

		<b>2020 Cement Concrete Producer Annual Document</b>			
<b>Approved by:</b> Richard Mulcahy	<b>Section:</b> RMS	<b>Position:</b> Materials Field Control Engineer	<b>Approval Date:</b> 11/21/2019	<b>Revision Date:</b> 12/16/2019	<b>Rev. No.:</b> 0

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### 1.0 OBJECTIVE

This document is intended to serve as a collection of instructions and procedures to be followed by all Cement Concrete Producers who intend on supplying cement concrete to MassDOT projects during the 2020 approval cycle.

Should there be any questions or concerns regarding the processes and/or requirements listed herein, Cement Concrete Producers may contact the following MassDOT RMS personnel:

- Richard Mulcahy (RMS Materials Field Control Engineer)
  - Email: [richard.mulcahy@dot.state.ma.us](mailto:richard.mulcahy@dot.state.ma.us)
  - Work Phone: (857) 368-3422
- Aidan Bates (RMS Engineer in the Field Control Section)
  - Email: [aidan.bates@dot.state.ma.us](mailto:aidan.bates@dot.state.ma.us)
  - Work Phone: (857) 368-3445
- Colin O'Brien (RMS Engineer for Precast/Prestress)
  - Email: [colin.obrien@dot.state.ma.us](mailto:colin.obrien@dot.state.ma.us)
  - Work Phone: (857) 368-3439

## 2.0 PRELIMINARY SUBMITTALS

All prequalification documentation shall be submitted to MassDOT Research & Materials (RMS) electronically through the “MassDOT Cement Concrete Producer SharePoint Site”. Instructions on how to gain access and utilize this SharePoint site can be found in the “2020 Cement Concrete Producer User Manual” (see attached appendix). The manual, along with other helpful links and documents, can also be found by accessing the Home Page of the “2020 Cement Concrete Producer User Manual” (see link below):

[https://projectcontrols2.massdot.state.ma.us/sites/Concrete20/\\_layouts/15/start.aspx#/](https://projectcontrols2.massdot.state.ma.us/sites/Concrete20/_layouts/15/start.aspx#/)

### 2.1 Cement Concrete Mix Design Sheet

Cement Concrete shall be composed of precise proportions by weight of MassDOT approved aggregates, hydraulic cement, supplementary cementitious materials (SCM), water, and admixtures to form a homogenous composition. All mix design yields shall be calculated at 1.0 cubic yard. A tolerance of +/- 1.0% will be allowed for the design yield. The tolerance for batching quantities shall be per AASHTO M 157. All mix design formulations shall be considered “proprietary” and will not be shared publicly.

Prior to the production of cement concrete, the Cement Concrete Producer shall report and submit all proposed mix design formulations and its constituent materials to the MassDOT Research and Materials Section (RMS) for review and approval, as instructed below. Cement Concrete Producers shall only submit mix designs for plants in operation and capable of storing the mix design’s constituent materials to be sampled by RMS personnel.

- Report mix design formulations onto the “RMS 043 Cement Concrete Mix Design Sheet.xlsx” Excel Workbook (found in the “Forms Library” section of the SharePoint site) in its entirety. All the entry fields listed on the RMS 043 shall be reported, including but not limited to:
  - plant, plant location, contact information, contract number (if applicable), mix strength, mix type, and all the mix design’s constituent materials’ sources, locations, types, quantities, specific gravities, and gradations
- Print completed “RMS 043 Cement Concrete Mix Design Sheet.xlsx” Excel Workbook, provide signature, and scan document in Portable Document Format (.pdf).
- Upload completed RMS 043 Excel Workbooks and signed .pdfs to the “2020 Cement Concrete Producer SharePoint Site”, prior to **February 28, 2020** and per the instructions provided in the “2020 Cement Concrete Producer User Manual” (see attached appendix).

Production of cement concrete shall not occur without prior MassDOT mix design approval. During production, the Producer is prohibited from altering the previously approved mix design formulation. Proposed alterations, including but not limited to plant, plant location, or the mix design’s constituent materials’ sources, locations, types, quantities, specific gravities, or gradations shall require a new submission of the “RMS 043 Cement Concrete Mix Design Sheet” and be considered new mix design formulations (see Section 5.1 – New Mix Designs and Trial Batch Testing for all requirements).

It is highly encouraged, due to the time needed to review these submissions, that all proposed mix design formulations be submitted to the MassDOT Research and Materials Section (RMS) per the instructions provided herein, by **February 28, 2020**. Proposed mix design formulations will be reviewed in the order that they are received. Proposed mix design formulations submitted after the **February 28, 2020** deadline and throughout the 2020 cycle will be accepted, however this may result in the delay of the submittal's review and approval due to the time needed to review these submissions. Failure to adhere to the instructions provided herein may also result in the delay of the submittal's review and approval.

Producers are to refer to the "2020 Cement Concrete Producer User Manual" for further instructions on how to navigate the SharePoint site and how to complete and submit the RMS 043 (see attached appendix).

### **2.1.1 Combined Aggregate Gradation**

The Cement Concrete Producer is to enter the gradations of all sieves onto the "RMS 043 Cement Concrete Mix Design Sheet" for each aggregate stockpile incorporated into the proposed mix design formulations in order to calculate the combined gradations properly. The combined gradations are calculated onto the "Combined Gradation" tab within the same Excel Workbook, from the stockpile gradations and aggregate weights provided on the RMS 043 Cement Concrete Mix Design Sheet. The Cement Concrete Producer is to review the "Combined Aggregate Gradation Sheet" tab prior to MassDOT Research and Materials Section (RMS) review and approval (please also see the Future Considerations section for more information).

### **2.1.2 Volume of Paste**

The Cement Concrete Producer is to enter the specific gravities and weights of all the aggregate, cementitious, and supplementary cementitious sources, as well as volume of water and admixtures, onto the "RMS 043 Cement Concrete Mix Design Sheet" in order to calculate the volume of paste properly. The volume of paste is calculated onto the "Volume of Paste Sheet" tab within the same Excel Workbook, from the specific gravities, weights, volume of water, and volume of admixtures provided on the RMS 043 Cement Concrete Mix Design Sheet. The Cement Concrete Producer is to review the "Volume of Paste Sheet" tab prior to MassDOT Research and Materials Section (RMS) review (please also see the Future Considerations section for more information).

