NYSDOT Performance Engineered Concrete Mixes NESMEA

2022

Dan Dennis, PE & Adam Miller
Materials Engineering Bureau – Field Engineering I Section

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

Meeting Outline

Share our recent experience with Performance Engineered Mixtures and the opportunities they present toward achieving better performing and more sustainable concrete.

Performance Engineered Mixtures (PEM)

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

  - CP Tech Center

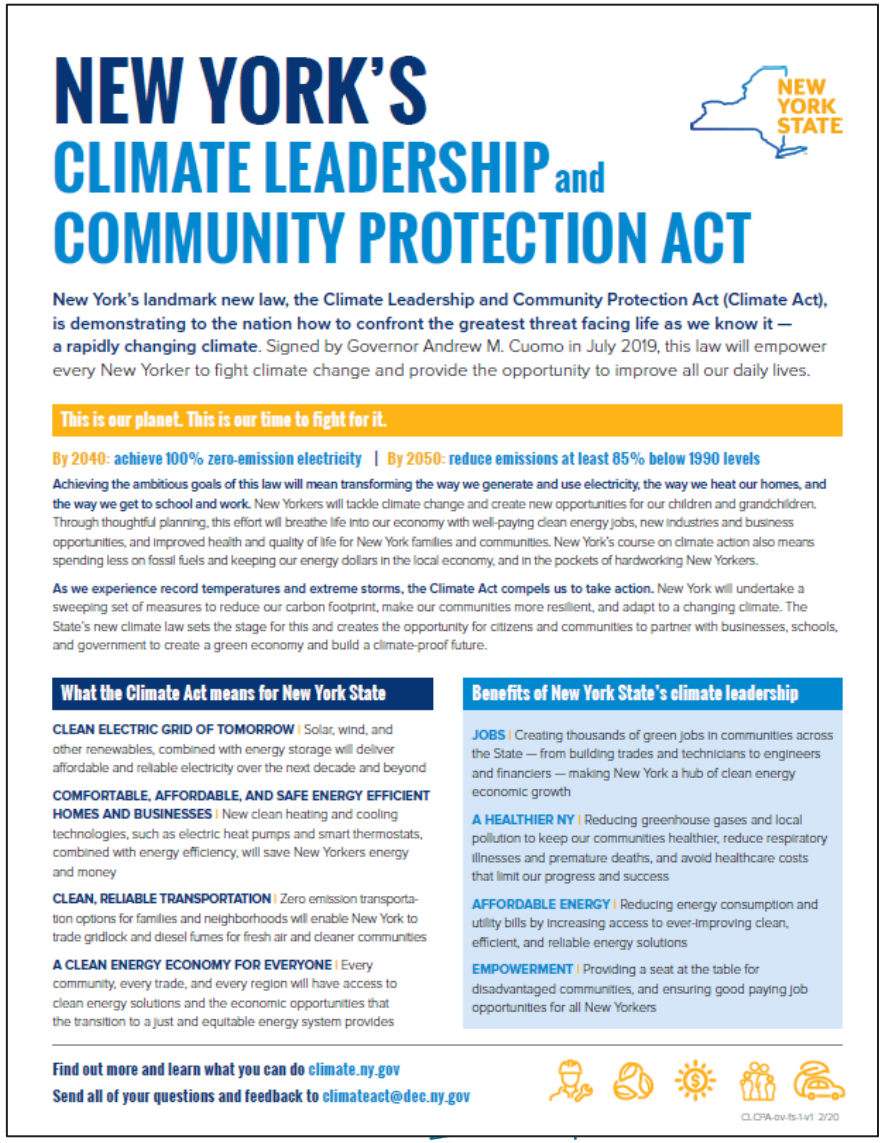
Why PEM, why now?

- Our Existing Concrete Specifications (ie: Section 501) “outdated”
  - Prescriptive Based Standard Class mixtures (3000 psi)
  - Specialty Applications (Design Build / Signature Structures) require higher strength, increased performance that preclude use of standard class mixtures
  - Raw material / cost saving opportunities
  - Taking better advantage of Contractor/Producer experience/innovation

We need a model that can accommodate better performing & more sustainable mixtures (reduced carbon footprint)

Climate Leadership & Community Protection Act (CLCPA)

- Impact on the PCC Materials Arena
  - Use of more sustainable mixtures – reduced cement use
  - Consideration of recycled/alternate type material use that have consistent properties, when appropriate
  - Ensure safety, durability, overall performance



NEW YORK'S
CLIMATE LEADERSHIP and
COMMUNITY PROTECTION ACT

NEW YORK STATE

New York's landmark new law, the Climate Leadership and Community Protection Act (Climate Act), is demonstrating to the nation how to confront the greatest threat facing life as we know it — a rapidly changing climate. Signed by Governor Andrew M. Cuomo in July 2019, this law will empower every New Yorker to fight climate change and provide the opportunity to improve all our daily lives.

This is our planet. This is our time to fight for it.

By 2040: achieve 100% zero-emission electricity | By 2050: reduce emissions at least 85% below 1990 levels

Achieving the ambitious goals of this law will mean transforming the way we generate and use electricity, the way we heat our homes, and the way we get to school and work. New Yorkers will tackle climate change and create new opportunities for our children and grandchildren. Through thoughtful planning, this effort will breathe life into our economy with well-paying clean energy jobs, new industries and business opportunities, and improved health and quality of life for New York families and communities. New York's course on climate action also means spending less on fossil fuels and keeping our energy dollars in the local economy, and in the pockets of hardworking New Yorkers.

As we experience record temperatures and extreme storms, the Climate Act compels us to take action. New York will undertake a sweeping set of measures to reduce our carbon footprint, make our communities more resilient, and adapt to a changing climate. The State's new climate law sets the stage for this and creates the opportunity for citizens and communities to partner with businesses, schools, and government to create a green economy and build a climate-proof future.

