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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

MIX DESIGN FOR PORTLAND CEMENT CONCRETE

1. PURPOSE

1.1 To establish a procedure for testing the physical properties of a proposed mix design.

1.2 To establish criteria for evaluating the test data to arrive at acceptable batch proportions for an approved mix design.

2. SCOPE

2.1 This procedure shall apply to the design of all portland cement concrete which is required by the specifications to be batched in accordance with an approved mix design with the exception of concrete specified in Section 603.

3. TEST PROCEDURE

3.1 The mix design shall be performed in accordance with the applicable requirements of ASTM C 192 by a Division Approved Laboratory. To obtain Division approval, a laboratory must demonstrate that they are equipped, staffed, and managed so as to be able to batch and test portland cement concrete in accordance with applicable ASTM Methods of Test. The most expeditious means of demonstrating such ability is by submission of a copy of the laboratory's latest report of concrete and aggregate inspection by the Cement and Concrete Reference Laboratory, National Bureau of Standards, together with a letter detailing the actions taken to correct any deficiencies noted therein. A listing of approved laboratories is available on the WVDOT internet site.

3.2 The following information for each of the materials listed below that are to be used in the proposed mix design shall be listed in Attachment 1.

Cement:	Type, Source and Location, Source Code, Specific Gravity
Pozzolan:	Type, Source and Location, Source Code, Specific Gravity
Chemical Admixtures:	Type, Source and Location, Source Code
Coarse Aggregate:	Type, Size, Source and Location, Source Code, Specific Gravity, Absorption, A-Bar, Unit Weight
Fine Aggregate:	Type, Source and Location, Specific Gravity, Absorption, A-Bar, Fineness Modulus

3.2.1 The mass and volume of each material that is to be used in each batch shall be listed in Attachment 2.

3.2.2 The aggregate correction factor, as defined in AASHTO T 152, shall be listed in Attachment 3.

3.3 All classes of the concrete (except Class H and concrete for specialized overlays) for the proposed mix design shall be batched in at least four separate batches. Two of the batches shall be proportioned to produce a mix having a minimum cement factor, and two of the batches shall be proportioned to produce a mix having a minimum cement factor equal to the specified minimum cement factor plus one bag of cement [94 lb (42.6 kg)].

3.3.1 Class H concrete and concrete for specialized overlays, as set forth in Section 679 of the specifications, for the proposed mix design shall be batched in at least two separate batches.

The batches for Class H concrete shall be produced at the cement factor for Class H concrete that is required in the specifications. The rapid chloride permeability test, in accordance with AASHTO T 277, specified in Section 601.3 shall be performed on each of these batches.

The batches for specialized concrete overlays shall be produced at or above the minimum cement factor specified in Section 679.2.2.1 or 679.2.2.2. The rapid chloride permeability test specified in Section 679.2.2 shall be performed on each of these batches.

3.3.2 When a Type A, D, F, or G admixture(s) is(are) used in a mix design, an additional batch of concrete (designated as a reference batch) shall be produced at the same cement factor, aggregate content, air content (± 0.5 percent), and consistency [± 0.5 in. (12 mm)] as the two batches produced in Section 3.3 (or 3.3.1) at the minimum cement factor, but the Type A, D, F, or G admixture(s) shall not be included in this reference mix. The water content of this reference mix may exceed the maximum water content specified in Table 601.3.1A. This reference mix is necessary to fulfill the requirements of Sections 707.2.2.1 and 707.3.2.1.

3.4 Each batch of concrete shall be tested in the plastic state for air, consistency and yield. Each batch shall be adjusted as necessary to produce a plastic concrete having an air content, consistency, and yield equal to the specified value plus or minus a reasonable laboratory working tolerance. The following tolerances shall be used as a guide: Air Content, ± ½ percent; Consistency, ± ½ in. (± 12 mm) of slump; Yield, ± 2 percent.

3.5 When the properties of a concrete batch have been established within acceptable limits, seven 6 by 12 in. (150 by 300 mm) cylinders shall be made from each batch produced in Section 3.3 (or 3.3.1) and 3.3.2 and tested in compression at the following ages: one cylinder at age 24 hours ± 4 hours (the exact age to the nearest hour at time of test shall be noted on the report); one cylinder at age 3 days; one cylinder at age 7 days; one cylinder at age 14 days; and three cylinders at age 28 days. The values of the physical properties of each mix shall be the average of the physical properties established in each of the two batches produced in Section 3.3 (or 3.3.1). These values shall be listed in Attachment 3.