### **2.1.3 New Mix Designs and Trial Batch Testing**

New mix designs submitted by the Cement Concrete Producer shall be subject to Trial Batch Testing, as specified in the special provisions, standard specifications, and herein. New mix designs shall be defined as follows:

- Mix designs that have not been previously approved by the MassDOT Research and Materials Section (RMS)
- Proposed alterations, including but not limited to plant, plant location, or the mix design's constituent materials' sources, locations, types, quantities, specific gravities, or gradations

Trial Batch Testing may include but is not limited to unit weight, slump, air, temperature, and compressive strength testing (must achieve overdensity strength, as specified). Precast and Prestressed Manufacturers shall perform AASHTO T 197 Time of Setting of Concrete Mixtures by Penetration Resistance for every new mix design submitted. Specialty or contract-specific mix designs that have not been utilized in MassDOT projects during the previous two years will be subject to new submittals and trial batches. For any mix design, if trial batch test results are out of specification limits, the Producer will be notified immediately and the mixtures utilizing those materials shall be removed from the RMS 043 Mix Design Sheet. Requests for Trial Batch Testing must be made, via email to **ALL** of the following addresses, and must be witnessed by MassDOT personnel:

- TO: [richard.mulcahy@dot.state.ma.us](mailto:richard.mulcahy@dot.state.ma.us) (RMS Field Control Materials Engineer)
- TO: [aidan.bates@dot.state.ma.us](mailto:aidan.bates@dot.state.ma.us) (RMS Engineer in the Field Control Section)
- TO: [colin.obrien@dot.state.ma.us](mailto:colin.obrien@dot.state.ma.us) (RMS Engineer for Precast/Prestress)
- TO: District Materials Engineer (choose your corresponding district):
  - District 1: [john.bianco@dot.state.ma.us](mailto:john.bianco@dot.state.ma.us)
  - District 2: [amy.bisbee@dot.state.ma.us](mailto:amy.bisbee@dot.state.ma.us)
  - District 3: [thomas.kwiatkowski@dot.state.ma.us](mailto:thomas.kwiatkowski@dot.state.ma.us)
  - District 4: [albert.kwok@dot.state.ma.us](mailto:albert.kwok@dot.state.ma.us)
  - District 5: [jason.lema@dot.state.ma.us](mailto:jason.lema@dot.state.ma.us)
  - District 6: [brian.kelleher@dot.state.ma.us](mailto:brian.kelleher@dot.state.ma.us)

## 2.2 Persons of Contact

The Cement Concrete Producer is to submit the “Cement Concrete Producer Persons of Contact” no later than **February 28, 2020**, to the “MassDOT Cement Concrete Producer SharePoint Site” (refer to Cement Concrete Producer User Manual), in the following format:

- Microsoft Excel (.xlsm)

## 2.3 Precast Concrete Fabricator Standard Shop Drawing Checklist

The purpose of the Precast Concrete Fabricator Standard Shop Drawing Checklist is to confirm all Precast Concrete Fabricators doing business with MassDOT are in conformance with the most recent MassDOT Standard Shop Drawings. Precast Concrete Fabricators are responsible for checking the relevant boxes on this form that state their standard precast unit drawings are in conformance with the Standard MassDOT Shop Drawings. The Precast Concrete Fabricator is to submit the “Precast Concrete Fabricator Standard Shop Drawing Checklist” no later than **February 28, 2020**, to the “MassDOT Cement Concrete Producer SharePoint Site” (refer to the Cement Concrete Producer User Manual), in the following formats:

- Microsoft Excel (.xlsm)
- Print, provide signature and scan document in Portable Document Format (.pdf)

For more information regarding the MassDOT Standard Drawings, please use the following link:

<https://www.mass.gov/lists/construction-details>

## **2.4 Precast Concrete Fabricator Standard Shop Drawings**

Precast Concrete Fabricators are to submit their standard shop drawings on file, that were selected on the “Precast Concrete Fabricator Standard Shop Drawing Checklist”, no later than **February 28, 2020**, to the “MassDOT Cement Concrete Producer SharePoint Site” (refer to the Cement Concrete Producer User Manual), in the following formats:

- Portable Document Format (.pdf)

## **2.5 Precast / Prestressed Concrete Fabricator Producer Plant Certification**

Precast / Prestressed Concrete Fabricators are to submit a copy of their company’s current NPCA or PCI Certification to the “2020 MassDOT Cement Concrete Producer SharePoint Site” (refer to Cement Concrete Producer User Manual).

## **2.6 Precast / Prestressed Concrete Fabricator Quality Control Personnel Certifications**

Precast / Prestressed Concrete Fabricators are to submit a copy of their current Quality Control Personnel certifications to the “2020 MassDOT Cement Concrete Producer SharePoint Site” (refer to Cement Concrete Producer User Manual).

### **3.0 SPECIFICATIONS**

#### **3.1 Qualified Construction Materials List (QCML)**

The following cement concrete related items shall be listed on the Qualified Construction Materials List (QCML).

##### **3.1.1 Qualified Alkali Silica Reactivity (ASR) Testing Laboratories**

<https://www.mass.gov/service-details/qualified-alkali-silica-reactivity-asr-testing-laboratories>

##### **3.1.2 Cement Concrete Admixtures**

<https://www.mass.gov/info-details/concrete-admixtures>

##### **3.1.3 Precast Cement Concrete Fabricators**

<https://www.mass.gov/service-details/precast-concrete-producers>

##### **3.1.4 Prestressed Cement Concrete Fabricators**

<https://www.mass.gov/service-details/prestressed-cement-concrete-producers>

##### **3.1.5 Ready-Mix Cement Concrete Producers**

<https://www.mass.gov/service-details/ready-mix-cement-concrete-producers>

##### **3.1.6 Reinforced Concrete Pipe**

<https://www.mass.gov/service-details/reinforced-concrete-pipe-m-5021>

##### **3.1.7 Volumetric (Mobile) Cement Concrete Mixers**

<https://www.mass.gov/service-details/volumetric-mobile-concrete-mixers>

##### **3.1.8 Rapid Set Concrete Patch Materials**

<https://www.mass.gov/service-details/rapid-set-concrete-patch-materials-horizontal-verticaloverhead>

#### **3.2 Engineering Directives**

MassDOT periodically issues Engineering Directives on important changes to procedures and/or specifications. Producers are responsible for keeping informed as to all changes to procedures and/or specifications. The following link is available to view all MassDOT Engineering Directives:

<https://www.mass.gov/service-details/massdot-highway-engineering-directives>

### **3.3 MassDOT Standard and Supplemental Specifications**

The website link to the “MassDOT Manuals, Publications, and Forms”, where digital copies of the MassDOT Standards and Supplemental Specifications is provided below:

<https://www.mass.gov/massdot-highway-division-manuals-and-publications>

### **3.4 Cement Concrete Admixtures**

Cement Concrete admixtures must be pre-qualified by MassDOT and listed on the Qualified Construction Materials List (QCML). However, concrete admixtures that are not on the QCML may be approved by MassDOT RMS for use on project specific contract or special applications, so long as the Engineer of Record approves the proposed non-QCML admixture for the intended application. MassDOT RMS shall review the recommendation by the Engineer of Record to determine what testing may be required in the approval process for the proposed non-QCML admixture. Concrete admixtures must also be evaluated by the AASHTO National Transportation Product Evaluation Program (NTPEP) before they will be considered for review and acceptance.

Any cement concrete mix design using a colored concrete admixture must be submitted on a project-specific RMS 043 Mix Design Sheet for each project that will be using the colored concrete mix design. For each project, color plates shall be submitted by the Producer to the District, Designer, or city for approval of the final concrete color. Written acceptance of the color plate from the District, Designer, or city is required to be uploaded for each project to the MassDOT Cement Concrete Producer SharePoint Site by the Producer prior to MassDOT RMS mix design approval.