What the Climate Act means for New York State

CLEAN ELECTRIC GRID OF TOMORROW | Solar, wind, and other renewables, combined with energy storage will deliver affordable and reliable electricity over the next decade and beyond

COMFORTABLE, AFFORDABLE, AND SAFE ENERGY EFFICIENT HOMES AND BUSINESSES | New clean heating and cooling technologies, such as electric heat pumps and smart thermostats, combined with energy efficiency, will save New Yorkers energy and money

CLEAN, RELIABLE TRANSPORTATION | Zero emission transportation options for families and neighborhoods will enable New York to trade gridlock and diesel fumes for fresh air and cleaner communities

A CLEAN ENERGY ECONOMY FOR EVERYONE | Every community, every trade, and every region will have access to clean energy solutions and the economic opportunities that the transition to a just and equitable energy system provides

Benefits of New York State's climate leadership

JOBS | Creating thousands of green jobs in communities across the State — from building trades and technicians to engineers and financiers — making New York a hub of clean energy economic growth

A HEALTHIER NY | Reducing greenhouse gases and local pollution to keep our communities healthier, reduce respiratory illnesses and premature deaths, and avoid healthcare costs that limit our progress and success

AFFORDABLE ENERGY | Reducing energy consumption and utility bills by increasing access to ever-improving clean, efficient, and reliable energy solutions

EMPOWERMENT | Providing a seat at the table for disadvantaged communities, and ensuring good paying job opportunities for all New Yorkers

Find out more and learn what you can do climate.ny.gov
Send all of your questions and feedback to climateact@dec.ny.gov

CLCPA-ov-fs-1-v1 2/20

Our current PCC Standard Specification

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

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

TABLE 501-3 CONCRETE MIXTURES[1]

Primary Application / use[2]	Design Mix Performance Criteria: Compressive Strength (psi)	Air Content % desired (range)	Resistivity[3] (kΩ-cm) α = 1.5	Specialty Criteria[4]: Scaling, freeze/thaw, or shrinkage requirements
Superstructures: bridge decks, approach slabs, sidewalk and safety walk on decks, concrete barrier	4000	5-9	>30	Qualify mix using ASTM C672 ≤ 2 **or** ASTM C666 with DF ≥ 90% **or** AASHTO TP 118 ≤ 0.20 **and** paste factor ≤ 25% per AASHTO PP-84
Substructures[7]: abutments, backwalls, wing walls, columns, pier caps, pedestals	4000	5-9	>30	ASTM C666 with DF ≥ 90% **or** AASHTO TP 118 ≤ 0.20 **and** paste factor ≤ 25% per AASHTO PP-84
Footings[7]	4000	5-9[5]	>18[6]	--
Piles, drilled shafts, underground applications	4000	5-9[5]	>18[6]	--
Tremie	4000	5-9[5]	>18[6]	--
Overhead sign bases, signal pole bases, and bases supporting overhead uses	4000	5-9	>18[6]	ASTM C666 DF ≥ 90% **or** AASHTO TP 118 ≤ 0.20
Sign bases, misc. items	3000	5-9	--	--
Pavement	4000	5-9	>21	ASTM C672 ≤ 2 **or** ASTM C666 DF ≥ 90% **or** AASHTO TP 118 ≤ 0.20
Sidewalks, gutters, curbs	4000	5-9	>21	ASTM C672 ≤ 2 **or** ASTM C666 DF ≥ 90% **or** AASHTO TP 118 ≤ 0.20
Barriers	4000	5-9	>21	ASTM C666 DF ≥ 90% **or** AASHTO TP 118 ≤ 0.20
Headwalls, drainage elements, pipe inverts	4000	5-9	>18	ASTM C666 DF ≥ 90% **or** AASHTO TP 118 ≤ 0.20
Maintenance repair	3000	5-9	>18	--

NOTES:

1. Mixture proportions shall be provided by the Contractor, using the fineness modulus and bulk specific gravities (saturated surface dry) of the aggregates proposed for use, and included as appendices to the Contractors QC Plan.
2. Any mixture developed for accelerated strength gain shall have the rate of strength gain evaluated at the time of mixture development. The Contractor shall 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. The trial batch shall use the same materials and processes as those to be used to produce concrete for the contract. The Contractor shall provide the Engineer a 14-day minimum advance notification of trial batch production and shall produce and place the trial batch in the presence of the Engineer, the Regional Materials Engineer, and Materials Bureau personnel. The Contractor shall:
   - Determine the compressive strength of the trial batch concrete at the desired time as specified in the specification or plans.

Direction Forward

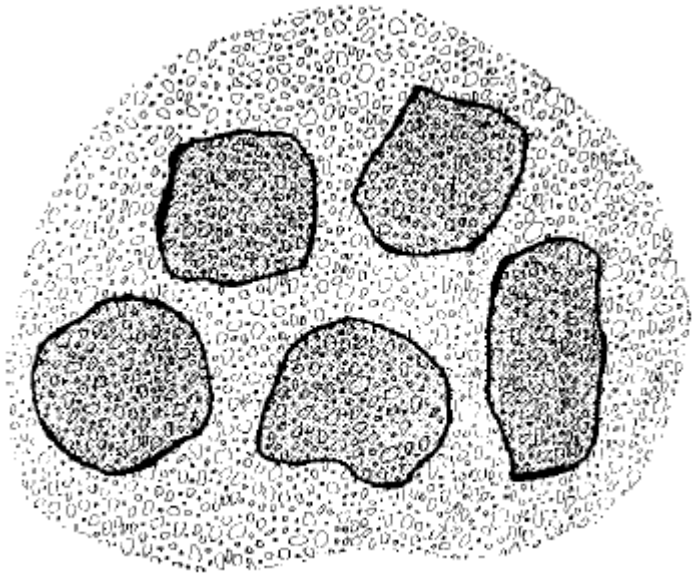
- Performance criteria specified in lieu of mix proportions
- Slump & w/c ratio removed as acceptance criteria
- Introduce new performance measures
  - Strength, Resistivity and Super Air Meter (SAM)