3.5.1 If it is desired to use 4 by 8 in. (100 by 200 mm) cylinders as the basis for acceptance or early strength determination in the field, in accordance with Section 601.4.4, then seven 4 by 8 in. (100 by 200 mm) cylinders shall be fabricated and tested as outlined in Section 3.5 for both of the trial batches at the minimum cement factor in addition to the seven 6 by 12 in. (150 by 300 mm) cylinders.

3.5.1.1 If the average compressive strength of the six 28-day 4 by 8 in. (100 by 200 mm) cylinders for the batches at the minimum cement factor is not more than 10.0 percent greater than the average compressive strength of the six 28-day 6 by 12 in. (150 by 300 mm) cylinders for the batches at the minimum cement factor, then 4 by 8 in. (100 by 200 mm) cylinders will be permitted to be used in the field. Otherwise, any cylinders fabricated in the field for acceptance or early strength determination must be 6 by 12 in. (150 by 300 mm) cylinders.

3.5.1.2 The following formula shall be used during the mix design approval process to determine if the average compressive strength of the three 28-day 4 by 8 in. (100 by 200 mm) cylinders is greater than 110.0 percent of the average compressive strength of the three 28-day 6 by 12 in. (150 by 300 mm) cylinders:

If $\bar{X}_{4x8} > \bar{X}_{6x12} \times 1.10$, then 4 by 8 in. (100 by 200 mm) cylinders are not permitted to be used in the field.
Where:
$\bar{X}_{6\times12}$ = Average 28-day compressive strength of 6 by 12 in. (150 by 300 mm) cylinders.
$\bar{X}_{4\times8}$ = Average 28-day compressive strength of 4 by 8 in. (100 by 200 mm) cylinders.

3.5.2 The following properties of each batch of concrete produced in Sections 3.3 (or 3.3.1) and 3.3.2 shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and yield, water-cement ratio, and temperature.

4. ACCEPTANCE CRITERIA

4.1 If the standard deviation of the concrete plant production has been established, the mix design must have an average laboratory compressive strength ,based on the

6 by 12 in. (150 by 300 mm) cylinder results equal to or greater than the "Design 28-Day Compressive Strength" required by the specifications plus two times the standard deviation. Data used to establish the standard deviation shall be taken from the Division's data bank and shall consist of at least 30 individual test results obtained from recent plant production of concrete with proportions similar to the design mix. Information relative to the statistics for a particular plant will be furnished to the Contractor upon request.

4.2 If the standard deviation of the concrete plant production has not been established, or in the case of mobile mixer units, the mix design must have an average laboratory compressive strength equal to or greater than the "Design 28-Day Compressive Strength" plus 1,300 psi (9 MPa).

4.2.1 Note that the "Design 28-Day Compressive Strength" required by the Specifications is the minimum field strength sought in 6 by 12 in. (150 by 300 mm) or 4 by 8 in. (100 by 200 mm) cylinders representing the concrete being placed in the field, and should not be confused with the laboratory compressive strengths required for design.

5. PROPORTIONING DESIGN MIX

5.1 If the average of the batches produced in Section 3.3 (or 3.3.1), with the specified minimum cement factor, satisfies the acceptance criteria of Section 4, then it will be considered acceptable as the mix design for the class of concrete being designed.

5.2 If the average of the batches produced in Section 3.3 with the specified minimum cement factor does not satisfy the acceptance criteria of Section 4, then a linear compressive strength-cement factor relationship will be established using the average 28-day compressive strength, based on the 6 by 12 in. (150 by 300 mm) cylinder results, of the batches with the minimum cement factor and the average 28-day compressive strength of the batches with the minimum cement factor plus one bag of cement. This relationship will be interpolated to determine a cement factor [to the nearest 1 lb (2.2 kg)] which would cause the acceptance criteria to be satisfied. This interpolated cement factor will be considered acceptable for proportioning the mix design for the class of concrete being designed.

5.2.1 If neither of the averages of the batches produced in Section 3.3 satisfies the acceptance criteria of Section 4, then that proposed mix design cannot be considered as acceptable, and a new mix design will be required.

