MaineDOT Policies and Procedures for Structural Portland Cement Concrete (PCC)

Contents

PCC Mix Designs

General

PCC Mix Designs are submitted by the contractor for all projects where Methods A, B, and C cast-in-place concrete is specified. These Mix Designs are required to be a part of the contractors Quality Control Plan (QCP). Mix Design submittals must be received no less than 30 days prior to any related work being performed. Review and approval of the QCP and concrete mix designs shall be completed within 14 days of receipt.

Mix Designs submitted for approval shall contain the following information:

1. Cement and Pozzolans
    a. Description and source, including up to date mill certs
    b. Amount of cement and pozzolan intended for use
2. Coarse Aggregate
    a. Original source and location
    b. Bulk specific gravity
    c. Absorption
    d. Gradation
        i. If multiple coarse aggregates are used, a combined gradation shall be supplied
    e. Composite blend flat and elongated
    f. Composite blend Micro-Deval or L.A. Abrasion
    g. Alkali silica reactivity test results
3. Fine Aggregate
    a. Original source and location
    b. Bulk specific gravity
    c. Absorption
    d. Gradation
    e. Fineness Modulus (F.M.)
    f. Organic impurities
    g. Sand Equivalency test results
    h. Alkali silica reactivity test results
4. Chemical Admixtures
    a. Manufacture and product name, shall be off MaineDOT QPL
    b. Type
    c. Target Dosage
5. Mix Properties
    a. Target water/cementitious ratio
    b. Maximum water/cementitious ratio
    c. Target water content by volume
    d. Target concrete unit weight
    e. Target strength
    f. Target surface resistivity value
    g. Target entrained air content

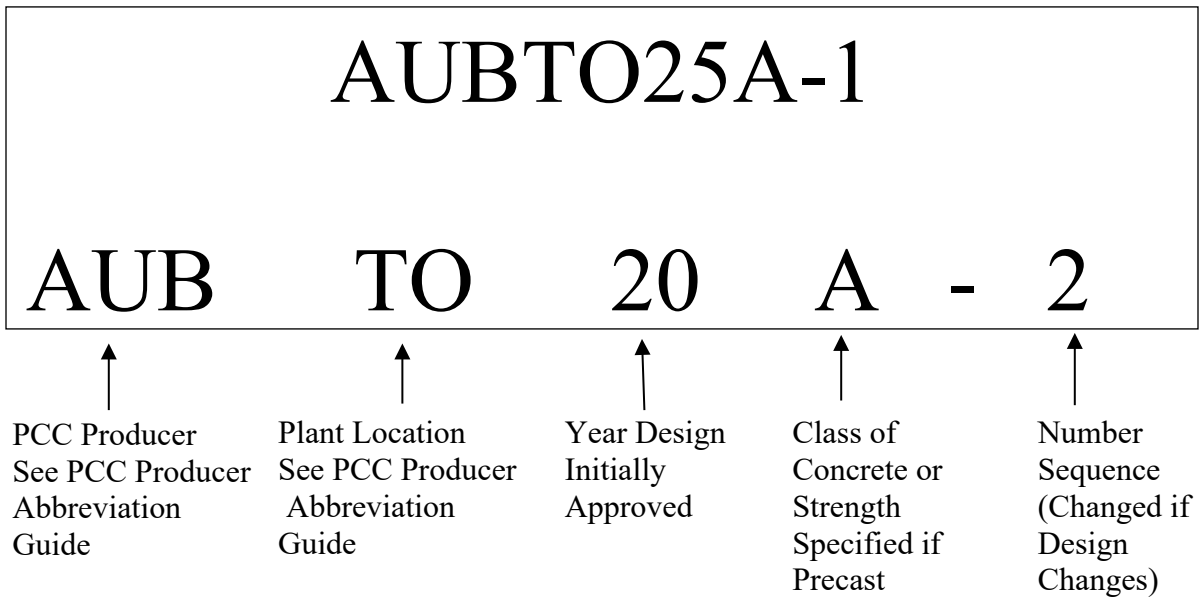
h. Target slump (or spread)
i. Target fresh concrete temperature

Self-Consolidating Concrete (SCC)

SCC may be used for Class A, LP, and Class P concrete when approved by the Resident. SCC concrete shall meet the requirements of the respective concrete class. SCC shall be tested for slump flow per ASTM C1611 with a visual stability index (VSI) of 0 or 1. Care shall be taken when delays occur placing subsequent lifts of SCC concrete to ensure that each new layer is blended with preceding layer to avoid a cold joint or lift line. While not always required, there are times when SCC concrete may need to be vibrated for better consolidation. Caution should be taken to avoid over vibration resulting, as this may result in segregation of aggregates in the mix.