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

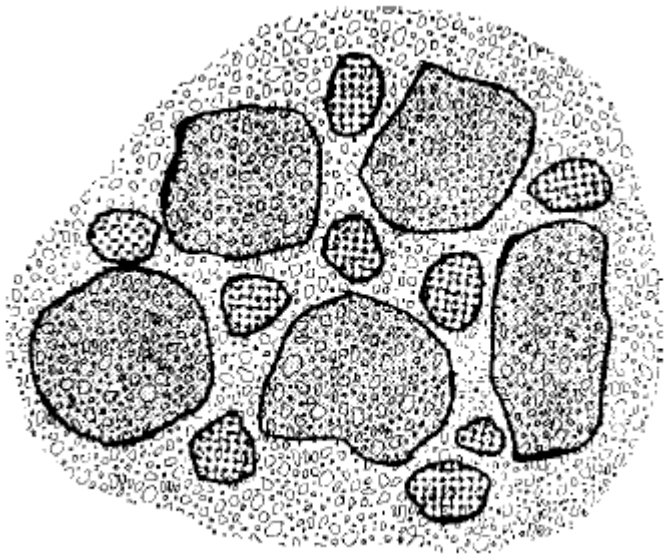
PCC Performance Criteria

- Higher Compressive Strength (4000 psi)
- Air content
- Durability – Freeze/Thaw, Scaling resistance (Super Air Meter)
- Permeability (Surface Resistivity)
- Optimized Aggregate Gradation
- Maximum Paste Factor
  - Reduced cement use, shrinkage reduction

Newer Performance Criteria - Paste Factor



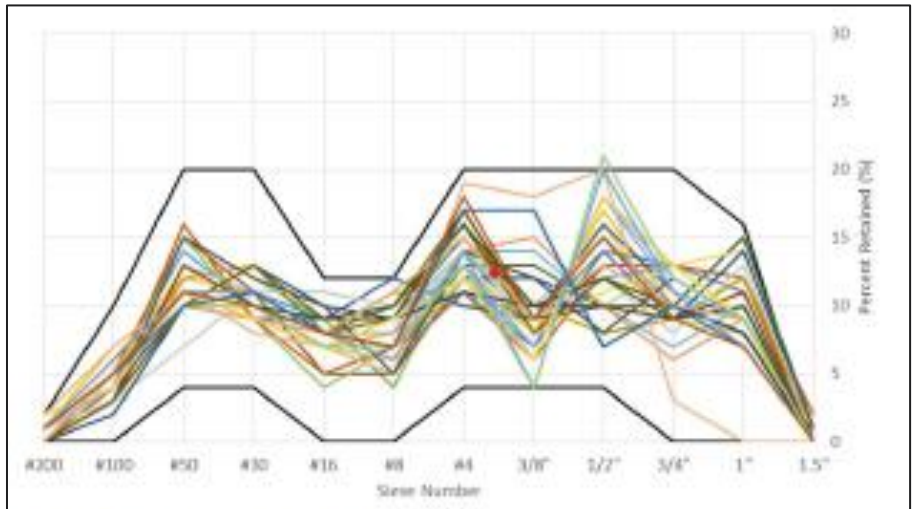
Traditional Gap Graded Mix – Higher Paste (30%) and Cementitious Content



Optimized Gradation (Well Graded) – Reduced Paste (25-27%) and Cementitious Content

Optimized Aggregate Gradation

- *The Contractor shall develop mixtures having a well graded aggregate gradation to minimize the paste content while maintaining workability*.
- Optimization Techniques
  - Tarantula Curve
  - Shilstone
- FHWA Tech Brief – *Blended Aggregates for Concrete Mixture Optimization*



Ley et al. 2014 with data from Maria Masten

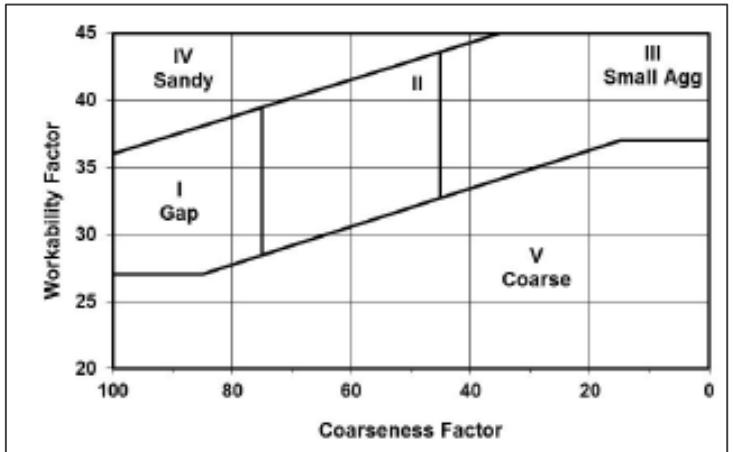


Figure 2. Shilstone workability factor chart

Newer testing tools & methods

- Super Air Meter (AASHTO TP 118)
  - Air void structure assessment of plastic concrete
  - Ability to detect & address issues sooner


www.superairmeter.com

- Surface Resistivity Meter (AASHTO T358)
  - Permeability assessment
  - Ability to detect & address issues sooner

Each of our 11 Regions were outfitted with this equipment

National Level Participation

- AASHTO Innovation Initiative (formerly TIG) for Surface Resistivity Test
- Pooled Fund – TPF-5(368) Performance Engineered Mixtures
- Pooled Fund – 1338 Improving Specifications to Resist Frost Damage in Modern Concrete Mixtures
  - Further development and adoption of use of the Super Air Meter (SAM) towards improved assessment of long term pcc durability

Performance Engineered Concrete for Pavements

- Special Specification Item 504.00000011
- Modifies Standard Specification 502-2 & 502-3 – replaces Class C
- Developed in conjunction with the criteria established in AASHTO PP 84 – *Standard Practice for Developing Performance Engineered Concrete Pavement Mixtures*

ITEM 504.00000011 – PERFORMANCE ENGINEERED CONCRETE MIXTURE FOR PAVEMENTS

DESCRIPTION

Develop a Performance Engineered Mixture (PEM) for Portland Cement Concrete (PCC) pavement applications to meet specified performance criteria. The PEM shall be used at locations specified in the contract.