5.2.2 Section 5.2 does not apply to Class H concrete or specialized overlay concrete. Therefore, if the average compressive strength of the Class H or specialized overlay concrete batches in Section 3.3.1 does not satisfy the acceptance criteria of Section 4, then that proposed mix design cannot be considered as acceptable, and a new mix design will be required.

5.3 The submittal for a proposed mix design shall include completed copies of Attachments 1 and 3. It shall also include a completed copy of Attachment 2 for the reference batch, a completed copy of Attachment 2 for each of the batches at the minimum cement factor, and a completed copy of Attachment 2 for each of the batches at the minimum cement factor plus one bag of cement, when applicable. All pertinent information supporting these attachments and pertaining to the information in them shall be submitted also.

5.4 Although the Contractor has satisfied all requirements for concrete design and a mix design has been approved by the Engineer, the Contractor may still be required to adjust the approved mix design in the field as necessary to maintain all properties within the limits of the specification. These field adjustments shall include increasing the cement factor above the value specified in the approved mix design if such an adjustment would be necessary to cause the strength of the field placed concrete to conform to the requirements of the specification.

6. MIX DESIGN RE-APPROVAL

6.1 Each mix design shall remain approved for a period of three years from the date of approval, after which the mix design may be re-approved for an additional three years based on re-qualification tests outlined in Section 6.2 and conducted at the Concrete Producer. If a mix design is used often enough (at least ten air content, slump, and compressive strength tests each year for the previous three year period), the re-qualification tests shall not be required, and the mix design may be re-approved based on the actual field tests performed during the previous three year period.

6.1.1 Mix designs for which the rapid chloride permeability test is required shall be re-approved at the same frequency as noted in Section 6.1, but a re-qualification test, as outlined in Section 6.2.3 for the rapid chloride permeability test need only be performed once every six years.

6.2 The following procedures shall be used to re-approve concrete mix designs that do not meet the criteria in Section 6.1.

6.2.1 The Concrete Producer shall provide a statement to the Engineer verifying that all sources of materials used in the approved mix designs are unchanged and the same as

used in the original approved mix design. All materials shall meet the applicable sections of the specifications.

6.2.2 Coarse and fine aggregate samples shall be obtained at the Concrete Producer's facility in accordance with MP 700.00.06, and the following tests shall be conducted on those aggregate samples by a WVDOH certified Aggregate Inspector: specific gravity (both coarse and fine aggregate), combined A-bar of total solids, absorption (both coarse and fine aggregate), fineness modulus (fine aggregate), and unit weight (coarse aggregate). The results of these tests shall be used by a WVDOH certified PCC Technician at the Concrete Producer to establish a new target A-bar for the mix design and, if necessary, to adjust any batch volumes.

6.2.3 The Concrete Producer shall then, at the Producer's facility and in the presence of WVDOH District Materials personnel, produce a representative batch (acceptable to both the Producer and the WVDOH personnel) in accordance with Sections 601.6 and 601.7, of no less than 6 yd^3 (4.6 m^3) of the concrete mix subject for re-approval. This batch shall be tested for air content, slump, unit weight and yield. Also, three 6 by 12 in. (150 by 300 mm) 28-day compressive strength specimens, and if applicable, two rapid chloride permeability specimens (each to be tested at an age of 90 days or earlier and the average result used) shall be fabricated and tested from this batch.

6.2.4 If a Concrete Producer desires to have the option of using 4 by 8 in. (100 by 200 mm) cylinders in the field for a mix design which has already been approved, then at the time of mix design re-approval, or at any time prior to that time three additional 6 by 12 in. (150 by 300 mm) 28-day compressive strength specimens and six 4 by 8 in. (100 by 200 mm) 28-day compressive strength specimens shall be fabricated and tested from the batch produced in Section 6.2.3. The six 6 by 12 in. (150 by 300 mm) cylinders shall then be compared to the six 4 by 8 in. (100 by 200 mm) cylinders as outlined in Section 3.5.1.1 in order to determine if 4 by 8 in. (100 by 200 mm) cylinders will be permitted in the field for the subject mix design.

6.3 The results of all tests required and the proportions used in the batch outlined in Section 6.2 shall be recorded in the applicable sections of Attachments 1, 2, and 3 and submitted to MCS&T Division for evaluation. Based on these results, the existing mix design will either be re-approved (possibly with slight adjustments), or the current mix design will be considered to have expired and a new mix design will be required. When a mix design is re-approved by MCS&T Division, the laboratory approval number for that mix shall not be changed, but the approval date (the "Date Sampled") shall be revised.

