- In line with compression testing passing rate

PEM Performance – Pavement Concrete

PEM is Performing Well in Pavement

- 118 sets have been tested in Compression
- 97.5% were above 4000 psi at 28 days
- 100% were above 3000 psi at 28 days (target)

- 93 sets were tested for Surface Resistivity
- 91 sets exceed target (97%), 2 were just below target

Was Switching to PEM really THAT perfect?

Unfortunately, No

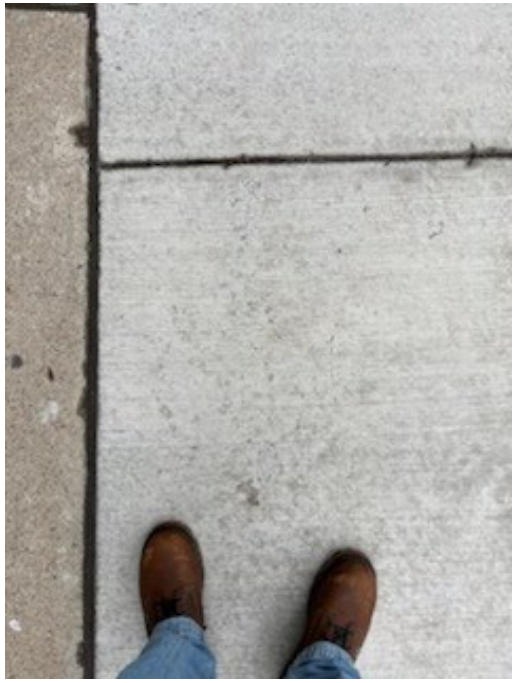
- Until recently, three scaling sidewalks could be explained
  - Mobile mixer issues with unstable air
  - A specific mix with low workability/finishing issues

- The weather got warm and all the snow melted
  - Reports of spalled sidewalks in three Regions on several projects
  - Multiple producers and multiple contractors
  - Investigation has just begun

- Worth noting, sidewalk scaling is an issue in NYC this spring
  - They do not use our specs
  - They pour a lot of sidewalks, same mix for years

Same Project, Same Mix, Same Contractor

Previous Class Mix – Also Last Year



Ongoing Forensic Investigation

- Most Issues in 2 of 11 Regions so far
- Multiple mixes from multiple producers
- Multiple contractors/concrete finishers
- Going through tickets, placement dates, mix designs
- Will be taking cores for petrography
- An Engineer in Buffalo noted the Region's best performing sidewalks were:
  - Late season placements
  - Quick and heavily application of curing compound
  - Blanketed

Bailey on her personal couch

Questions?

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