The Contractor shall perform all Quality Control (QC) activities, including providing a QC plan for PCC production, sampling and testing of concrete as required to produce PCC that meets all specification requirements, and provide control charts to track mixture characteristics.

MATERIALS

The provisions of §502-2 shall apply, except as modified herein.

1. Design a concrete mixture proportioned according to AASHTO PP 84, *Developing Performance Engineered Concrete Pavement Mixtures*, for the below specified performance criteria. The mix shall have a well graded aggregate gradation to minimize the paste content while maintaining workability. Aggregate gradation shall meet the requirements of the Tarantula curve (or Shilstone method or 8-18 method) as defined by FHWA at https://www.fhwa.dot.gov/pavement/concrete/pubs/hif15019.pdf

   Produce a homogeneous mixture of cement, pozzolan (fly ash or GGBFS), fine aggregate, coarse aggregate, air entraining agent, water-reducing and set-retarding admixture, and water using NYSDOT Approved List materials. Other admixtures may be used as approved by the Director, Materials Bureau.

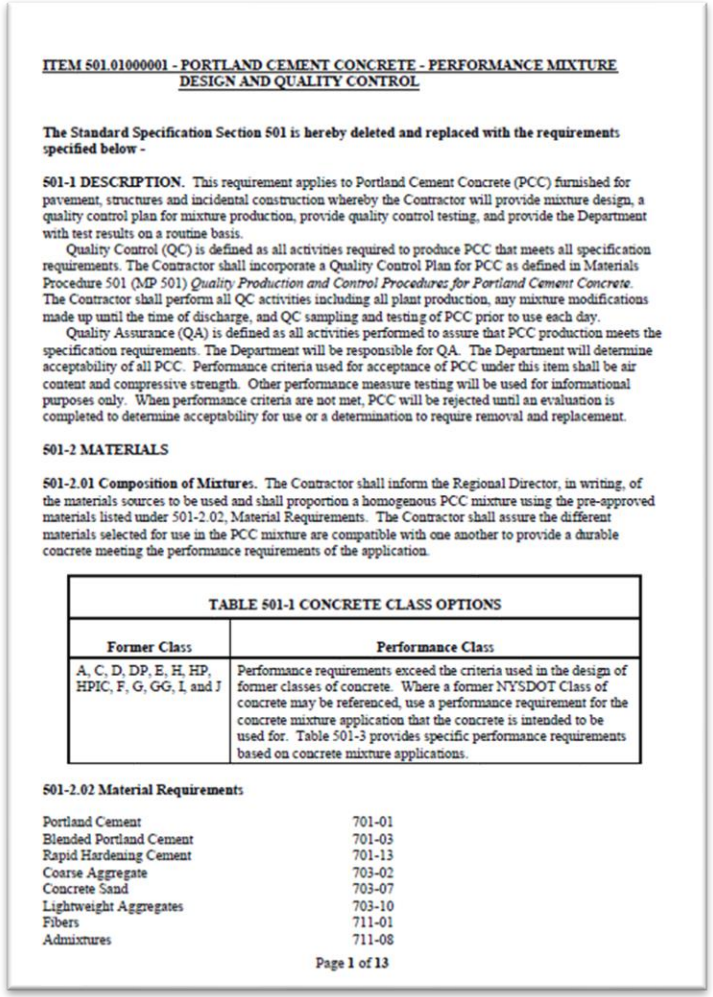
2. Design a concrete mixture to meet the following requirements:
   - Hardened samples (compressive and flexural strength samples), cured as per ASTM C31
   - Compressive Strength of 3,000 psi minimum at 28 days per ASTM C39 based on ACI 214
   - Flexural Strength of 600 psi minimum at 28 days as per AASHTO T97
   - Slump as desired by contractor for workability per ASTM C143
   - Entrained Air of 5% to 10% per ASTM C231
   - Super Air Meter (SAM) number ≤0.20 using AASHTO TP118
   - Water/Total Cementitious Material Ratio of 0.40 maximum
   - Paste volume maximum 25% as defined by AASHTO PP84
   - Resistivity ≥16.5 kΩ-cm on 4"x 8" cylinders, using AASHTO T358

3. Provide a copy of the proposed mixture design(s) and test batch results to the Director, Materials Bureau, submitted through the Regional Materials Engineer. Submit sufficient data to permit an informed evaluation. Include at least the following:
   - Concrete mix proportions
   - Aggregate composition and gradation
   - Material sources. Include fineness modulus and specific gravity for all aggregates
   - Compressive Strength at desired age of opening to traffic, and 7, 14 and 28 day results
   - Flexural Strength at 28 days
   - Target slump for placement
   - Target air content of plastic concrete

PAGE 1 of 4 April 25, 2019

501 Pilot Specification

- Special Specification 501.01000001
  - Supersedes the requirements of Standard Specification Section 501
- Concrete Mixture design requirements with enhanced performance criteria
- QC Plan requirements to define the production and supply processes
- Acceptance based on Strength/Air Content – Informational testing (SAM & Surface Resistivity)



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

Page 1 of 13

501 Pilot Specification (cont'd)

- Lump Sum Pay Item to cover cost of furnishing all materials, equipment and labor necessary to:
  - Development of PCC Mixture Designs Develop and follow a QC Plan for production and delivery of PCC
  - Progress QC activity for all PCC placements
- Pay Factors – calculated as a shadow program
  - Compressive Strength
  - Surface Resistivity

No Concrete pay adjustments will be implemented under this item but shall be calculated as a shadow program for future specifications.