6.3.1 For mix design re-approval purposes, the compressive strength of the representative batch produced in Section 6.2.3 must meet or exceed the "Design 28-day

Compressive Strength" in Section 601.3, but it does not have to meet the "overdesign" acceptance criteria outlined in Section 4.

6.3.2 For mix design re-approval purposes, the average of the two rapid chloride permeability test results from the representative batch produced in Section 6.2.3 must be 1,000 coulombs or less in order for the mix design to be re-approved.

6.3.3 If a mix design has expired, it may still be used on projects which have started before the mix design expired. However, after its date of expiration, a mix design may not be used on any new projects; a new mix design shall be required for these projects.

7. CHANGING A COMPONENT MATERIAL USED IN A MIX DESIGN

7.1 Whenever more than one component material in an approved mix design is changed simultaneously, a new laboratory mix design, in accordance with Section 3 shall be required.

7.1.1 There are circumstances when one component material in an approved mix design may be changed to another WVDOH approved component material without requiring a new laboratory mix design. Those circumstances, and the subsequent steps which must be taken in order for that component material change to be approved, are outlined in the following sections.

7.2 The changes, outlined below, to any of the following component materials are permitted provided the requirements in Section 7.3 are met. Only one component material may be changed at a time, otherwise a new laboratory mix design in accordance with Section 3 shall be required. When changing the type and/or source of any one component material, minor adjustments to the quantities of other component materials in the mix design are permitted, in order to maintain desired mix properties.

7.2.1 Cement: The source of cement may be changed provided the requirements of Section 7.3 are met.

7.2.2 Pozzolan: The source and/or type of pozzolan may be changed provided the requirements of Section 7.3 are met.

7.2.3 Chemical Admixture: The source and/or type of any individual admixture (*i.e.*, air entraining, water reducing, or water-reducing and retarding, *etc.*) may be changed provided the requirements of Section 7.3 are met. If more than one admixture is used in a mix design, a change to an individual component material means a change in only one of those admixtures. If more than one admixture is used in a mix design, and a change to one of these admixtures is desired (a change to an individual

component material), then the source of the new admixture must still be the same as the source of the rest of the admixtures in the mix (*i.e.*, water-reducing admixture A from Source X may be changed to water-reducing admixture B from Source X.)

7.2.4 Latex Admixture: The source of latex admixture may be changed provided the requirements of Section 7.3 are met.

7.2.5 Fine Aggregate: The source of fine aggregate may be changed provided the requirements of Section 7.3 are met. However, if the type of fine aggregate changes (*i.e.*, silica sand to limestone sand or natural sand to manufactured sand), a new laboratory mix design in accordance with Section 3 shall be required.

7.2.6 Coarse Aggregate: The source of coarse aggregate may be changed provided the requirements of Section 7.3 are met. However, if the type or size of coarse aggregate changes (*i.e.,* river gravel to limestone or #57 limestone to #67 limestone), a new laboratory mix design in accordance with Section 3 shall be required.

7.3 When a change to any individual component material in an approved mix design, as outlined in Sections 7.1.1 and 7.2, is desired, the Concrete Producer shall, at the Producer's facility and in the presence of WVDOH District Materials personnel, produce two separate representative batches (acceptable to both the Producer and the WVDOH personnel) in accordance with Sections 601.6 and 601.7. Each of these batches shall be no less than 3 yd^3 (2.3 m^3), shall be batched at the target cement factor, and shall consist of the concrete mix with the proposed material change. The proportions for these batches shall be determined by a WVDOH certified PCC Technician.

7.3.1 If there is a change to either the coarse or fine aggregate, then a sample of the new material shall be obtained at the Concrete Producer's facility in accordance with MP 700.00.06, and the following tests shall be conducted by a WVDOH certified Aggregate Inspector on that aggregate sample: specific gravity, solid A-bar of the new material and A-bar of total solids, absorption, fineness modulus (fine aggregate), and unit weight (coarse aggregate). The results of these tests shall be used by a WVDOH certified PCC Technician at the Concrete Producer to establish a new target A-bar for the mix and, if necessary, to adjust any batch volumes.