Mix Design Designation

The following is an example of a concrete mix design designation:



PCC producer mix design designations shall include Plant Location, Year Design initially approved, Class, and #. They do not have to include Dashes or Producer abbreviation (only if PCC Producer logo or information is provided elsewhere on the batch tickets). Below are acceptable mix design designations on Contractor Certificate of Compliance.

AUBTO25A-1
AUBTO25A1
TO25A-1
TO25A1

All field samples taken by MaineDOT representatives are required to put the full MaineDOT mix design designation on sample ID forms.

MaineDOT PCC Producer Abbreviations		Redi Mix	Precast
ACI	American Concrete		X
AUB	Auburn Concrete	X	
BPI	Blakeslee Prestress Inc		X
BET	Beton Brunswick	X	
CAM	Carroll Materials	X	
COL	Coleman Concrete	X	
CSI	Concrete Systems Inc		X
CCC	Clayton Concrete CO		
CJG	CJGeo (Portable Foam Concrete Plant)	X	
DSG	Dayton Sand & Gravel	X	
HAL	Haley Construction	X	
HIS	Hissong	X	
ITI	InTerra Innovation Inc.	X	
JPC	JP Carrara		X
LEE	Lee's Concrete	X	
MBM	Meadowbrook Materials	X	
MIC	Michie Corporation		X
MAT	Mattingly Products Co	X	
OLD	Oldcastle Infrastructure		X
OJF	Owen J Folsom	X	
POM	Precast of Maine		X
PHX	Phoenix Precast		X
RED	Redimix Concrete LLC	X	
RPS	R. Pepin & Sons	X	X
SSI	Steelstone Industries	X	
SCL	Strescon Limited		X
SUP	Superior Concrete		X
TIN	Trombley Industries	X	
TRM	Trombley Redi Mix	X	
UCP	United Concrete Products		X
WEP	Weed Precast		X

Town Abbreviations			
AB	Auburn	RMA	Rehoboth, MA
AG	Augusta	RO	Rockland
AL	Alfred	SA	Sangerville
ANJ	Allentown, NJ	SF	Sanford
AN	Anson	SNB	Saint John, NB
ACT	Avon, CT	SP	Searsport
BR	Berwick	TO	Topsham
BA	Bangor	VZ	Veazie
BNS	Bedford, NS	WCT	Wallingford, CT
BE	Bethel	WB	Westbrook
BI	Biddeford	WBA	West Bath
CPVA	Chesapeake, VA		
CA	Calais		
CMA	Chelsea, MA		
CWNH	Conway, NH		
CCNH	Concord, NH		
DF	Dover-Foxcroft		
DNH	Dover, NH		
DS	Damariscotta		
DA	Dayton		
EDNB	Edmundston, NB		
EL	Eliot		
EW	Ellsworth		
EMA	East Machias		
FA	Farmington		
FR	Frenchville		
GONH	Gorham NH		
GFNB	Grand Falls, NB		
HA	Hartland		
HDNH	Hudson, NH		
HENH	Henniker, NH		
HK	Hancock		
HO	Houlton		
LR	Limerick		
LS	Limestone		
LN	Lincoln		
MO	Monmouth		
MVT	Middlebury, VT		
NA	Naples		
OT	Old Town		
ONH	Ossipee NH		
PI	Presque Isle		
PMA	Pittsfield, MA		

Mix Design Approval

Concrete Batch Weights

While not the responsibility of the Department, determining concrete batch weights and how they are determined may help to understand concrete, in general, and why some changes to mix designs are required. For the most part, all concrete mixes are designed to yield 27 cubic feet per cubic yard, or slightly more. This is done to ensure that contractors receive the correct amount ordered and do not under-yield on large placements. Care should be taken when initial batching takes place to verify that all mix ingredients are batched within allowable tolerances to ensure that design yields are maintained. A primary reason for under yielding on a mix can be water that is withheld during batching which is not added back into the mix due to a high- range water reducer being used and achieving the desired workability. While this is a good thing for strength and surface resistivity concerns, on a large placement such as decks, piers, and abutments the cumulative effects on yields can result in significant under yielding.