Pay adjustments computations will be made for cast-in-place concrete that does not meet specified performance characteristics and shall be computed on the actual quantity of concrete representing an element placed, or part thereof, on a given day. Performance data will be tracked and documented for pilot project consideration only, with no penalties enforced for non-conformance.

The concrete pay adjustment (CPA) will be computed for non-conforming material according to the formulas defined as follows:

For concrete not meeting strength requirement, but allowed to remain in place, the payment representing the quantity of concrete for a given day / element's placement shall be reduced as follows:

Compressive Strength	Pay Factor (PF)
>95.0% and <100.0% of f'_c	The Department will pay 87.5%
≥90.0% and ≤95.0% of f'_c	The Department will pay 75%
< 90.0% of f'_c	Reject concrete

For concrete not meeting resistivity / permeability requirements, but allowed to remain in place, the payment representing the quantity of concrete for a given day / element's placement shall be reduced as follows:

Surface Resistivity[1] (kΩ-cm)	Pay Factor (PF)
<target and ≥85% of target	The Department will pay 87.5%
< 85% of target and ≥70% of target	The Department will pay 75%
<70% of target	Reject concrete

[1] Resistivity values are based on 4 in x 8 in cylinders. If 6 in x 12 in cylinders are used or Rapid Chloride Permeability Testing results these factors will be adjusted by the Director, Materials Bureau. When a concrete mix contains corrosion inhibitor, all resistivity values will be decreased by 20% or permeability values will be increased by 20%.

For concrete not meeting SAM requirements, but allowed to remain in place, the payment representing the quantity of concrete for a given day / element's placement shall be reduced as follows:

Page 12 of 13

Aug. 2, 2019

QC/QA key role in a Performance Specification

- Contractor Required Quality Control Plans for PCC
  - Contractor/Producers to define QC process for mix proportioning and delivery
  - DOT to audit QC processes and perform all Quality Assurance activity

- Department responsible for QA
  - DOT to audit QC processes and perform all Quality Assurance activity

Ongoing PEM projects:

- PEM Special Specification for PCC Pavement Applications
  - (5) projects to date
- Special Provisions for Performance Engineered Concrete Mixtures (SP-9) for Design Build projects
  - (4) projects to date
- 501 Pilot Special Specification - Item 501.01000001
  - (5) complete, (4 +) in progress

Typical PEM placement

Observations from PEM work completed to date

- In general, cement content was reduced by 10-15% (roughly 40-75 lbs/cy depending on standard requirements for the application).
  - In most instances where strength requirements exceeded our standard class mix design (3000 psi), PEM mixes were designed without the need for increased cement content.
  - Use of limestone blend cements offer further benefit
- Very few loads found to be out of compliance/rejected.
- Little to no cracking
- Some expected “learning curve” for all – ***most all of which has been worked out through partnering & collaboration***.

Communication key to success…..

- Meeting with Contractor Producer within 60 days of award (preferably sooner) to discuss specification objectives and begin conversations
- Collaboration with Producer toward PEM mix design and QC plan development
- Trial batching and monitor
  - Partnering with Regional Materials groups
- Once good results obtained, work can commence

Going Forward - Challenges / Opportunities

Challenges

- Resistance to Change
- Mix Development – understanding requirements & longer timeframe
- Newer testing techniques – learning curve
- Early age strength gain - sometimes slower
- 56-day age acceptance?

Opportunities

- Better Performing, Longer lasting mixtures
- Optimized mix designs are more efficient and cost effective.
- Improved Sustainability with reduced cement use

Performance Engineered Mixes - Project Experience

Adam Miller – NYSDOT

North Eastern States' Materials Engineers Association

Albany, NY – November 1, 2022

PEM 501 Pilot Projects

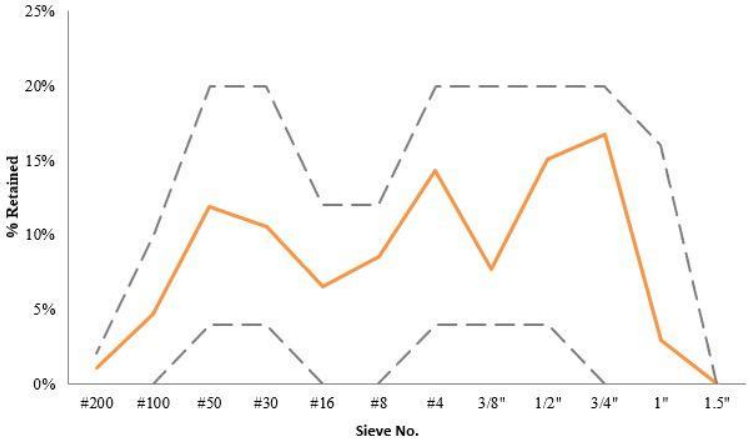
- 2020: Region 1: 220 ft long, 2 lane, single span bridge.
- 2021: Region 2: 90 ft long, 2 lane, single span bridge.
- 2021: Region 2: 224 ft long, 6 lane, 2 span bridge.
- 2021: Region 9: 45 ft long, 2 lane, single span bridge.
- 2022: Region 3: 250 ft long, 2 lane, 2 span bridge.