7.3.2 In lieu of the two batches produced at the Producer's facility, as outlined in Section 7.3, two batches may be produced at a Division Approved Laboratory, meeting the requirements of Section 3.1. These batches do not need to be witnessed by WVDOH personnel. The sizes of these batches shall be the same as the size of the batches produced for new laboratory mix designs, and their proportions shall be determined by certified laboratory personnel. If there are any changes to either the

coarse or fine aggregate, certified laboratory personnel may perform the testing and mix adjustments as stated in Section 7.3.1.

7.3.3 All of the information pertaining to the materials used in these batches shall be listed in Attachments 1, 2, and 3 as outlined in Section 3.2.

7.3.4 Both batches of concrete shall be tested in the plastic state for air, consistency, and yield. Each batch shall be adjusted as necessary to produce a plastic concrete having an air content, consistency, and yield equal to the specified value plus or minus the following tolerances: Air content, ± 1 percent; Consistency, ± 1 in. (± 25 mm) of slump; Yield, ± 2 percent.

7.3.4.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.3.2, then the batch tolerances specified in Section 3.4 shall apply.

7.3.5 When the properties of a concrete batch have been established within acceptable limits, three 6 by 12 in. (150 by 300 mm) cylinders shall be made from each batch produced in Section 7.3 and tested in compression at an age of 28 days. The values of the physical properties of this new mix design (with the component material change) shall be the average of the physical properties established in the two batches produced in Section 7.3. These values shall be listed in the column for the mix with the "Minimum Cement Factor" in Attachment 3.

The following properties of each batch of concrete produced in Section 7.3 shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and & yield, water-cement ratio, and temperature.

7.4 When it is desired to change a component material in a mix which requires the rapid chloride permeability test (Class H concrete and specialized concrete overlays as outlined in Section 679), a minimum of one permeability specimen shall be fabricated from each of the batches produced in Section 7.3. The average value of these permeability specimens shall be no more than 10 percent greater than the mix design permeability value, required in the applicable specification, when tested at the time frame specified in the applicable specification.

7.4.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.3.2, then the average value of these permeability specimens shall be less than or equal to the mix design permeability value required in the applicable specification, when tested at the time frame specified in the applicable specification.

7.5 If 4 by 8 in. (100 by 200 mm) cylinders were approved for use with the mix design which was approved prior to the component material change, then 4 by 8 in.

(100 by 200 mm) cylinders shall also be approved for use with the new mix (with the component material change) with no further testing required.

7.5.1 Otherwise, if it is desired to use 4 by 8 in. (100 by 200 mm) cylinders as the basis for acceptance or early strength determination in the field with the new mix (with the component material change) then three 4 by 8 in. (100 by 200 mm) 28-day compressive strength specimens shall be fabricated and tested from each of the batches produced in Section 7.3. The six 6 by 12 in. (150 by 300 mm) cylinders from these batches shall then be compared to the six 4 by 8 in. (100 by 200 mm) cylinders from these batches as outlined in Sections 3.5.1.1 and 3.5.1.2 in order to determine if 4 by 8 in. (100 by 200 mm) cylinders will be permitted in the field for the subject mix design.

7.6 The average compressive strength of the two batches produced at the Producer in Section 7.3 must have an average compressive strength which exceeds the "Design 28-Day Compressive Strength" required by the specifications by the value (f'_{cr}) obtained from the formula below. The criteria used to establish the standard deviation is outlined in Section 4.1.

$$f'_{cr} = f'_c + 2.33\sigma - 500$$

Where:
f'_{cr} = Required average compressive strength of the batches produced in Section 7.3 (expressed in psi)
f'_c = Design 28-Day Compressive Strength (expressed in psi)
σ = Concrete Plant Standard Deviation (outlined in Section 4.1)

7.6.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.3.2, then the average compressive strength of these batches must have an average compressive strength which exceeds the "Design 28-Day Compressive Strength" required by the specifications by the value (f'_{cr}) obtained from the formula below. The criteria used to establish the standard deviation is outlined in Section 4.1.

$$f'_{cr} = f'_c + 2\sigma$$

7.6.2 If the average compressive strength of the two batches produced in Section 7.3 (f'_{cr}) is less than the "Design 28-Day Compressive Strength" (f'_c) required by the specifications, the new mix (with the component material change) cannot be considered as acceptable, unless the requirements of Section 7.7 are met.