Typically, a concrete mix begins with the selection of a cement content which also may include a Pozzolan. Cement contents are normally chosen to achieve the specified design strength. Next, a water to cementitious ratio is chosen which also is dependent on a specified compressive strength. Once these two factors are determined its simple math to calculate how many cubic feet these materials generate in relationship to the target of 27 cubic feet. The mix designer then determines the percent of fine aggregate for the mix along with the total amount of coarse aggregate. The proportioning of the fine and coarse aggregate will complete the target of 27 cubic feet per cubic yard. Concrete admixtures typically do not generate much of a cubic foot adjustment to the overall mix design except that when large amounts of corrosion inhibitors or non-chloride chemical accelerators are used, free water from these admixtures are significant enough to warrant inclusion in the water to cement ratio calculations. A typical weight for one gallon of Corrosion Inhibitor is around 10.7 lbs. per gallon with 7.0 lbs. per gallon of that being free water in the Corrosion Inhibitor.

PCC Plant Inspection

Prior to accepting mix on any MaineDOT project, the concrete plant must be inspected and approved by MaineDOT or certified by the National Ready Mixed Concrete Association. Inspection certificates are valid for one year from the date of inspection. Detailed plant inspection forms are available from MaineDOT. Among the more critical equipment inspected are the water meter, aggregate weigh scales, cement and pozzolan scales, and liquid admixture dispensers. Other areas inspected are the silos holding the cement and pozzolans, bins and stockpiles used for storing aggregates, and any lab facilities used for quality control gradations and determining aggregate free moistures.

Mixer inspection is also part of this process. Mixers that meet specifications are given a one-year inspection decal. Among the more important criterion is the condition of the fins inside of the mixer drum. Worn fins and fins covered in an excess of hardened concrete can cause many issues with concrete mixes and are the most critical to maintain. Other items inspected are the revolution rates of the drum, mixer rating plate, water meter, and

general mechanical operation of the mixer.

Precast concrete plants meeting standards 712.061 or 535 must be inspected and approved by MaineDOT, PCI, or NPCA.

Trial Batches

PCC trial batches shall be performed by concrete suppliers for any new batch plants, new mix designs, or if an existing approved batch plant changes the source of cement or pozzolan. Trial batches shall be performed at the batch plant utilizing transit mixers. Because concrete suppliers cannot readily perform surface resistivity testing, the contractor shall submit four 4x8 cylinders, between the age of 2 to 7 days to the Department to perform surface resistivity testing. These cylinders shall include full documentation of fresh concrete test results (including but not limited to entrained air content, w/c ratio, slump, and fresh concrete temperature) and batch tickets.

If the trial batch cylinders fail to meet design requirements the contractor will need to make appropriate adjustment to the mix design's and provide additional cylinders for testing.

Aggregate Process Control & Production Monitoring

Aggregates will be sampled yearly by qualified MaineDOT or qualified consultant personnel to verify specification compliance. The supplier's Process Control Technician (PCT) is encouraged to be present and may obtain a split whenever the Department is collecting aggregate samples.

Aggregate samples will be obtained in accordance with AASHTO R 90, "Standard Practice for Sampling Aggregate Products. Whenever possible, a loader will be used to dig into the stockpiles and create a pad to sample from. For more information on sampling techniques, refer to the video "Aggregate Sampling Best Practices" available at:

https://www.youtube.com/watch?v=R5e94iXfEbE

MaineDOT requires one sample of each fine aggregate source per year and one sample of each coarse aggregate blend per year for each plant where the aggregate is used. Some coarse aggregate tests are run on specimens that are batched according to the mix design blend percentages; because of this it is not possible to sample each coarse aggregate size once and use those values for all blend percentages. Qualities will be run yearly from last date of sampling and will be based on per aggregate source per plant.