Any Specialized (Type S) admixtures used in cement concrete mix designs may require extra testing by RMS or an independent laboratory. Type S admixture will have their tech data sheets reviewed by RMS before trial batching begins to determine if extra testing requirements are needed.

### **3.5 Aggregate**

Fine aggregate for Cement Concrete shall conform to MassDOT Standard Specifications, section M4.02.02A and AASHTO M 6. The use of manufactured fine aggregate shall be allowed. Coarse aggregate for Cement Concrete shall conform to MassDOT Standard Specifications, section M4.02.02B and AASHTO M 80. MassDOT shall have the ability to obtain source samples at the plant through an agreed upon method with the manufacturer.

The tolerance for batching of aggregate shall be per AASHTO M 157. Weekly coarse aggregate gradation and periodic specific gravity quality control testing at the batch plant shall be performed. All plants are required to maintain a laboratory with all equipment calibrated as per AASHTO R 18 and as per the MassDOT Standard Specifications section M4.02.08.



### 3.6 Hydraulic Cement

Portland Cement shall conform to MassDOT Standard Specifications section M4.01.0 and the requirements of AASHTO M 85. Blended Hydraulic Cements shall conform to MassDOT Standard Specifications section M4.01.1 and the requirements of AASHTO M 240.

The tolerance for batching hydraulic cement shall be per AASHTO M 157. Periodic specific gravity quality control testing at the batch plant shall be performed. All plants are required to maintain a laboratory with all equipment calibrated as per AASHTO R 18 and as per the MassDOT Standard Specifications section M4.02.08.

### 3.7 Supplementary Cementitious Materials (SCMs)

Fly ash shall conform to MassDOT Standard Specification section M4.01.2 and the requirements of AASHTO M 295. Slag shall conform to the requirements of AASHTO M 302. Silica Fume shall conform to AASHTO M 307. MassDOT shall be able to obtain source samples at the plant through an agreed upon method with the manufacturer.

The tolerance for batching supplementary cementitious materials (SCMs) shall be per AASHTO M 157. Periodic specific gravity quality control testing at the batch plant shall be performed. All plants are required to maintain a laboratory with all equipment calibrated as per AASHTO R 18 and as per the MassDOT Standard Specifications section M4.02.08.

#### 3.7.1 Temporary Change of Supplementary Cementitious Materials (SCM) Source Request

In the event of an extenuating circumstance (supply shortage, shutdown, etc.), where a sudden source change is required, the Producer shall notify RMS, via e-mail to **ALL** the following addresses:

- TO: [richard.mulcahy@dot.state.ma.us](mailto:richard.mulcahy@dot.state.ma.us) (RMS Field Materials Control Engineer)
- TO: [aidan.bates@dot.state.ma.us](mailto:aidan.bates@dot.state.ma.us) (RMS Engineer in the Field Control Section)
- TO: [colin.obrien@dot.state.ma.us](mailto:colin.obrien@dot.state.ma.us) (RMS Engineer for Precast/Prestress)

The Producer shall attach a letter to this email, addressed to the Director of Research & Materials, requesting a substitution of the SCM in question on the RMS 043 Mix Design Sheet that has already been approved. A template for this “Source Change Request Letter” can be found on the Home Page of the Cement Concrete Producer SharePoint Site. At a minimum, the letter shall state the following:

- The source of the original SCM
- Why the substitution is needed
- The proposed new SCM source
- The duration of the substitution
- The substitution shall be a “one for one” replacement of the previously listed SCM (i.e. same weights/quantities)



- Language stating “This letter shall be clearly posted by the Producer with the approved mix designs for this construction year at the concrete plant so that any and all MassDOT inspectors are aware of the change in material”
- Language stating “The substituted material source [New Source Name] will not negatively affect the compressive strength or long-term durability of the cement concrete supplied to any and all MassDOT projects”
- Language stating “In addition, [Plant Name] will provide Research and Materials with six months of quality control test results from [New Source Name] showing laboratory testing required by AASHTO. We will also provide a five-gallon sample of the material to Research and Materials for verification testing.”

RMS will determine if this source change is acceptable and if it warrants additional testing (Trial Batch, Alkali Silica Reactivity, etc.). If it is determined that testing is not required, the Producer will be notified that the SCM source change has been accepted. The Producer will then be approved to perform a “one to one” substitution of the new SCM source into the mix design. The Producer is to also submit a new RMS 043 Mix Design Sheet which reflects the approved SCM source change.

Please note that this Source Change Request Letter is only intended to serve as a temporary solution for up to one month of mix design approval. Producers are to inform RMS as soon as possible if a source change is expected to last longer than one month. If the period of SCM substitution exceeds one month, Alkali Silica Reactivity (ASR) and trial batch testing are required on the mix design with the substituted SCM. ASR testing shall be performed by a MassDOT Approved Independent AASTHO Accredited ASR Laboratory (see Section 2.5 for more information). Since the contingency mix design will not be approved for use past one month, Producers are encouraged to begin the ASR and trial batch testing as soon as possible if there is a concern that the original SCM source will remain unavailable.

### **3.8 Precast Concrete Highway Units Special Provision**

The following Precast Concrete Highway Units shall meet the materials and fabrication requirements specified in the Precast Concrete Highway Units Special Provision:

- Standard Temporary and Permanent Barriers
- Box Culverts with spans less than or equal to 10 feet
- Catch basins
- Drainage Pipes
- Pipe Flared Ends
- Manholes
- Handholes
- Proprietary Retaining Wall Systems
- Traffic Light Pole Bases
- Luminaire Bases

### Trial Batch Sampling and Testing for New Mix Designs

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Slump <sup>(a)</sup>	AASHTO T 119	Per AASHTO	Max. 8 inches or as approved by the Engineer	Quality Control
Air Content (AC)	AASHTO T 152	Per AASHTO	$5\% \leq AC \leq 8\%$	Quality Control
Temperature (°F)	AASHTO T 309	Per AASHTO	$50^{\circ}\text{F} \leq ^{\circ}\text{F} \leq 90^{\circ}\text{F}$	Quality Control
Compressive Strength <sup>(b)</sup>	AASHTO T 22 AASHTO T 23	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Lab Mixed: 130% $f'_c$ at 28 days	MassDOT
			Batch Mixed: 120% $f'_c$ at 28 days	
Alkali-Silica Reaction (ASR) <sup>(c)</sup>	ASTM C 1567	Per ASTM	M4.02.00	Quality Control
Resistance to Chloride Ion Penetration <sup>(d)</sup>	AASHTO T 358 <sup>(e)</sup>	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Resistivity $\geq 15$ k $\Omega$ -cm at 28 days	MassDOT

#### Notes:

- (a) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.
- (b) Trial batch compressive strength testing shall be performed by MassDOT. Cylinders shall be haLaboratory mixed trial batch compressive strength results shall achieve 130% Design Strength ( $f'_c$ ). Batch mixed trial batch compressive results shall achieve 120%  $f'_c$ . Acceptance will be based on compressive strength testing performed by MassDOT.
- (c) Alkali Silica Reaction (ASR) testing shall meet the requirements of M4.02.00. Independent laboratories performing ASR testing shall be listed on the MassDOT Quality Construction Materials List (QCML).
- (d) Resistance to Chloride Ion Penetration testing shall be performed only on proposed High Performance Cement Concrete mix designs. The calcium nitrite shall be removed from mix designs containing the admixture and replaced by an equivalent quantity of water when preparing Chloride Ion Penetration resistance trial batch test specimens.
- (e) The Wenner probe tip spacing “a” shall be 1.5.