7.7 It is not required, but if the Concrete Producer desires, two additional separate batches may be produced, at the same time that the two batches in Section 7.3 are being produced. These two additional batches shall be acceptable to both the

Producer and the WVDOH personnel, and shall be produced in accordance with Sections 601.6 and 601.7. Each of these batches shall be no less than 3 yd^3 (2.3 m^3), shall be batched at the target cement factor plus one bag of cement [94 lb (42.6 kg)], and shall consist of the concrete mix with the proposed material change.

7.7.1 In lieu of the two batches produced at the Producer's facility, as outlined in Section 7.7, two batches at the target cement factor plus one bag of cement [94 lb (42.6 kg)] may be produced at a Division Approved Laboratory, meeting the requirements of Section 3.1. These batches, produced at a Division Approved Laboratory, do not need to be witnessed by WVDOH personnel. The sizes of these batches shall be the same as the size of the batches produced for new laboratory mix designs, and their proportions shall be determined by certified laboratory personnel.

7.7.2 Production of these two additional batches is not an option for Class H concrete or specialized overlay concrete.

7.7.3 Both batches of concrete shall be tested in the plastic state for air, consistency and yield. Each batch shall be adjusted as necessary to produce a plastic concrete having an air content, consistency, and yield equal to the specified value plus or minus the following tolerances: Air Content, ± 1 percent; Consistency, ± 1 in. (± 25 mm) of slump; Yield, ± 2 percent.

7.7.3.1 If laboratory batches are produced in lieu of batches at the Producer, as outlined in Section 7.7.1, then the batch tolerances specified in Section 3.4 shall apply.

7.7.4 When the properties of a concrete batch have been established within acceptable limits, three 6 by 12 in. (150 by 300 mm) cylinders shall be made from each batch produced in Section 7.7 and tested in compression at an age of 28 days. The values of the physical properties of this new mix design (with the component material change) shall be the average of the physical properties established in the two batches produced in Section 7.7. These values shall be listed in the column for the mix with the "Minimum Cement Factor + 1 Bag" in Attachment 3.

The following properties of each batch of concrete produced in Section 7.7 shall be listed in Attachment 2: A-bar of total solids, consistency, air content, unit weight and yield, water-cement ratio, and temperature.

7.7.5 If the average of the batches produced in Section 7.3, with the specified target cement factor, does not satisfy the acceptance criteria set forth in Section 7.6, then a linear compressive strength-cement factor relationship will be established using the average 28-day compressive strength [based on the 6 by 12 in. (150 by 300 mm) cylinder results] of the batches with the target cement factor (Section 7.3) and the average 28-day compressive strength of the batches with the target cement factor plus one bag

of cement (Section 7.7). This relationship will be interpolated to determine a cement factor [to the nearest 1 lb (2.2 kg)] which would cause the acceptance criteria to be satisfied. This interpolated cement factor will be considered acceptable for proportioning the design mix for the class of concrete being designed.

7.7.6 If neither of the averages of the batches produced in Sections 7.3 or 7.7 satisfy the acceptance criteria in Section 7.6, then that proposed component material change cannot be considered as acceptable, and a new laboratory mix design will be required in order to make a change in component materials.

7.8 The submittal for a proposed mix design change, as outlined in Section 7, shall include completed copies of Attachments 1 and 3. It shall also include a completed copy of Attachment 2 for each of the batches produced in Section 7. All pertinent information supporting these attachments and pertaining to the information in them shall be submitted also. This new mix design shall be submitted to the District in the same manner as a normal mix design, and it shall then be forwarded to MCS&T Division for review and approval. If approved, a new lab number will be assigned to this mix design, and it shall, from that point forward be treated as a new mix design.

7.9 No additional component material changes are permitted to this mix design (without a new laboratory mix design) until there are a minimum of 20 consecutive field test results, from this new mix design, which meet or exceed the design compressive strength requirements. Once there are 20 consecutive field test results, from this new mix design, which meet or exceed the design compressive strength requirements, this mix design is eligible for another component material change in accordance with Section 7.