In addition to those tests performed during mix design approval, aggregate stockpiles will be tested for gradations once per month if the plant is actively producing for a project. The following procedure shall be observed in the event of failing production or qualities samples:

1. The contractor and PCC supplier will be notified of the failing test. Within 24 hours the contractor and PCC supplier shall investigate to determine the cause and will provide corrective action.

2. The contractor shall notify the Department when the material is ready to retest. The Department will coordinate with the supplier to obtain new samples of the material and retest.

3. If the retest fails, PCC mix designs from that plant utilizing the failing Combined Aggregate Grading will not be allowed on DOT projects until a compliant Department gradation test is provided. The contractor must provide a passing gradation before DOT will resample.

AGGREGATE TESTING REQUIREMENTS

Annual Verification Testing – 1/source /aggregate size/plant/year			
Test Property	Test Method	Fine Aggregate	Coarse Aggregate
Sieve Analysis	AASHTO T 27 & T 11	X	X
Fineness Modulus	-	X	
Specific Gravity & Absorption	AASHTO T 84	X	
	AASHTO T 85		X
Organic Impurities	AASHTO T 21	X	
Sand Equivalent	AASHTO T 176	X	
Micro-Deval [1]	AASHTO T 327		X
Los Angeles Abrasion [1,2]	AASHTO T 96		X
Flat & Elongated Particles [1]	ASTM D4791		X
Gradation Verification Testing – 1/source /aggregate size/plant/month			
Test Property	Test Method	Fine Aggregate	Coarse Aggregate
Sieve Analysis	AASHTO T 27 & T 11	X	X
Fineness Modulus	-	X	

[1] Test performed on a composite blend using the mix design percentages.
[2] Only required for aggregates with >18.0% loss on AASHTO T 327.

CONCRETE AGGREGATE MINIMUM SAMPLE SIZES

Aggregate Size	Number of 3.5 gallon Buckets Required	
	Annual Verification	Monthly Gradation Sample
Fine Aggregate	1	1
Coarse Agg. (≤ 3/8”)	2	1
Coarse Agg. (> 3/8”)	3	1

Precast concrete meeting standards 712.061 or 535 will require similar yearly aggregate testing mentioned above. Additional verification gradations of aggregate stockpiles will be done once per project prior to starting work. If a precast plant starts multiple projects at the same time, only one verification gradation will be taken to represent these projects.

Long Term Mix Designs

PCC Mix design approval is on a project-by-project basis.

A project that experiences a winter shutdown or long-term delay of concrete operations may use the previously approved design provided proportioning and material sources have not changed. Multiple projects using the same concrete batch plant may use the same concrete design provided the proposed materials are identical and the initial aggregate test data is from within one year from the start of use for the new project using the design. If the aggregate test data was not obtained within the current year the design may be used but the Department will need to obtain samples to verify the aggregate properties.

Changes to Mix Designs

Once a design has been submitted and approved for use, the following mix design changes will require a resubmittal and issue of new mix design.

A. Change in cement manufacturer or type
B. Change in type, manufacturer, or percentage of Pozzolan
C. Change in coarse or fine aggregate source
D. Change in target fine or coarse aggregate batch weight(s)
E. Change in aggregate grading from the Classes noted in Section 703.02 of the Standard Specification.

The following mix design changes will not require a new mix design submittal but will require notification be made to the MaineDOT project Resident and Concrete Quality Specialist prior to the change.

A. Changes to chemical admixture dosages
B. Changes in aggregate size designation
C. Addition of a retarder, hydration stabilizer, or accelerator

Field References

Random Numbers

Random numbers must be generated by one of the following methods:

1. Using a computer program or spreadsheet designed specifically to generate random numbers or locations for material sampling.

2. Using a handheld calculator with a random number generating function.

3. Manually, per ASTM D3665.

Random numbers are generated to determine the target testing cubic yardage within a Lot of Method A or Method B concrete, for Acceptance testing purposes, as outlined in Standard Specification Sections 106 and 502.

Immediately after random numbers have been generated, they shall be recorded in their entirety. This recordation shall include the numbers, date generated, method used, signature of the individual that generated the numbers, and the MaineDOT project number for which they have been generated.