The entire special provision shall be adhered to and is found in the contract’s special provisions document or the Home Page of the Cement Concrete Producer SharePoint Site:

[https://projectcontrols2.massdot.state.ma.us/sites/Concrete20/\\_layouts/15/start.aspx#/](https://projectcontrols2.massdot.state.ma.us/sites/Concrete20/_layouts/15/start.aspx#/)

### 3.9 Precast, Prestressed, and Prefabricated Concrete Bridge Structures Special Provisions

The following Precast, Prestressed, and Prefabricated Concrete Bridge Structures shall meet the materials and fabrication requirements specified in the following special provisions:

- Precast Concrete Bridge Elements
  - Substructure Elements (abutments, piers, footings, wingwalls, & approach slabs), Pile Caps, Highway Guardrail Transitions, Box Culverts (>10 foot span), Three-sided Frames and Arches (>10 foot span)
- Prestressed Concrete Beams
- Precast Concrete Deck Panels
- Prefabricated Bridge Units (PBUs)

#### Trial Batch Sampling and Testing for New Mix Designs

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Slump <sup>(a)</sup>	AASHTO T 119	Per AASHTO	Max. 8 inches or as approved by the Engineer	Quality Control
Air Content (AC)	AASHTO T 152	Per AASHTO	$5\% \leq AC \leq 8\%$	Quality Control
Temperature (°F)	AASHTO T 309	Per AASHTO	$50^{\circ}\text{F} \leq ^{\circ}\text{F} \leq 90^{\circ}\text{F}$	Quality Control
Compressive Strength <sup>(b)</sup>	AASHTO T 22 AASHTO T 23	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Lab Mixed $f'_{cr} = 1.3 f'_c$ at 28 days	MassDOT
			Batch Mixed $f'_{cr} = 1.2 f'_c$ at 28 days	
Alkali-Silica Reaction (ASR) <sup>(d)</sup>	ASTM C 1567	Per ASTM	M4.02.00	Quality Control
Resistance to Chloride Ion Penetration <sup>(e)</sup>	AASHTO T 358 <sup>(f)</sup>	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Resistivity $\geq 21$ k $\Omega$ -cm at 28 days	MassDOT
Freeze/Thaw Durability <sup>(c)</sup>	AASHTO T 161 (Procedure A)	Per AASHTO	Relative Dynamic Modulus of Elasticity after 300 cycles $\geq 80\%$	Quality Control

#### Notes:

(a) Self-consolidating concrete (SCC) shall meet the requirements of M4.02.17.

- (b) Trial batch compressive strength testing shall be performed by MassDOT. Acceptance will be based on compressive strength testing performed by MassDOT. For mixes requiring  $f'_c > 8,000$  psi, three consecutive trial batches shall be performed, all achieving  $f'_{cr} \geq 1.1 f'_c$ , for MassDOT approval.
- (c) If an AASHTO accredited laboratory is preparing the trial batch test specimens, MassDOT Acceptance presence is not required. If the Fabricator is preparing the trial batch test specimens, MassDOT Acceptance presence is required during trial batch test specimen preparation.
- (d) Alkali Silica Reaction (ASR) testing shall meet the requirements of M4.02.00. Independent laboratories performing ASR testing shall be listed on the MassDOT Quality Construction Materials List (QCML).
- (e) Calcium nitrite shall be removed from mix designs containing the admixture and replaced by an equivalent quantity of water when preparing Chloride Ion Penetration resistance trial batch test specimens.
- (f) The Wenner probe tip spacing “a” shall be 1.5.

The entire special provision shall be adhered to and is found in the contract’s special provisions document, Bridge Construction Special Provisions website, or the Home Page of the Cement Concrete Producer SharePoint Site:

<https://www.mass.gov/info-details/bridge-construction-special-provisions>

[https://projectcontrols2.massdot.state.ma.us/sites/Concrete20/\\_layouts/15/start.aspx#/](https://projectcontrols2.massdot.state.ma.us/sites/Concrete20/_layouts/15/start.aspx#/)

### **3.10 High Performance Concrete**

Please note that MassDOT may be utilizing a 4000 psi ¾” 585 Max High Performance (HP) concrete mixtures for exposed deck projects. The required Los Angeles Abrasion percentage loss for this product shall be no more than 30%.

Please note, the “total cementitious content” of HP concrete mixtures specified under Section M4.06.1 shall be considered maximum cementitious content.

Please note, for new HP mix designs, testing for AASHTO T 277 Standard Method of Test for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration is no longer required and has been replaced by AASHTO T 358 Standard Method of Test for Surface Resistivity Indication of Concrete’s Ability to Resist Chloride Ion Penetration, as specified in the table below. If test results are out of specification limits, the Producer will be notified immediately and the mixtures utilizing those materials shall be prohibited from use.

### Resistance to Chloride Ion Penetration Trial Batch Sampling and Testing for New High Performance Concrete Mix Designs

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Resistance to Chloride Ion Penetration <sup>(e)</sup>	AASHTO T 358 <sup>(f)</sup>	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Resistivity $\geq 21$ k $\Omega$ -cm at 28 days	MassDOT

#### Notes:

- (e) Calcium nitrite shall be removed from mix designs containing the admixture and replaced by an equivalent quantity of water when preparing Chloride Ion Penetration resistance trial batch test specimens.
- (f) The Wenner probe tip spacing “a” shall be 1.5.

### 3.11 Self-Consolidating Concrete (SCC)

Approval of Self-Consolidating Concrete (SCC) mix designs is contingent on meeting the trial batch testing requirements shown in the table below and found in the newly published **Subsection M4.02.17** of the latest MassDOT Supplemental Specifications. Production of all proposed SCC mix designs **shall not proceed** until all required trial batch test results specified in the table below, and located in **Subsection M4.02.17**, have been received from the Fabricator and accepted by MassDOT RMS.