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ACG:Mw

Attachments

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ATTACHMENT 1

Source: _____
Source Location: _____
Design Laboratory: _____
Class of Concrete: _____
Date: _____

Cementitious Material Data			
Data	Cement	Pozzolan 1	Pozzolan 2
Name			
Type			
Source			
Source Location			
Source Code			
Specific Gravity			

Admixture Data			
Data	Air Entrainment	Additional Admixture 1	Additional Admixture 2
Name			
Type			
Source			
Source Location			
Source Code			

Aggregate Data		
Data	Coarse Aggregate	Fine Aggregate
Class/Size		
Type		
Source		
Source Location		
Source Code		
Specific Gravity		
A-Bar		
Absorption		
Fineness Modulus		
Unit Weight		

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ATTACHMENT 2

Source: _____

Source Location: _____

Design Laboratory: _____

Class of Concrete: _____

Date: _____

Check The Appropriate Box For Designated Batch:	Reference Batch	Minimum Cement Factor		Mininimum Cement Factor + 1 Bag		Additional Batch
		Batch 1	Batch 2	Batch 1	Batch 2	

Material	Mass	Units	Volume		Units
Cement		lb (kg)			ft^3 (m^3)
Pozzolan 1		lb (kg)			ft^3 (m^3)
Pozzolan 2		lb (kg)			ft^3 (m^3)
Latex Admixture		lb (kg)	gal (L)		ft^3 (m^3)
Water		lb (kg)	gal (L)		ft^3 (m^3)
Air Content, by volume		%			ft^3 (m^3)
Coarse Aggregate		lb (kg)			ft^3 (m^3)
Fine Aggregate		lb (kg)			ft^3 (m^3)
Total		lb (kg)			ft^3 (m^3)
Air Entrain. Admixture		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 1		oz/Cwt (mL/100kg)			fl. oz. (mL)
Chemical Admixture 2		oz/Cwt (mL/100kg)			fl. oz. (mL)

Mixture Test Data							
$\bar{A}$ Total Solids	W/C Ratio	Cement Factor	Temperature	Consistency	Air Content	Unit Weight	Yield

Compressive Stength, psi (MPa)			
Specified Test Age:	Actual Test Age (hours)	6" x 12" (150 x 300 mm) Strengths	4" x 8" (100 x 200 mm) Strengths
24 ± 4 Hours			
3 Days			
7 Days			
14 Days			
28 Days			
28 Days			
28 Days			
Avg. 28 Day Strength			

Rapid Chloride Permeability Testing (When Applicable)	
Age at Time of Test (Days)	Total Adjusted Charge Passed (Coulombs)

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ATTACHMENT 3

SUMMARY

Source: _____

Source Location: _____

Design Laboratory: _____

Class of Concrete: _____

Date: _____

	Reference		Minimum Cement Factor		Minimum Cement Factor + 1 Bag	
Material	Mass	Units	Mass	Units	Mass	Units
Cement		lb (kg)		lb (kg)		lb (kg)
Pozzolan 1		lb (kg)		lb (kg)		lb (kg)
Pozzolan 2*		lb (kg)		lb (kg)		lb (kg)
Water		lb (kg)		lb (kg)		lb (kg)
Coarse Aggregate		lb (kg)		lb (kg)		lb (kg)
Fine Aggregate		lb (kg)		lb (kg)		lb (kg)
Total		lb (kg)		lb (kg)		lb (kg)
Air Entrain. Admixture		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 1		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Chemical Admixture 2		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)		oz/Cwt (mL/100kg)
Total A Bar Solids						
Water Cement Ratio						
Cement Factor						
Temperature		°F (°C)		°F (°C)		°F (°C)
Consistency		inches (mm)		inches (mm)		inches (mm)
Air Content		%		%		%
Unit Weight		lb/ft^3 (kg/m^3)		lb/ft^3 (kg/m^3)		lb/ft^3 (kg/m^3)
Yield		ft^3 (m^3)		ft^3 (m^3)		ft^3 (m^3)
Aggregate Correction Factor per AASHTO T 152				%		%

Compressive Strength, psi (Mpa)	Reference Batch	Minimum Cement Factor Batch		Minimum Cement Factor + 1 Bag Batch
		6" x 12" Cyl. (150x300 mm)	4" x 8" Cyl. (100x200 mm)	
1 Day				
3 Days				
7 Days				
14 Days				
28 Days				
28 Days				
28 Days				
Avg. 28 Day Strength				
If applicable, are 4" x 8" (100 x 200 mm) cylinders permitted in the field:				

Average Value of Rapid Chloride Permeability Test (Coulombs):	