MaineDOT will have the random numbers to be used on the project generated prior to the pre-placement meeting. The random numbers generated by MaineDOT for Acceptance testing will be kept in a secure location by the Resident. At no time will the random numbers generated for Acceptance testing be available to the contractor prior to testing. Specific random numbers and locations may be viewed by the contractor only after testing has been completed on material sampled from the random location.

Preplacement Conference

Prior to any major or complicated concrete placements occurring on a project, it's a good idea to have all parties meet to discuss logistics and scheduling concerns related to the upcoming work. Typically, this would include the general contractor, any subcontractors involved and the concrete supplier. If possible, the Contractor's QC technician and the Department's acceptance sampler and/or Inspector should attend.

The topics of discussion should include the following:

1. Discussion of mix designs to be utilized and any special needs/admixtures.
2. Discussion of any anticipated traffic control issues.
3. Set up of pump trucks and possible moving of pump trucks during placement.
4. Set up of cranes if placed by bucket.
5. Quality control testing frequency and personnel required.
6. Quality Acceptance testing frequency and method of achieving samples.
7. Location and maintenance of curing boxes for all cylinders cast.
8. Location and amounts of field cured cylinders, if required.
9. Number of workers required to complete placement in a timely manner.

10. Discussion of any specialized equipment needed to complete work such as screeds or deck finishing machines.
11. Concrete finishing requirements.
12. Discussion of proposed curing methods and curing materials needed. This should include the source of water, types of blankets, and maintaining of concrete temperatures during curing period.

Example preplacement, placement, and postplacement checklist documents can be found at the Department's Construction Support Documents website.

Mixing and Delivery

Delivery and discharge from the mixer shall be completed within 90 minutes from the time cement is added to the aggregate, except that in hot weather when the concrete temperature exceeds 70ºF, or under other conditions contributing to quick stiffening of the concrete, delivery and discharge from the mixer shall be completed within 60 minutes. When approved by the Resident, the use of a retarding admixture may be used for increasing the discharge time from 60 minutes to 90 minutes, provided concrete temperatures are kept below 80ºF and conditions contributing to quick stiffening of the concrete are not present.

A hydration stabilizer may also be used to increase the discharge time beyond the 90/60 minute time limit. Justification for the need for a hydration stabilizer shall be provided in the QC Plan. When used, the QCP shall provide details on how the concrete will be monitored for Accelerated Hydration Gain. Accelerated Hydration Gain being the condition where the fresh concrete has hydrated to the point where the workability and finishability is detrimental to the quality of the final product. Dosage rates shall be determined based on anticipated haul time to the project from the batch plant, difficult or slow placement rates, ambient temperatures, mix temperatures, or traffic delays. These factors shall be discussed at a preplacement conference between the Department, contractor, and concrete supplier.

Sample Tag Form

The following is an example of the current sample tag form used when obtaining samples of Concrete or Hot Mix Asphalt. Care should be taken to ensure all applicable fields are filled in as these represent the acceptance tests used to determine acceptability of PCC and HMA samples. These forms must accompany all samples sent to Department Labs for acceptance testing. Should a sample fail to meet specifications, these sample tags are among the first documentation to be reviewed, so it is critical that care be taken to provide all pertinent data and field test results.

MaineDOT	HMA and PCC Sample Identification Form			Materials Testing and Exploration
❑ Accept. Method A ❑ Accept. Method B ❑ Accept. Method C ❑ Accept. Method D ❑ Indep. Assurance ❑ Verification ❑ Maintenance ❑ Indep. Verification ❑ QC ❑ Other	Reference Number 281301	Sample Description		
	Date Sampled	Sampler	Sampler's Employer	
	WIN	Town		
	Plant	Location		
	Item No.	Lot No.	Sublot No.	Sublot Size
	MaineDOT Design No.			Comparison No.