Property	Test Method	Target Value
Filling Ability	Slump Flow (AASHTO T 347)	22 – 29 in.
Passing Ability	Slump Flow (AASHTO T 347) J-Ring Flow (AASHTO T 345)	The measured difference between the Slump Flow and the J-Ring Flow shall be < 2 in.
Static Stability	Column Segregation (ASTM C 1610)	Percent static segregation (S) $\leq$ 15%
	Visual Stability Index (AASHTO T 351)	0 or 1

Additional targets based off the trial batch results need to be met during production of a SCC mix design. These production testing requirements can be found in the table below and in **Subsection M4.02.17**:

Property	Test Method	Target Value	Testing Frequency
Filling Ability	Slump Flow (AASHTO T 347)	+/- 2 in. of Trial Batch Slump Flow Target Value and within Range of 22 – 29 in.	1 per Sublot
Static Stability	Visual Stability Index (AASHTO T 351)	0 or 1	1 per Sublot

The acceptable slump range during production is within +/- 2 inches of the slump recorded during the trial batch and must be within 22 – 29 inches. This means that a SCC mix design with a slump of 23 inches during the trial batch will be accepted during production so long as the slump falls between 22 – 25 inches.

### 3.12 Volumetric (Mobile) Concrete Mixers

Use of Volumetric (Mobile) Concrete Mixers shall conform to the Engineering Directive E-10-004 – Procedures for the Use of Concrete Produced by Volumetric (Mobile) Concrete Mixers (link provided below).

<https://www.mass.gov/files/documents/2018/03/15/e-10-004.pdf>

Volumetric (Mobile) Concrete Mixers shall be listed on the Qualified Construction Materials List (QCML). Upon written request by a Contractor, the District Construction Engineer may approve the use of concrete proportioned by a Mobile Concrete Mixer for the following applications.

- Concrete for backing curb stones
- Concrete for setting castings

No other use of concrete proportioned by a Mobile Concrete Mixer shall be allowed, however, the Contractor on behalf of the Volumetric (Mobile) Concrete Mixer subcontractor may generate a submittal to the District Construction Engineer requesting that this specific requirement be waived. The submittal shall include all the requirements specified in the Engineering Directive 10-004 and shall be forwarded by the District Construction Engineer to the Research and Materials Section Field Control Engineer for review. An interoffice memo will be generated by the Research and Materials Section Field Control Engineer, through the Acting Director of the Research and Materials Section to the District Construction Engineer.

In addition to the Engineering Directive 10-004, special provisions, applicable standard specifications, and trial batch requirements, Volumetric (Mobile) Concrete Mixers shall also adhere to the “Preliminary Submittals” requirements as specified above. The RMS 043 Cement

Concrete Mix Design Sheet shall be reported and submitted with the contract number entered into the “Contract No.” field.

### 3.12.1 Rapid Setting Concrete for Deck Repair

Contract Special Provisions for Rapid Setting Low Permeability Deck Repair Concrete typically call for the following trial batch mix design performance criteria. The AASHTO T 277 Rapid Chloride Ion Penetration Testing is no longer required and has been replaced by AASHTO T 358 Surface Resistivity Testing, which will be conducted by MassDOT.

#### Trial Batch Mix Design Performance Criteria

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Slump	AASHTO T 119	Per AASHTO	7 in. $\leq$ x in. $\leq$ 9 in.	Quality Control
Air Content (AC)	AASHTO T 152	Per AASHTO	3% $\leq$ AC $\leq$ 7%	Quality Control
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F $\leq$ °F $\leq$ 90°F	Quality Control
Unit Weight	AASHTO	Per AASHTO	150 pcf	Quality Control
Compressive Strength	AASHTO T 22 AASHTO T 23	4-hour Cylinders: One (1) set of Three (3) 4 x 8 in.	$\geq$ 3000 psi	MassDOT
		6-hour Cylinders: One (1) set of Three (3) 4 x 8 in.	Informational	MassDOT
		30-hour Cylinders: One (1) set of Three (3) 4 x 8 in.	$\geq$ 5000 psi	MassDOT
		7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	$\geq$ 6000 psi	MassDOT



### Trial Batch Mix Design Performance Criteria (Continued)

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Initial Set	AASHTO T 131	Per AASHTO	30 Minutes	Quality Control
Final Set	AASHTO T 131	Per AASHTO	40 Minutes	Quality Control
Slant Shear Bond Strength	ASTM 882	24 hours	$\geq 1200$ psi	Quality Control
		7 days	$\geq 1900$ psi	Quality Control
		28 days	$\geq 2200$ psi	Quality Control
Alkali-Silica Reaction (ASR)	ASTM C1567	Per ASTM	$\leq 0.08\%$	Quality Control
Resistance to Chloride Ion Penetration	AASHTO T 358	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Resistivity $\geq 21$ k $\Omega$ -cm at 28 days	MassDOT
Shrinkage	ASTM C157	28 days	$\leq 0.04\%$	Quality Control
Freeze/Thaw Durability	AASHTO T 161 (Procedure A)	Per AASHTO	Relative Dynamic Modulus of Elasticity after 300 cycles $\geq 80\%$	Quality Control

### 3.13 Portable Concrete Mixers

Rapid Setting Concrete produced by Portable Concrete Mixers for emergency concrete deck repair contracts shall adhere to special provisions, applicable standard specifications, trial batch requirements, and the “Preliminary Submittals” requirements as specified herein. The RMS 043 Cement Concrete Mix Design Sheet shall be reported and submitted with the contract number entered into the “Contract No.” field. Rapid Set Concrete Patch Materials incorporated into the mix design shall participate in the National Transportation Products Evaluation Program (NTPEP) for Rapid Set Concrete Patch Materials (RSCP) and shall be listed on the MassDOT QCML for Rapid Set Concrete Patch Materials (link provided below).

<https://www.mass.gov/service-details/rapid-set-concrete-patch-materials-horizontal-verticaloverhead>

NTPEP RSCP testing cycle shall be verified by manufacturer. All products on this list must be submitted to NTPEP for testing during the open submission cycle. Failure to do so may precipitate removal from the QCML. NTPEP retests rapid sets every five (5) years. Products on this list are

approved as neat (mortar) only and are not to be used for full depth repairs. Products extended with aggregate shall be tested with extended aggregate in accordance with the National Transportation Products Evaluation Program (NTPEP) for Rapid Set Concrete Patch Materials (RSCP). Extended aggregate incorporated into the Rapid Setting Concrete shall be non-reactive aggregate for Alkali Silica Reaction (ASR).

The Contractor shall generate a submittal to the District Construction Engineer for review and shall be forwarded by the District Construction Engineer to the Research and Materials Section Field Control Engineer for review and approval. An interoffice memo will be generated by the Research and Materials Section Field Control Engineer, through the Acting Director of the Research and Materials Section to the District Construction Engineer.