- Future PEM Projects
  - There are currently (4) PEM projects in place for 2023

Mix Design Review Process

Paper Review & Trial Batch

- Material Sources
- Gradations
- Paste Content
- Target Slump
- Target Air
- Super Air Meter (SAM)
- Surface Resistivity
- Compressive Strengths



Mix Design Achievements/Challenges

Super Air Meter (SAM)

- 150+ side by side tests performed between Type B and SAM.
  - Average difference in Air Content was 0.0%
  - 75% of Standard Class SAM tests were less than 0.30
- Designing for SAM <0.20 has very low failing results in field.
  - 160+ tests done in on PEM projects.
  - 93% of all PEM SAM tests were less than 0.30
  - SAM has been used to save loads with low air content in QC plans.
    - If the air content was less than spec but the SAM number tested on the same sample fell between 0.20 - 0.30, we used the concrete.

Mix Design Achievements/Challenges

Surface Resistivity

- NYSDOT tested over 1400 sets of Standard Class HP cylinders that showed an average 28-day age Surface Resistivity of 39 kΩ-cm.
- For PEM projects:
  - 100 + Surface Resistivity tests conducted (28-day age)
    - 34.5kΩ-cm avg
  - In some instances, the 28-day age Surface Resistivity results did not meet 30kΩ-cm requirement, however when carried out to 56 day-age the results typically exceeded the requirement.

Mix Design Achievements/Challenges

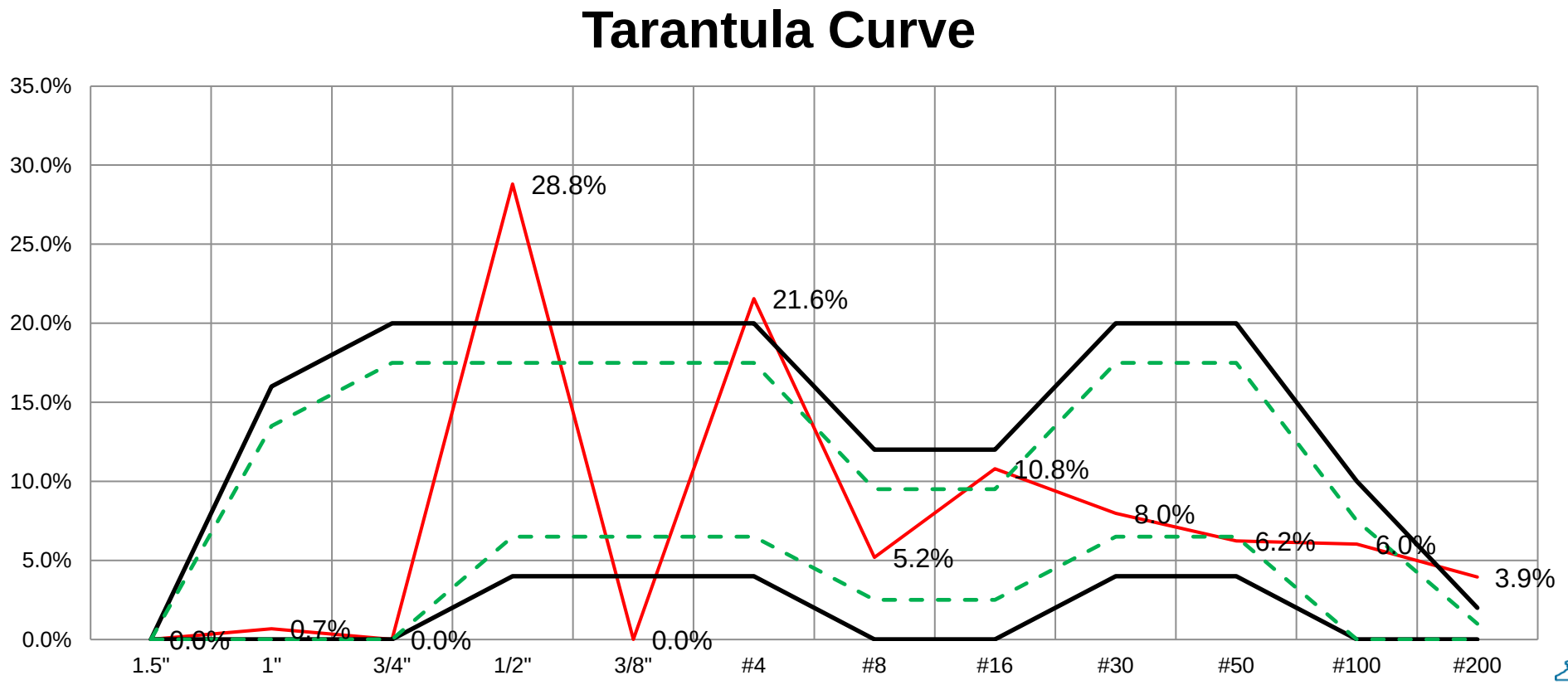
Compressive Strength

- Compressive strength increased with the optimized gradation and reduced paste
- Mixes have 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 last 3 years
  - 5278 psi - 99.5% above 3000 psi

Mix Design Achievements/Challenges

Optimized Gradation

Standard Gap Graded Class HP Mix design – Only looking at few coarse aggregate sieve sizes