HMA Mix Samples						
Ticket No.	❑ Test Strip	❑ Method D - Gmm Needed for the 2 required cores	Temp. °F	❑ Truck at plant	Station	❑ LT ❑ RT ❑ CL

HMA Cores					
Mix Sample Ref No. 2nd Mix (CL) Ref No.	❑ Test Strip	Spec ❑ 92.5, min. ❑ 92.5 – 97.5 ❑ 93.5 – 98.5 ❑ 91.0, min. (CL Density) ❑ Information only (shoulder, etc.)	Station	Offset	❑ LT ❑ RT ❑ CL

Portland Cement Concrete						
Admixtures Total (plant + jobsite) dosage Admixture oz/yd³		Ticket No.	❑ Slump, in. ❑ Spread, in.	Air, %	Temp., °F	w/c Ratio
		Strength, Age to Break: ❑ 21 ❑ 28 ❑ 56 ❑ ___	❑ Permeability ❑ Surface Resistivity	Age To Test: ❑ 14 ❑ 28 ❑ 56 ❑ 120 ❑ ___		
		Represents _____of _____ yd3 (total placement size)		Placement Location:		
		Comments:				Revision 04/2012
		Contact Phone No.	**Report Results To:**			

Calculation of Water/ Cement Ratio

The following are the batch weights for a typical 10 cubic yard load of concrete:

- Cement 3,170 lbs.
- Slag 3,180 lbs.
- Silica Fume 250 lbs.
- Total weight of 6,600 lbs.
- Corrosion Inhibitor 30 gal (3 gal/CY) (7.0 lbs. per gallon of free water) = 210 lbs.
- Sand 12,000 lbs.
- Stone18,000 lbs.
- Moistures from aggregates:
- Sand 4.8% - 1.8 Absorption = 3.0 % 100 = .03 x 12000 = 360 lbs. of water
- Stone 1.5% - 1.3 Absorption = 0.2 % / 100 = .002 x 18000 =36 lbs. of water
- Water added during batching was 210 gallons x 8.34 lbs./gal = 1751.4 lbs. of water
- Water added on site 20 gallons x 8.34 lbs. gal = 166.8 lbs. of water

Water/cement ratio = 1751.4 + 166.8 + 360 + 36 + 210 = 2524.2 / 6,600 = 0.382, rounded to 0.38

Method A and B Concrete

Quality Level Analysis

As outlined in Section 106 – Quality in the MaineDOT standard specifications, the objective of a QA program is "to produce and document a high quality project, meeting or exceeding the quality requirements of the Contract." In order to achieve a high level of quality, concrete must be produced from raw materials having consistent properties using well-controlled production processes. The goal is to produce material that consistently meets the mix design targets. Material that is produced with a specified property (such as air content) falling near the upper or lower specification limit or exhibiting a large amount of variability indicates a lack of control and a lower quality level.

Quality Level Analysis (QLA) is the procedure used by the Department to estimate the percentage of material in a Lot that is within specification limits (also referred to as percent-within-limits, or PWL) under Method A and Method B specifications. The measured PWL determines the acceptability and payment for the Lot. Acceptance is determined on a Lot-by-Lot basis. A Lot is defined as a discrete quantity of a concrete, typically the total quantity represented by each class of concrete in the Contract. Each Lot is divided into a minimum of 3 and up to a maximum of 10 sublots for sampling purposes. On projects with large quantities of concrete, it may be necessary to divide a concrete class into two or more Lots.

The Department tests the concrete for acceptability by random sampling methods as described earlier in this document, and tests once per sublot of concrete at the cumulative cubic yardage determined by the random number generated. The typical sublot size is 50 cubic yards but on larger projects sublots can be as high as 250 cubic yards. After a Lot of concrete is completed, the test results are analyzed using QLA in order to determine acceptance and payment. The calculated PWL is used to determine a pay factor for each quality characteristic. A quality level of 90 PWL is required in order for a Lot to be accepted at 100 percent payment. Lots with quality levels higher or lower than 90 PWL will be assigned a pay factor using the specified pay adjustment formula. To determine the pay adjustment the generated pay factor is multiplied by the total quantity placed and the P Value to determine if the contractor earns a monetary incentive or disincentive. The P Value is a value determined by the Department which represents the cost of the concrete, the cost of contractor provided quality control, and construction and labor costs.