### 3.13.1 Rapid Setting Concrete for Emergency Concrete Deck Repair

#### Trial Batch Mix Design Performance Criteria

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Slump	AASHTO T 119	Per AASHTO	7 in. $\leq$ x in. $\leq$ 9 in.	Quality Control
Air Content (AC)	AASHTO T 152	Per AASHTO	3% $\leq$ AC $\leq$ 7%	Quality Control
Temperature (°F)	AASHTO T 309	Per AASHTO	50°F $\leq$ °F $\leq$ 90°F	Quality Control
Unit Weight	AASHTO	Per AASHTO	150 pcf	Quality Control
Compressive Strength	AASHTO T 22 AASHTO T 23	2-hour Cylinders: One (1) set of Three (3) 4 x 8 in.	$\geq$ 2000 psi	MassDOT
		7-day Cylinders: One (1) set of Three (3) 4 x 8 in.	$\geq$ 5000 psi	MassDOT

### Trial Batch Mix Design Performance Criteria (Continued)

Quality Characteristic	Test Method	Sample Size	Specification Limit	Performed By
Initial Set	AASHTO T 131	Per AASHTO	30 Minutes	NTPEP
Final Set	AASHTO T 131	Per AASHTO	40 Minutes	NTPEP
Slant Shear Bond Strength	ASTM 882	24 hours	$\geq 1200$ psi	NTPEP
		7 days	$\geq 1900$ psi	NTPEP
		28 days	$\geq 2200$ psi	NTPEP
Alkali-Silica Reaction (ASR)	ASTM C1567	Per ASTM	$\leq 0.08\%$	Quality Control
Resistance to Chloride Ion Penetration	AASHTO T 358	28-day Cylinders: One (1) set of Three (3) 4 x 8 in.	Resistivity $\geq 21$ k $\Omega$ -cm at 28 days	MassDOT
Shrinkage	ASTM C157	28 days	$\leq 0.04\%$	NTPEP
Freeze/Thaw Durability	AASHTO T 161 (Procedure A)	Per AASHTO	Relative Dynamic Modulus of Elasticity after 300 cycles $\geq 80\%$	NTPEP

### 3.14 Ultra High Performance Concrete (UHPC)

In addition to special provisions, applicable standard specifications, and trial batch requirements, Cement Concrete Producers of Ultra High Performance Concrete (UHPC) shall also adhere to the “Preliminary Submittals” requirements as specified above. The RMS 043 Cement Concrete Mix Design Sheet shall be reported and submitted with the contract number entered into the “Contract No.” field.

### 3.15 High Early Concrete

In addition to special provisions, applicable standard specifications, and trial batch requirements, Cement Concrete Producers of High Early Concrete shall also adhere to the “Preliminary Submittals” requirements as specified above. The RMS 043 Cement Concrete Mix Design Sheet shall be reported and submitted with the contract number entered into the “Contract No.” field.

### 3.16 Low Heat Cement Concrete

In addition to special provisions, applicable standard specifications, and trial batch requirements, Cement Concrete Producers of Low Heat Cement Concrete shall adhere to the “Preliminary

Submittals” requirements as specified above. The RMS 043 Cement Concrete Mix Design Sheet shall be reported and submitted with the contract number entered into the “Contract No.” field.

## 4.0 INDEPENDENT TESTING SUBMITTALS

### 4.1 New Source: ASTM C295 Petrographic Examination of Aggregates

ASTM C 295 Petrographic Examination of Aggregates shall be required for the following:

- New aggregate source that has not been previously used in an approved MassDOT Cement Concrete Mix Design. Test results must be performed by an accredited independent laboratory within the previous two years to be considered.

Producers are to submit their signed Independent Test Results no later than **April 1, 2020**, to the “MassDOT Cement Concrete Producer SharePoint Site” (refer to Cement Concrete Producer User Manual). If test results are out of specification limits, the Producer will be notified immediately and the mixes utilizing those materials will be disapproved.

### 4.2 New Source: Aggregate Testing

For new aggregate sources, Producers shall submit Independent Test Results from an AASHTO Accredited Laboratory, no later than **April 1, 2020**, to the “MassDOT Cement Concrete Producer SharePoint Site”.

Producers are to refer to MassDOT Standard Specifications, sections M4.02.02A and M4.02.02B for the testing requirements required to approve sources of fine and coarse aggregates, respectively. Additionally, for new sources of fine and coarse aggregates, producers are required submit results for ASTM C 295 (Petrographic Examination of Aggregates). Producers are also required to send a 25 lbs. sample of the new aggregate source to Research and Materials for testing.

Below is a summary of the Independent Test Results that shall be submitted by the Producer before an aggregate can be approved for use in cement concrete mix designs:

<b>FINE AGGREGATE PREQUALIFICATION TESTING REQUIREMENTS</b>		
	<b>AASHTO Test Method</b>	<b>Maximum Percent by Weight</b>
<b>Clay Lumps and Friable Particles</b>	T 112	3.0
<b>Coal and Lignite</b>	T 113	0.5
<b>Materials Passing No. 200 Sieve</b>	T 11	3.0
<b>Organic Impurities</b>	T 21	*Pass
<b>Soundness (Na<sub>2</sub>SO<sub>4</sub>) - 5 Cycles</b>	T 104	10

\*Sand when tested for mortar making properties as specified above shall produce a compressive strength, at any period of time, equal to or greater than that developed by mortar of the same

proportions and consistency made of the same cement and sand after the sand has been treated in a 3% solution of sodium hydroxide in accordance with AASHTO – T 71.

<b>COARSE AGGREGATE PREQUALIFICATION REQUIREMENTS</b>		
	<b>AASHTO Test Method</b>	<b>Maximum Percent by Weight</b>
<b>Clay Lumps and Friable Particles</b>	T 112	2.0
<b>Chert (Less than 2.40 Sp. Gr. SSD)*</b>	T 112	3.0
<b>Sum of Clay Lumps, Friable Particles and Chert (Less than 2.40 Sp. Gr. SSD)*</b>	T 112	3.0
<b>Material Finer than No. 200 Sieve</b>	T 11	1.0
<b>Coal and Lignite</b>	T 113	0.5
<b>Percent of Wear (LA Abrasion Test)</b>	T 96	45 for concrete below 5000psi
		30 for 5000psi and above
<b>Sodium Sulphate Soundness (5 Cycles)</b>	T 104	10

\*These limitations apply only to aggregates in which chert appears as an impurity.

### 4.3 New Source: Cement Testing

For new cement sources, Producers shall submit the following to MassDOT RMS, no later than **April 1, 2020**:

- A 25 lbs. sample of the new cement source to MassDOT RMS Laboratory for testing
- Independent Test Results (upload to the “MassDOT Cement Concrete Producer SharePoint Site”)
- The previous six months of mill certifications from the plant producing the materials (upload to the “MassDOT Cement Concrete Producer SharePoint Site”)

### 4.4 New Source: Supplementary Cementitious Materials (SCM) Testing

If the Producer submits a MassDOT RMS 043 Cement Concrete Mix Design Sheet with an SCM source that has not been previously approved for use, the Producer must first perform AASHTO T 303 Modified ASR testing through an Independent AASHTO Accredited Laboratory, as well as, request Trial Batch Testing (see section titled “Trial Batch Testing” for more information) prior to RMS 043 Mix Design approval. Producers shall also submit the following to MassDOT RMS, no later than **April 1, 2020**:

- A 25 lbs. sample of the new SCM source to RMS for testing
- Independent Test Results (upload to the “MassDOT Cement Concrete Producer SharePoint Site”)

- The previous six months of mill certifications from the plant producing the materials (upload to the “MassDOT Cement Concrete Producer SharePoint Site”)

#### **4.5 New Mix Design: AASHTO T 161 Rapid Freezing and Thawing (Procedure A)**

New mix designs for precast, prestressed, or prefabricated concrete bridge structures require AASHTO T 161 Rapid Freezing and Thawing (Procedure A) testing to be performed by an independent laboratory, as described in *Section 3.4 – Precast, Prestressed, and Prefabricated Concrete Bridge Structures Special Provisions* above.