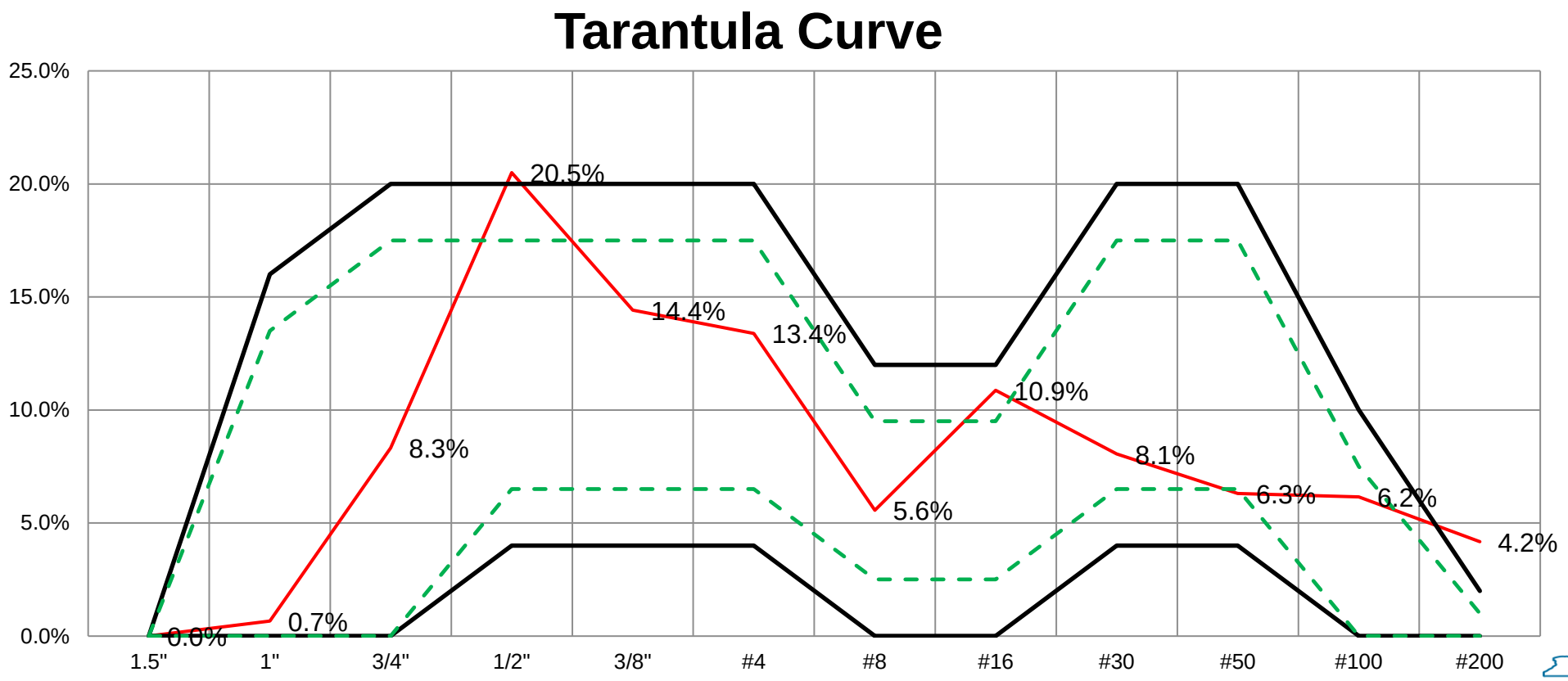


NEW YORK STATE OF OPPORTUNITY. Department of Transportation

Mix Design Achievements/Challenges

Optimized Gradation

Same Mix as before – Looking at all the sieves

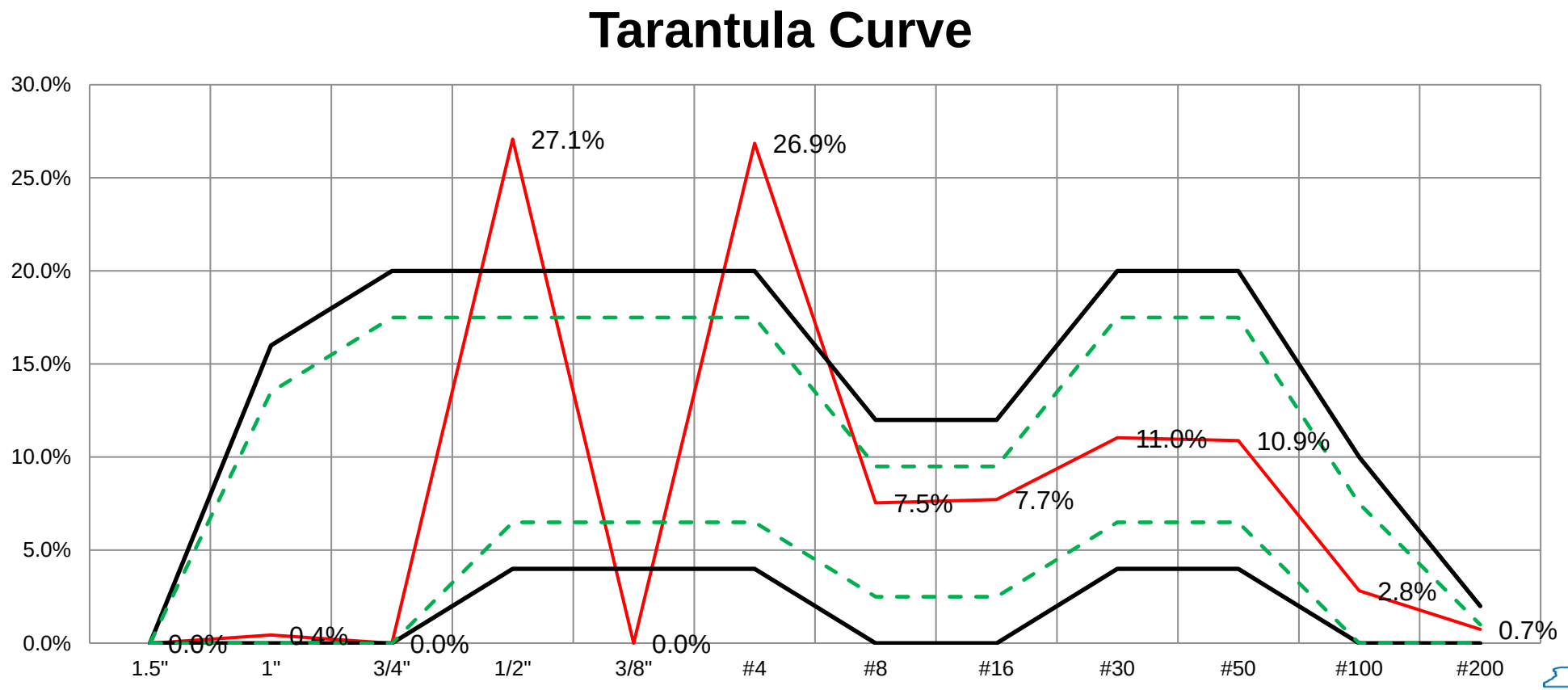


NEW YORK STATE OF OPPORTUNITY. Department of Transportation

Mix Design Achievements/Challenges

Optimized Gradation

PEM Mix Design – R3 Project – Before Optimization

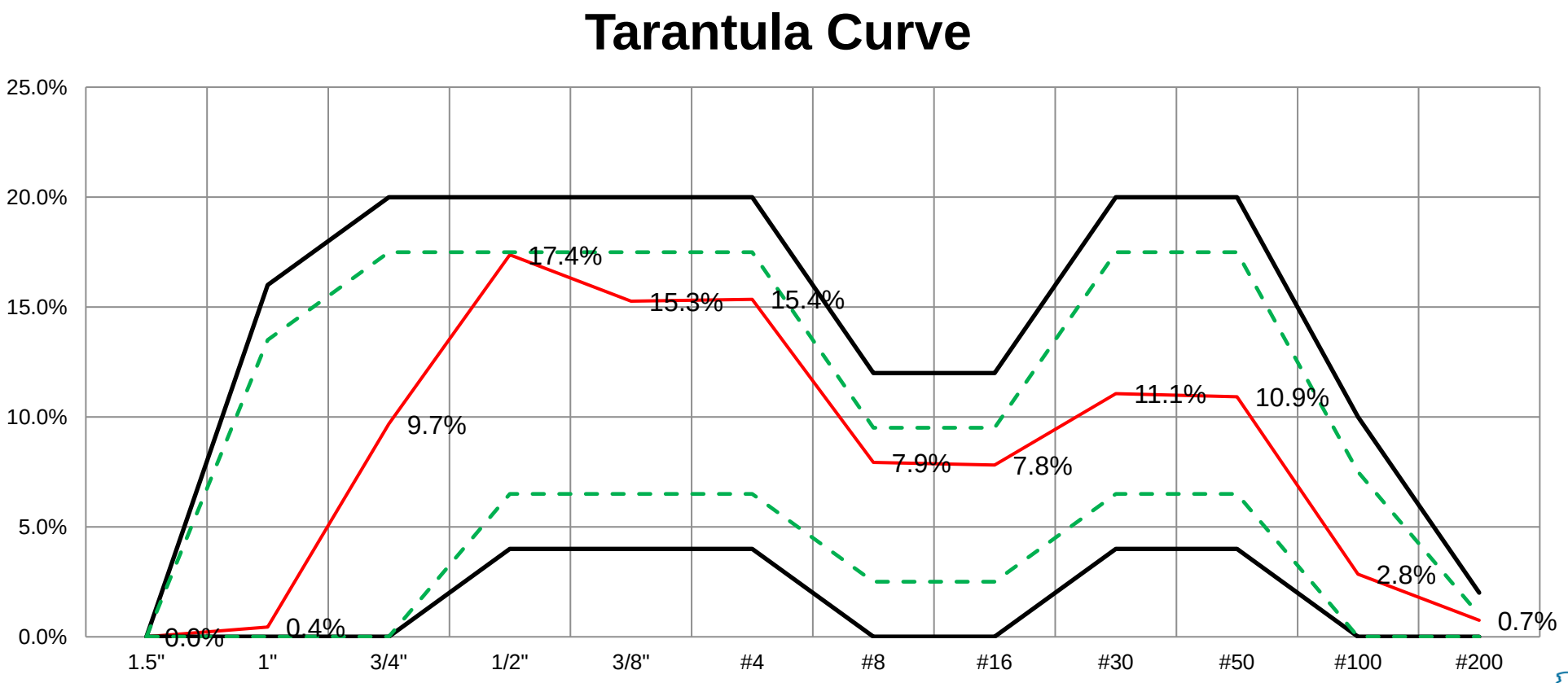


NEW YORK STATE OF OPPORTUNITY. Department of Transportation

Mix Design Achievements/Challenges

Optimized Gradation

PEM Mix Design – R3 Project



NEW YORK STATE OF OPPORTUNITY. Department of Transportation

Sustainability Benefit

- Optimized gradations and reduced cement per cubic yard add up to significant reductions on a project level.
  - D264040: 38,850lb or 19.4 ton reduction in cement vs Class HP
  - D264331: 17,064lb or 8.5 ton reduction in cement vs Class HP
  - D264350: 82,860lb or 41.4 ton reduction in cement vs Class HP
  - D264366: 27,300lb or 13.7 ton reduction in cement vs Class HP
  - D264564: 49,440lb or 24.7 ton reduction in cement vs Class HP
- The **108 tons of cement saved** on these projects would produce 432 cy of Class HP or roughly 508 cy.
- These projects reduce CO2 by 194,400 lbs compared to Class HP concrete.

Lessons Learned

- Paste content increased from 25% to 27%.
- Meeting with Contractor/Producer required within 60 days of notice to proceed.
- Mix submittal/test results required 45 day prior to use. Increased from 30 days.
- Specific sieve sizes called out for coarse aggregate gradations.
- Surface Resistivity being considered at 56-day age instead of 28-day age.
- Early loading requirement added into Note 2 under Table 501-03.
- SAM being utilized as a QC tool in the field.

Questions / Discussion

Dan.Dennis@dot.ny.gov
(518) 457-9798

Adam.Miller@dot.ny.gov
(518) 457-9435