Quality Control Plans

Prior to concrete work beginning on any project, a Quality Control Plan (QCP) must be submitted to the Department for review and approval. QCPs are required for Method A, B, and Method C concrete work. Specific requirements for Method A and B QCPs can be found in Standard Specification Section 502.1701. The purpose of the QCP is to identify the proposed methods the contractor will use to ensure concrete delivered to and placed on the project meets specifications. Frequency of testing is established, the name and qualifications of the QCT assigned to test on the project, and well as any others involved in the quality control process. Field curing and protection of concrete cylinders is addressed along with transporting of test cylinders to testing labs. Concrete Mix Designs

are also required to be submitted and are a part of the QCP. When the QCP is not followed, the Department has a recourse as described in Standard Specification Section 106.4.6.

Method C concrete requires an abbreviated QC Plan meeting Section 502.1702. Mix Designs are also required as part of a Method C QCP, but penalties for failing concrete test results are determined per the table presented in Section 502.195.

Method C Concrete

When quantities are such that the use of Method A or Method B is not practical, the Department specifies Method C. This method is often chosen because there is not enough quantity to set up Sublots and Lots and evaluate concrete quality by Quality Level Analysis. Method C may also be used for placements such as seal concrete placed underwater, buried approach slabs, or other similar items which are not deemed critical concrete and the Department has determined that a statistical approach such as QLA and the associated monetary incentives/disincentives is not warranted. Also, Class S and Class FILL concrete do not carry surface resistivity specifications, so cannot be evaluated by our current QLA specifications and composite pay calculations. This does not mean that the concrete is less important or that it's not as important that quality mix is placed. Concrete specified as Method C is evaluated by the same material standards as Method A and B concrete. No incentives can be earned, but disincentives can be applied to failing test results. The Department maintains a chart in section 502.195 of the Standard Specifications which determines the amounts of the penalties for failing results.

Examples of Method C testing frequencies are as follows. Transition barriers on a project approximately 5 CY and no other Class LP concrete is specified. One Method C test would be done by the Resident or their assigned tester.

Curb and sidewalks on a small structure, which typically total about 20 CY, are often split into two Method C tests. Many times, these are placed on different dates, so it's a good idea to get a test for each placement. By doing separate tests for each side of the bridge, the contractor can take corrective action for any failing test properties prior to the next placement. If only one test is performed on one of the two placements, and there are failing results, then the entire quantity of concrete placed will be included in the pay adjustment calculations.

For large seal placements, such as a few hundred cubic yards of Class S mix, the Resident may choose to set up testing by random number methods but the concrete is still evaluated by the chart in 502.195, and a failing test only applies to the quantity represented by the individual test.

Dispute Resolution

Resolution of disputed test results is covered by Standard Specification Section 502.1707. This includes Compressive Strength of concrete cylinders, Surface Resistivity, and measurement of entrained air in fresh concrete. For Compressive Strength and Surface Resistivity disputes, the specified dispute resolution method is to obtain drilled cores from

representative areas. These samples must be obtained within time limits prescribed in 502.1707. If it is determined that the Department's original test results were in error, the results of the cored samples will replace the original samples and be used for all pay factor purposes.

Disputes for air entrainment measurements are resolved onsite at the time of testing with comparisons of contractor and Department equipment. Generally, a 0.6 % or greater difference between air meters is what triggers the dispute resolution process. Concrete placements are typically halted until similar results are obtained and may require additional testing equipment be utilized or recalibration of air meters prior to the placement continuing.

PCC Field Sampling

Sampling of concrete for Acceptance testing is typically the sole responsibility of qualified Department personnel or qualified consultant personnel representing the Department. Contractor testing personal are typically not allowed to cast Acceptance samples and are only allowed to perform Quality Control testing functions. Under Method A and Method B concrete specifications, random sampling must be performed as discussed in earlier sections. Depending on quantities, Method C can be set up using random numbers, but for the most part, concrete quantities are small, and the Department can sample when appropriate. As mentioned earlier, no notice shall be given to the contractors as to when a random sample is intended to be obtained by the Department.

There are some exceptions to allowing contractors to perform Acceptance testing, such as on design-build contracts, where the design-builder is responsible for both Acceptance and Quality Control functions. On design-build contracts the Department performs Independent Verification functions.

Providing testing equipment for Acceptance and Quality Control is the sole responsibility of the contractor and all equipment provided is the property of the contractor. It is the responsibility of the Department to keep all provided testing equipment clean and in good working order.