Cement Concrete Producers are to send their **RMS 043 Cement Concrete Mix Design Sheet (.xslm)** to the independent laboratory of their choosing. Please fill in all necessary material information on the RMS 043 before sending it to the lab. The independent laboratory is to report the test results on the RMS 910 Test Report Form. The RMS 043 and RMS 910 are linked to eliminate erroneous entries onto the Test Report Form. Independent laboratories are to send the RMS 910 Test Report Form directly to their respective Cement Concrete Producer. Cement Concrete Producers are to save the RMS 910 Test Report Form to the “MassDOT Cement Concrete Producer SharePoint Site” (refer to Cement Concrete Producer User Manual) as close to the test completion date as possible, and no later than **April 1, 2020**, in the following formats:

- Microsoft Excel (.xslm)
- Print, provide signature and scan document in Portable Document Format (.pdf)

Please note that the RMS Modified AASHTO T 161 testing procedure requires that cement concrete bars used for Freeze/Thaw testing be cured for a minimum of 14 days and no longer than 21 days. The RMS Modified AASHTO T 161 testing procedure can be found on the Home page of the 2020 Cement Concrete Producers SharePoint site.

#### **4.6 Annually: ASTM C1567 Alkali-Silica Reactivity**

All aggregates (including lightweight and heavyweight) are to be tested for Alkali Silica Reactivity (ASTM C1567), using the Supplementary Cementitious Materials (SCMs) and cementitious percentages shown on the mix design, by MassDOT approved laboratories.

Independent ASR laboratories shall participate in the CCRL ASR Proficiency Program, score greater than or equal to 3, and submit the CCRL results directly to the following RMS personnel for review and approval:

- TO: [richard.mulcahy@dot.state.ma.us](mailto:richard.mulcahy@dot.state.ma.us) (RMS Field Control Materials Engineer)
- TO: [aidan.bates@dot.state.ma.us](mailto:aidan.bates@dot.state.ma.us) (RMS Engineer in the Field Control Section)
- TO: [colin.obrien@dot.state.ma.us](mailto:colin.obrien@dot.state.ma.us) (RMS Engineer for Precast/Prestress)

MassDOT approved Independent ASR laboratories are listed on the MassDOT Qualified Alkali Silica Reactivity (ASR) Testing Laboratories list.

Cement Concrete Producers are to send their RMS 043 Cement Concrete Mix Design Sheet Excel Workbook (.xslm) to the MassDOT approved laboratory(s) of their choosing. This Excel



Workbook includes the Alkali Silica Reactivity AASHTO T 303 Modified Test Report Form (RMS 905). The RMS 043 and RMS 905 are linked to eliminate erroneous entries onto the Test Report Form. Approved laboratories are to send the RMS 905 Test Report Form directly to their respective Cement Concrete Producer. Cement Concrete Producers are to save the RMS 905 Test Report Form to the “MassDOT Cement Concrete Producer SharePoint Site” (refer to Cement Concrete Producer User Manual) as close to the test completion date as possible, and no later than **April 1, 2020**, in the following formats:

- Microsoft Excel (.xlsm)
- Print, provide signature and scan and document in Portable Document Format (.pdf)

Coarse Aggregate from Aggregate Industries – Swampscott, MA, as well as Fine Aggregate from Ossipee Aggregates – Ossipee, NH are considered statistically non-reactive. Mix designs using these aggregate sources will not require annual mortar bar testing so long as minimum mitigation is utilized, as specified in Subsection M4.02.00. MassDOT reserves the right to require standard ASR testing for these aggregate sources if future mortar bar results show reactivity has increased.

MassDOT will be conducting ASR verification testing of mitigated concrete mixes submitted by ready-mix and precast/prestressed producers throughout the year. If test results are out of specification limits, the Producer will be notified immediately and the mix designs utilizing those materials will be disapproved. Additional SCM quantities may be required and all test data must be re-submitted, prior to a new approval.

## 5.0 PREQUALIFICATION OF NEW CEMENT CONCRETE PRODUCERS

The following sections are intended to serve as a guide for the process of submitting all necessary prequalification documents. Please also refer to the “2020 Cement Concrete Producer User Manual” for more information on how to navigate the RMS Forms and the SharePoint site.

### 5.1 Plant Inspections for New Ready-Mixed Cement Concrete Producers

Requests for plant inspection must be made, via email to the following MassDOT personnel:

- TO: [richard.mulcahy@dot.state.ma.us](mailto:richard.mulcahy@dot.state.ma.us) (RMS Field Materials Control Engineer)
- TO: District Materials Engineer (choose your corresponding district):
  - District 1: [john.bianco@dot.state.ma.us](mailto:john.bianco@dot.state.ma.us)
  - District 2: [amy.bisbee@dot.state.ma.us](mailto:amy.bisbee@dot.state.ma.us)
  - District 3: [thomas.kwiatkowski@dot.state.ma.us](mailto:thomas.kwiatkowski@dot.state.ma.us)
  - District 4: [albert.kwok@dot.state.ma.us](mailto:albert.kwok@dot.state.ma.us)
  - District 5: [jason.lema@dot.state.ma.us](mailto:jason.lema@dot.state.ma.us)
  - District 6: [brian.kelleher@dot.state.ma.us](mailto:brian.kelleher@dot.state.ma.us)

Once notified, the District is to inform the New Ready-Mix Cement Concrete Plant of the MassDOT plant inspection requirements and perform the plant audit and consistency testing.

### 5.2 Plant Inspections for New Precast / Prestressed Cement Concrete Fabricators

Requests for plant inspection must be made, via email to the following MassDOT personnel:

- TO: [richard.mulcahy@dot.state.ma.us](mailto:richard.mulcahy@dot.state.ma.us) (RMS Field Materials Control Engineer)
- TO: [colin.obrien@dot.state.ma.us](mailto:colin.obrien@dot.state.ma.us) (RMS Inspector Engineer for Precast/Prestress)
- TO: [aidan.bates@dot.state.ma.us](mailto:aidan.bates@dot.state.ma.us) (RMS Engineer in the Field Control Section)

Once notified, Colin O’Brien is to inform the New Precast/Prestressed Cement Concrete Plant of the MassDOT plant inspection requirements and schedule the plant audit to be performed.

## 6.0 FUTURE CONSIDERATIONS

Please note that the topics covered in this section are not currently specification requirements. However, a new Section M4 Cement Concrete Materials standard specification is currently under development that include these future considerations. It is within the Cement Concrete Producer's best interest to begin the process of re-designing proposed mix designs, to incorporate these future considerations. MassDOT understands that these changes will not and cannot happen overnight. MassDOT and Industry will work together in developing these new specifications so that all voices are heard.

### 6.1 Combined Aggregate Gradation

Please note that combined gradation requirements are based on the existing M4.02.02 Aggregates standard specification. However, please see the future considerations specified below:

Combined aggregate gradations for proposed mix design shall conform to the following "Tarantula Curve" criteria:

#### Combined Gradation Requirements

Sieve Designation	Minimum Retained (%)	Maximum Retained (%)
# 200	0	0
# 100	0	10
# 50	4	20
# 30	4	20
# 16	0	12
# 8	0	12
# 4	4	20
3/8	4	20
1/2	4	20
3/4	0	20
1	0	16
1 1/2	0	0
2	0	0

## 6.2 Volume of Paste

Please note that currently there are no volume of paste requirements in existing MassDOT specifications. However, please see the future considerations specified below:

The maximum allowable volume of paste percentage by total volume of concrete shall not exceed 28% and shall be calculated according to the Volume of Paste (%) formula referenced in AASHTO PP 84.

## 6.3 Minimum and Maximum Compressive Strength Ranges

Please note that currently there are no maximum compressive strength requirements in existing MassDOT specifications. However, please see the future considerations specified below:

Cement concrete shall be designated by class according to trial batch compressive strength results and coarse aggregate size. During trial batch testing, the design compressive strength ( $f'_c$ ) shall be within the allowable minimum ( $f'_{cr-min}$ ) and maximum ( $f'_{cr-max}$ ) compressive strength ranges as specified below. The classes of concrete to be used shall be designated on the plans or in the specifications for the particular work.

### Classification of Concrete Mixes

Maximum Coarse Aggregate Sizes	Design Compressive Strength ( $f'_c$ )	Min. Compressive Strength ( $f'_{cr-min}$ )	Max. Compressive Strength ( $f'_{cr-max}$ )
3/8 in. 1/2 in. 3/4 in. 1 1/2 in.	3000 psi	3600 psi	< 4800 psi
	4000 psi	4800 psi	< 6000 psi
	5000 psi	6000 psi	< 7200 psi
	6000 psi	7200 psi	< 7800 psi
	6500 psi	7800 psi	< 8400 psi
	7000 psi	8400 psi	< 8800 psi
	8000 psi	8800 psi	< 9900 psi
	9000 psi	9900 psi	< 11000 psi
	10000 psi	11000 psi	

Given these new compressive strength ranges, MassDOT will be looking into revising the current financial penalties for concrete that does not meet the compressive strength requirements during production.

## 6.4 Cement Concrete Pavement

- MassDOT to begin “piloting” cement concrete pavement on certain contracts.
- Introduce Quality Assurance and AASHTO PP 84 Performance Engineered Mix concepts.
- Use this as a baseline for developing MassDOT’s overall Section M4 Cement Concrete Materials Specification.

## **6.5 Remove and Replace Outdated “HP” Cement Concrete Specifications Mix Type**

High Performance (HP) Concrete is an outdated and undefined term which really isn’t relevant in today’s world of concrete. We need to change the way section M4 is currently written, break it down by “Mix Types”. Need to apply the concepts we wrote in the precast and prestressed specifications and apply it to an overall Section M4 Cement Concrete Materials Specification.

- Cement Concrete for Highway Units
- Cement Concrete for Structures
- Cement Concrete for Pavement
- Cement Concrete for Sidewalk
- Self-Consolidating Concrete (SCC)
- Controlled Density Fill (CDF)
- Low Heat Cement Concrete / Mass Cement Concrete
- Drycast Cement Concrete
- High Early Cement Concrete
- Rapid Setting Cement Concrete
- Ultra High Performance Concrete (UHPC)
- Latex Modified Cement Concrete
- Tremie Cement Concrete

## **6.6 Quality Assurance Specifications for Cement Concrete**

Please see the future Quality Assurance Specification considerations specified below. Cement Concrete Producers are encouraged to begin implementing Quality Control Activities.

- Cement Concrete Producer Quality Control, Contractor Quality Control, Utilization of Quality Control Results in Acceptance (after validation has been completed), Percent Within Limits (PWL), Engineering Limits, Specification Limits, Pay Factors (Incentives and Disincentives), Performance Engineered Mixes (PEM), etc.

## **6.7 Qualified Construction Materials List (QCML) for Hydraulic Cement**

Please note that currently there is no QCML for Hydraulic Cement. However, please see the future considerations specified below:

Hydraulic cement is defined as a fine powder that chemically reacts with water to form a hardened paste that bonds the aggregates together in concrete. Hydraulic cement shall be categorized as portland cement, blended hydraulic cement, and rapid hardening hydraulic cement. Hydraulic cement incorporated into MassDOT approved cement concrete mix designs shall be listed on the MassDOT Qualified Construction Materials List (QCML) for Hydraulic Cement, according to the proposed applications and requirements as specified herein.

Hydraulic cement products shall be listed on the MassDOT QCML for Hydraulic Cement and conform to the following requirements:

- AASHTO M 85 Standard Specification for Portland Cement
- AASHTO M 240 Standard Specification for Blended Hydraulic Cement
- ASTM C1600 Standard Specification for Rapid hardening Hydraulic Cement
- National Transportation Products Evaluation Program (NTPEP) for Portland and Blended Cement (PBC)
- Independent Laboratory Testing for Rapid Hardening Hydraulic Cement Products
- MassDOT Acceptance Specification Limits for each type of hydraulic cement

Test results generated by NTPEP (independent results for Rapid Hardening Hydraulic Cement) shall be used by MassDOT to determine the product's conformance to the MassDOT Acceptance Specification Limits. Non-conforming test results shall result in the hydraulic cement product's immediate removal from the MassDOT QCML and suspension from use until the non-conforming issue is resolved through corrective action.

**REVISION HISTORY**

<b>Revision No.</b>	<b>Revision Date</b>	<b>Description of Revision</b>	<b>Page(s) Revised</b>	<b>Page(s) Added</b>	<b>Page(s) Replaced</b>
0	11/21/2019	Draft	N/A	N/A	N/A
1	12/16/2019	Final	N/A	N/A	N/A



## **APPENDIX**

### **A. Cement Concrete Producer User Manual (2020)**

[Found on the 2020 Cement Concrete Producer SharePoint Home Page]

### **B. Temporary Change of Supplementary Cementitious Materials (SCMs) Letter Template**

[Found on the 2020 Cement Concrete Producer SharePoint Home Page]

### **C. RMS 910 Freeze-Thaw Test Report Form Submittal Guide**

[Found on the 2020 Cement Concrete Producer SharePoint Home Page]

### **D. SharePoint Training Manual – Setting Up Alerts**

[Found on the 2020 Cement Concrete Producer SharePoint Home Page]

### **E. Password Expiration Reset Instructions**

[Found on the 2020 Cement Concrete Producer SharePoint Home Page]