Testing locations should be chosen to minimize the risk of damaging samples during and after casting. Choose a site as close as possible to the area concrete is being deposited which provides a level surface and is safe from equipment and vehicles. Sites should also be as close as practical to the concrete curing box in order to minimize the risk of damaging a sample while being transported to the curing box. Great care should be taken to ensure the samples are properly marked and that sample tags accompany each sample delivered to the Department's testing labs.

Basic sample ID information such as the reference number should be written on each cylinder mold prior to transporting specimens to the lab. This will prevent misidentification of the samples in case the sample tags become separated from the cylinders. It also assists lab personnel with managing the moist curing and testing of cylinders.

When concrete needs to be transported to difficult to reach areas such as new concrete decks or piers placed in streams or rivers, concrete pump trucks are the most common means of delivering mix to the forms. One of the most difficult aspects of quality control is maintaining a stable entrained air content. Air contents can be greatly affected by the method of sampling from a concrete pump truck. Concrete must be sampled from the discharge point of the pump line for acceptance testing and great care should be taken to avoid letting the concrete fall any appreciable distance before landing in the wheelbarrow or bucket. The pump should be running continuously as a representative sample is collected. When possible, a preferred method is to lay the pump line on the deck or ground so that the line remains full of concrete. If the line remains vertical there can be a significant drop before the concrete is deposited in a wheelbarrow resulting in significant air loss to the test sample. Pump configurations can also influence air contents and every effort should be made to be consistent throughout the placement in order to keep variability to a minimum. Because air contents typically drop from the discharge point of the mixer to the discharge point of the pump line, contractors will usually sample from the mixer truck in order to establish a baseline air entrainment value and then sample again from the discharge point of the pump to gauge the drop in air entrainment. Once this has been established, the contractor can target a higher air content from the truck in order to anticipate the air drop from pumping and, hopefully, deliver concrete meeting the air entrainment requirements at its final destination. During hot weather placements or when the concrete has been on the job for extended periods of time, slump loss can and will occur. By no means is water allowed to be added by the pump truck operator to increase workability and pumpability of the mix.

2” Cube Samples

Some MaineDOT concrete elements are small and require compressive strength testing per ASTM C109 (2” cubes). The concrete for these elements is typically composed of straight cement or a combination of cement and fine aggregate. When required by contract documents, 2 in. cube samples should be made instead of 4x8 cylinder molds to measure compressive strength. Compressive strength results of 2 in. cubes and 4x8 cylinders will not be 1:1. When required by contract documents, PCC samples shall be fabricated per AASHTO R 64-22.

PCC samples shall be tested for compressive strength per ASTM C109, Section 11. Determination of Compressive Strength and calculated per Section 12. Calculation. Other applicable sections in ASTM C109 to be followed include:

a. Section 1. Scope
b. Section 2. Referenced Documents
c. Section 4. Significance and Use
d. Subsection 5.8 through Subsection 5.9.3.1, Apparatus
e. Section 13. Report
f. Section 15. Precision and Bias

The acceptance sampler shall document the final w/c ratio and any admixtures used. For each compressive strength test required, one result will be calculated based on the average

of three cubes. After initial curing, the acceptance sampler will transport the samples to the nearest MaineDOT Laboratory. The sample reference number shall be written on top of all three cubes. The personnel shall also drop off the complete sample kit for long term storage.

MTEx or other Department long term storage location, will keep each 2" cube sample kit available for request. Each kit will include the following items:

- Grout cube molds
- Tamping rod
- Trowel
- Petroleum Jelly
- Release Agent (WD-40, Liquid Wrench, or other products may be used)
- Burlap or Paper Towels or Moisture retention bag/saran wrap
- Laminated copy of ASTM C109

Communication List

Title	Name	Contact Number
QA Engineer	Kevin Cummings	207 - 592 - 0907
Fabrication Engineer	Jason Stetson	207 - 215 - 8818
Concrete Specialist	Taylor Clark	207 - 530 - 3632

Contact concrete.mainedot@maine.gov if you need assistance with field sampling, IA, or have an upcoming concrete placement. All field personnel from MTEx should have access to this shared email.